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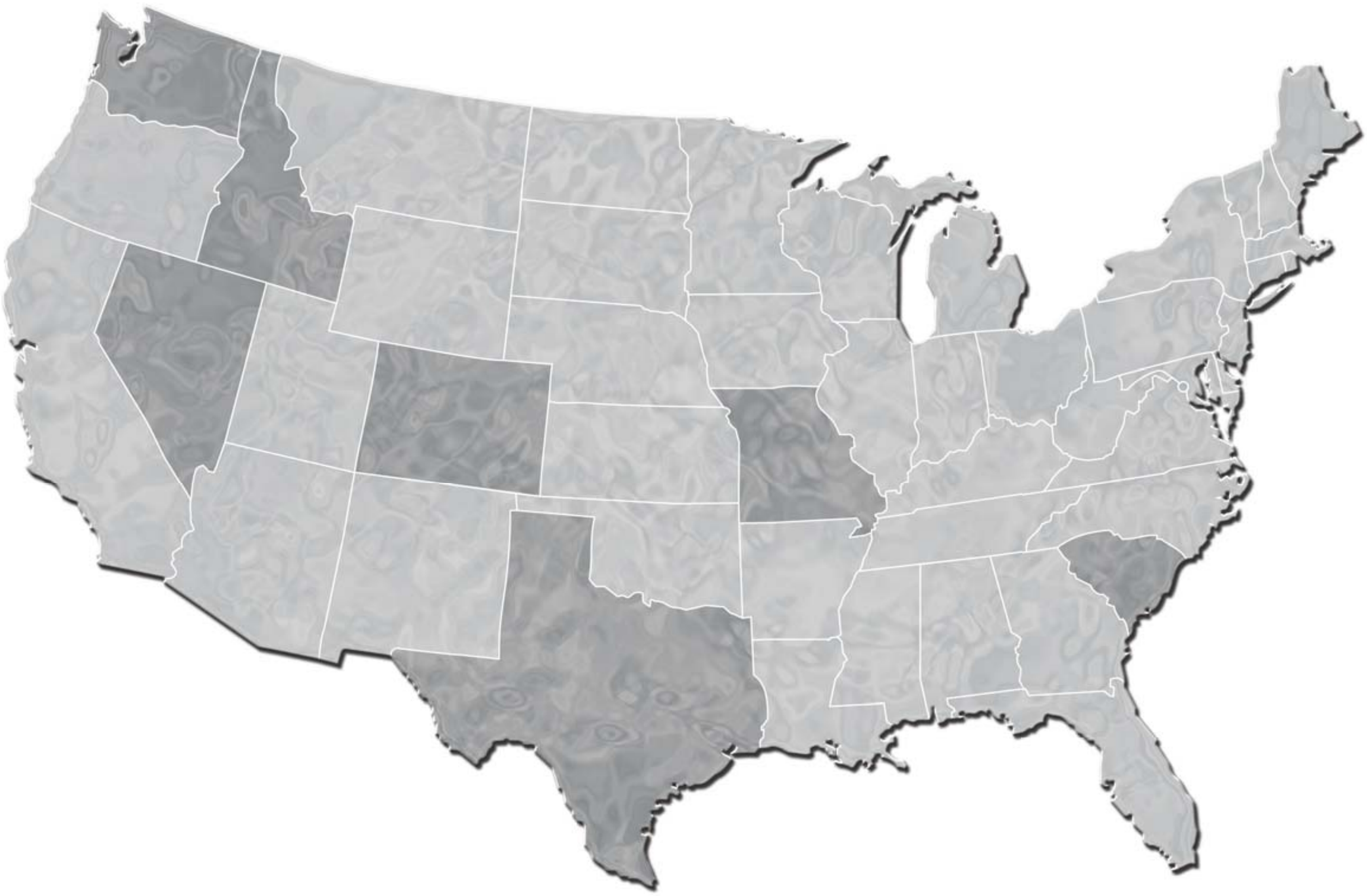
Draft

Long-Term Management and Storage of Elemental Mercury

Environmental Impact Statement



U.S. Department of Energy
Office of Environmental Management
Washington, DC

Availability of the Draft Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement

For information or to submit comments on this *Draft Mercury Storage EIS*, contact:

David Levenstein, Document Manager
Office of Environmental Compliance (EM–41)
U.S. Department of Energy
Post Office Box 2612
Germantown, MD 20874
Website: http://www.mercurystorageeis.com
Fax: 877-274-5462

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CHAPTER 1
INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

The U.S. Department of Energy (DOE) is required to develop a capability for the safe and secure long-term management and storage of elemental mercury pursuant to the Mercury Export Ban Act of 2008 (P.L. 110-414). Accordingly, DOE will identify or construct an appropriate facility(ies) to host this capability. DOE's proposed action is to select a suitable location for the long-term management and storage of elemental mercury generated in the United States. DOE has prepared this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement (Mercury Storage EIS)* in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321 et seq.), the Council on Environmental Quality implementing regulations (40 CFR 1500–1508), and DOE's NEPA implementing procedures (10 CFR 1021) to evaluate the reasonable alternatives for managing and storing elemental mercury. The U.S. Environmental Protection Agency and the Mesa County Board of Commissioners (Mesa County, Colorado) are cooperating agencies in the preparation of this *Mercury Storage EIS*.

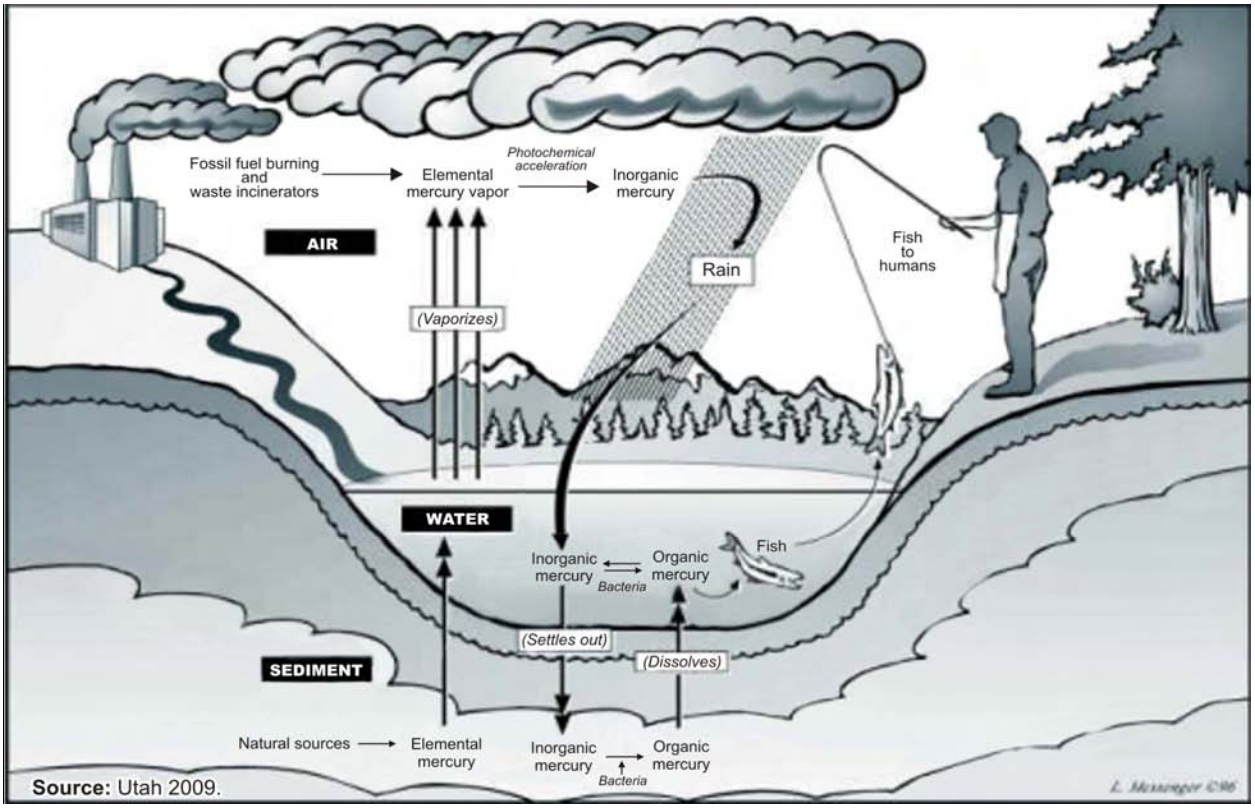
1.1 INTRODUCTION

Mercury is a naturally occurring element, liquid at room temperature, that enters the environment as a result of natural processes (e.g., volcanoes, wildfires, surface emissions) and human activities. Human activities that release mercury to the environment (i.e., anthropogenic sources) include fuel burning, incineration, metal smelting, use of mercury in industrial processes, mining, waste disposal, and production of commercial products containing mercury. Examples of products that historically contained or currently contain mercury include batteries, paint, thermometers, thermostats, blood pressure monitors, switches for automobile lighting, fluorescent lights, and dental fillings. Emissions from human activities worldwide are estimated at 1,220 to 2,900 metric tons (1,345 to 3,197 tons) per year, with natural emissions estimated at 900 to 2,300 metric tons (992 to 2,535 tons) per year (UNEP 2002:75; 2009:10). Mercury vapor in the atmosphere can be transported thousands of miles from the source of emission.

What Is Elemental Mercury?

Elemental mercury is a dense, naturally occurring metal that is liquid at room temperature. Sometimes called "quicksilver," liquid mercury has been used in manufacturing processes because it conducts electricity, reacts to temperature changes, and alloys with many other metals. Certain mercury-bearing wastes are hazardous wastes under the Solid Waste Disposal Act, as amended (commonly referred to as the "Resource Conservation and Recovery Act" [42 U.S.C. 6901 et seq.]). Mercury is designated a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601 et seq.) because it is a toxic pollutant under Section 307(a) of the Clean Water Act (33 U.S.C. 1251 et seq.) and a hazardous air pollutant under Section 112 of the Clean Air Act (42 U.S.C. 7401 et seq.). Furthermore, the transportation of mercury is regulated under Title 49 of the *Code of Federal Regulations*, Parts 171–178.

Mercury is a globally deposited pollutant, affecting water bodies near industrial sources (e.g., the Great Lakes) and remote areas (e.g., the Arctic Circle). Mercury is found in the environment as elemental mercury (e.g., elemental mercury vapor [Hg^0], inorganic mercury compounds (e.g., mercuric chloride [$HgCl_2$] and mercuric sulfide [HgS]); and organic mercury compounds (e.g., methylmercury [CH_3Hg]). It is emitted from human activities primarily in its elemental or inorganic forms. The inorganic form of mercury, when bound to airborne particles (Hg_p) or in its gaseous divalent form (Hg^{+2}), is readily removed from the atmosphere by dry deposition (settling) and wet deposition (precipitation). Most of the mercury in water, soil, sediment, plants, and animals is in the form of inorganic mercury salts (e.g., mercuric chloride) and organic mercury (e.g., methylmercury). As it cycles through the environment, mercury undergoes a series of chemical and physical transformations (EPA 1997:2-2, 2000:1). Figure 1–1 provides a simplified diagram of how mercury moves through the environment.



Source: Utah 2009.

Figure 1–1. The Mercury Cycle

Mercury and its compounds are persistent, bioaccumulative, and toxic, and they pose risks to human health and the environment. The toxic effects of mercury depend on its chemical form and the route of exposure. Methylmercury, a mercury compound that is generally not used commercially or stored, is the most toxic form. It can affect the immune system; alter genetic systems; and damage the nervous system, including coordination and the senses of touch, taste, and sight. Methylmercury can be particularly damaging to developing embryos. Exposure to methylmercury is usually by ingestion; it is absorbed more readily than other forms of mercury. Less toxic than methylmercury, elemental mercury (Hg^0) vapors can cause tremors, gingivitis, and excitability when inhaled over a long period of time. If elemental mercury is ingested, it is absorbed relatively slowly and can pass through the digestive system without causing damage (USGS 2000).

The free trade of elemental mercury on the world market encourages its continued use outside the United States, often involving highly dispersive activities such as artisanal gold mining. It is estimated that since the 19th century, the total amount of mercury available in the environment has increased by a factor of two to five above pre-industrial levels. As the quantity of available mercury in the environment has increased, so have the risks of neurological and reproductive problems for humans and wildlife. These increases in risk make mercury a pollutant of environmental concern in the United States and throughout the world (EPA 2000:1).

1.2 PURPOSE AND NEED FOR AGENCY ACTION

The Mercury Export Ban Act of 2008 (P.L. 110-414), hereafter referred to as "the Act," prohibits, as of October 14, 2008, any Federal agency from conveying, selling, or distributing to any other Federal agency, any state or local government agency, or any private individual or entity any elemental mercury[1] under the control or jurisdiction of the Federal agency (with certain limited exceptions, as described in the Act). A copy of the Act is included in Appendix A. The Act also prohibits the export of mercury from the United States effective January 1, 2013 (subject to certain essential-use exemptions). The United States is a net exporter of mercury, exporting over 600 metric tons (660 tons) of mercury between 2004 and 2007 (USGS 2009). Therefore, banning the export of mercury from the United States is expected to result in surplus inventories of mercury.

Section 5 of the Act, "Long-Term Storage," directs the U.S. Department of Energy (DOE) to designate a DOE facility(ies) for the long-term management and storage of mercury generated within the United States. Further, to comply with Section 5 of the Act, DOE needs to ensure the facility(ies) is operational and ready to accept custody of mercury by January 1, 2013. DOE thus needs to provide such a facility(ies) capable of managing a mercury inventory estimated to range up to 10,000 metric tons (11,000 tons) based on a 40-year period of analysis, as described in the next section. The Act specifies that the new DOE mercury storage facility(ies) shall not include the Y–12 National Security Complex (Y–12) or any other portion or facility of the Oak Ridge Reservation in Oak Ridge, Tennessee. DOE will take title to all mercury accepted for storage in the facility.

1.3 PROPOSED ACTION

DOE proposes to construct one or more new facilities and/or select one or more existing facilities (including modification as needed) for the long-term management and storage of mercury, as mandated by Section 5 of the Act. Any such facility must comply with applicable requirements of Section 5 of the Act, "Management Standards for a Facility," including the requirements of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.) and other permitting requirements.

1.3.1 Estimated Mercury Inventory

There are several potential sources of mercury in the United States, including mercury used in the chlorine and caustic soda manufacturing process (i.e., chlor-alkali industry), reclaimed from recycling and waste recovery activities, and generated as a byproduct of the gold-mining process. In addition, DOE currently stores approximately 1,200 metric tons (1,300 tons) of mercury at Y–12. In a 2007 report, the U.S. Environmental Protection Agency (EPA) estimated that between 7,500 and 10,000 metric tons (8,300 and 11,000 tons) of excess mercury could be generated over a 40-year period (EPA 2007), totaling 8,700 to 11,200 metric tons (9,600 to 12,300 tons) when added to the mercury stored at Y–12.

> **U.S. Department of Defense Mercury**
>
> The U.S. Department of Defense, Defense Logistics Agency (DLA) has determined to locate a permanent storage facility for its stockpile of approximately 4,400 metric tons (4,900 tons) of elemental mercury at the Hawthorne Army Depot in Hawthorne, Nevada (DNSC 2006). The DLA mercury is not part of the inventory considered in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement*, although the Hawthorne Army Depot is evaluated in this environmental impact statement for storage of the additional mercury for which the U.S. Department of Energy will be responsible.

In preparing this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement (Mercury Storage EIS)*, DOE has reexamined the amount of mercury that potentially could be stored at the DOE facility(ies). The Act contemplates indefinite storage at the DOE-designated storage facility(ies). For

[1] Unless indicated otherwise, elemental mercury is referred to hereafter simply as "mercury" in this environmental impact statement.

purposes of analysis in this *Mercury Storage EIS*, it was assumed the mercury storage facility(ies) would operate over a 40-year timeframe. This corresponds to the 40-year planning projection for receipt into storage of up to 10,000 metric tons (11,000 tons) of mercury. A 40-year period of analysis is consistent with the timeframe used in previous analyses by the Defense Logistics Agency (DLA) (DLA 2004) and EPA (EPA 2007). There currently is no approved method of treating high-purity elemental mercury for disposal. It is not known when such a treatment method might become available. These are estimates with a degree of uncertainty; therefore, it is possible that more or less than 10,000 metric tons (11,000 tons) of mercury could eventually require storage for a period longer or shorter than 40 years. Additional National Environmental Policy Act (NEPA) analysis may be required to expand the facility(ies) to accept more than 10,000 metric tons (11,000 tons) of mercury or extend its operations beyond the 40-year period of analysis.

As shown in Table 1–1, DOE estimates that up to approximately 10,000 metric tons (11,000 tons) of mercury would be available for storage over the next 40 years. Either the entire inventory of Y–12 mercury or a portion of this inventory could be retained in storage at Y–12, but, for purposes of analysis, the entire inventory was assumed to be sent to the new DOE mercury storage facility(ies).

Table 1–1. Anticipated Mercury Inventory (Based on a 40-Year Period of Analysis)

Source	Years Sent to Storage[a]	Quantity (metric tons)[b]
DOE Y–12 National Security Complex in Oak Ridge, Tennessee	2013–2014	1,200
Closure of four chlor-alkali plants or conversion to non-mercury-cell technology	2013–2019	1,100
Waste reclamation and recycling facilities	2013–2052	2,500
Byproduct of gold mining	2013–2052	3,700–4,900
Total		**8,500–9,700**

[a] For purposes of analysis, it was assumed that the mercury from the Y–12 National Security Complex would be shipped to the DOE-designated storage facility(ies) in the first 2 years of operation; chlor-alkali plant mercury would be shipped in the first 7 years of operation; and waste reclamation and recycling facility and gold-mining byproduct mercury would be shipped over the entire 40-year period of analysis.

[b] Rounded to two significant figures.

Note: To convert metric tons to tons, multiply by 1.1023.

Key: DOE=U.S. Department of Energy.

There is considerable uncertainty regarding the 10,000-metric-ton (11,000-ton) estimate of mercury that could be sent to DOE for storage. Estimates of mercury generated from gold mining are dependent on the amount of gold mining conducted. Mercury from gold mining could decrease as existing gold deposits are depleted or could increase if additional deposits are discovered. The amount of gold mined is also dependent on the price of gold. The quantity of mercury from waste reclamation and recycling facilities is dependent on the volume of waste and recyclable materials processed and are likely to decrease as programs to collect mercury-containing thermometers, thermostats, switches, and natural-gas-metering devices are completed. In addition, chlor-alkali plants may close or convert their mercury-cell processes before 2013.

The Act prohibits the export of elemental mercury from the United States beginning in 2013. The Act does not ban the export of mercury compounds. Recognizing the potential for exported mercury compounds to be processed into elemental mercury, Congress directed EPA to publish, no later than 1 year after the date of enactment of the Act, a report on "mercuric chloride, mercurous chloride or calomel, mercuric oxide, and other mercury compounds, if any, that may currently be used in significant quantities in products or processes." EPA submitted a report entitled *Potential Export of Mercury Compounds from the United States for Conversion to Elemental Mercury* to Congress in October 2009. The report provides information on sources, amounts, and uses of mercury compounds; assesses the potential for these compounds to be processed into elemental mercury after export; and provides information for Congress to consider in determining whether to extend the Act's mercury export prohibition to include one or more of these mercury compounds. The report concludes that one mercury compound—mercury(I) chloride (also known as mercurous chloride or calomel)—is likely to be exported and processed into elemental mercury after export. Mercury(I) chloride is currently produced in significant quantities from pollution-control equipment at U.S. gold mines. The report also finds that three other mercury compounds—mercury(II) oxide, mercury(II) sulfate, and mercury(II) nitrate—could possibly be exported and processed into elemental mercury after export (EPA 2009). If certain mercury compounds are eventually added to the mercury export ban, additional environmental review may be necessary. Mercury must meet the acceptance criteria for the DOE storage facility(ies) and must be at least 99.5 percent pure (DOE 2009a).

1.4 DECISIONS TO BE MADE

DOE intends to decide (1) where to locate the mercury storage facility(ies) and (2) whether to use existing buildings, new buildings, or a combination of existing and new buildings.

DOE's objectives for the long-term management and storage of mercury are important to DOE, EPA, and the public. They are, in part, as follows:

- Protect human health and the environment and ensure safety of the public and facility workers.
- Meet the requirements of the Mercury Export Ban Act of 2008.
- Comply with applicable Federal, state, and local statutes and regulations.

DOE will consider the environmental impact information presented in the final environmental impact statement (EIS), as well as other factors (e.g., cost, schedule, strategic objectives, and public comments) when making long-term mercury management and storage decisions. As required by Council on Environmental Quality (CEQ) regulations (40 CFR 1506.10), DOE will not make a decision on the proposed action until at least 30 days after EPA's Notice of Availability of the *Final Mercury Storage EIS* is published in the *Federal Register*.

1.5 SCOPE OF THIS EIS

To address the proposed action, DOE determined that it would need to prepare an EIS in accordance with NEPA of 1969, as amended (42 U.S.C. 4321 et seq.); DOE implementing procedures for NEPA (10 CFR 1021); and CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500–1508). To this end, DOE undertook a process to identify facilities that could potentially be suitable and a screening process to identify facilities and/or locations that would appropriately be included in the scope of this EIS.

1.5.1 Candidate Sites

In March 2009, DOE published a Request for Expressions of Interest in the *Federal Register* (74 FR 11923), as well as in *Federal Business Opportunities* (Fed Biz Opps 2009), seeking potential locations for the mercury storage facility(ies) from interested Federal agencies and the private sector. In addition, DOE issued an internal memorandum requesting that DOE site offices determine if they have a facility(ies) that could be used for mercury storage (Triay 2009). (Appendix A contains copies of the *Federal Register* and *Federal Business Opportunities* requests and the internal memorandum of inquiry to DOE offices.)

At the same time, DOE developed objective criteria for identifying candidate sites within the scope of this EIS. DOE based these criteria on criteria used in other EISs for similar purposes. The criteria are as follows:

The facility(ies) will not create significant conflict with any existing DOE site mission and will not interfere with future mission compatibility.

The candidate host location has an existing facility(ies) suitable for mercury storage with the capability and flexibility for operational expansion, if necessary.

The facility(ies) is, or potentially will be, capable of complying with RCRA permitting requirements (see Chapter 5, Sections 5.2.4 and 5.3), including siting requirements.

The facility(ies) has supporting infrastructure and a capability or potential capability for flooring that would support mercury loadings.

Storage of mercury at the facility(ies) is compatible with local and regional land use plans, and new construction would be feasible, as may be required.

The facility(ies) is accessible to major transportation routes.

The candidate location has sufficient information on hand to adequately characterize the site.

DOE received responses from the following 10 sites/companies indicating capability to store the mercury. Their responses are available on the EIS website at http://www.mercurystorageeis.com.

- DOE Grand Junction Disposal Site (GJDS), Grand Junction, Colorado
- DOE Hanford Site (Hanford), Richland, Washington
- Hawthorne Army Depot, Hawthorne, Nevada
- DOE Idaho National Laboratory (INL), Idaho Falls, Idaho
- DOE Kansas City Plant (KCP), Kansas City, Missouri
- Lowland Environmental Services et al., Knoxville, Tennessee
- Meritex Enterprises, Incorporated, Cumberland Furnace, Tennessee
- DOE Savannah River Site (SRS), Aiken, South Carolina
- Veolia ES Technical Solutions, LLC, Henderson, Colorado
- Waste Control Specialists, LLC (WCS), Andrews, Texas

DOE reviewed the screening criteria relative to the potential candidate sites as expressed by the respondents and confirmed that 7 of the 10 locations appeared to be within the range of reasonable alternatives for mercury storage. That is, 7 sites met most, if not all, of the screening criteria. Therefore, DOE included these 7 candidate locations, listed below, in the scope of this *Mercury Storage EIS*. A discussion of the reasons for eliminating the 3 locations from further consideration is included in Chapter 2, Section 2.6.

- GJDS, Grand Junction, Colorado
- Hanford, Richland, Washington
- Hawthorne Army Depot, Hawthorne, Nevada
- INL, Idaho Falls, Idaho
- KCP, Kansas City, Missouri
- SRS, Aiken, South Carolina
- WCS, Andrews, Texas

Existing buildings at the candidate locations are being considered to store the mercury where the requisite information is available. Recognizing that existing buildings may not be available or adequate at some candidate locations, DOE also evaluated construction and operation of new facilities that would meet

RCRA requirements. Because the mercury would of necessity be transported to the designated facility(ies), DOE included transportation analyses in the scope of this EIS. These three elements of the EIS scope are introduced in the sections below.

1.5.2 Construction and Modification

This *Mercury Storage EIS* analyzes the environmental impacts associated with constructing a new mercury storage facility(ies) and modifying existing buildings for mercury storage at the various candidate sites. Construction and modification impacts are those related to land disturbance, resource use, air and water emissions, and employment. Chapter 2, Section 2.3.1 and Appendix C, Section C.2.3, describe construction and modification activities. Chapter 4 describes the environmental impacts of the construction and modification activities.

1.5.3 Operations

This *Mercury Storage EIS* analyzes the environmental consequences of operation of one or more new or existing mercury storage facilities at the various candidate sites. Operational impacts include those related to resource use, air and water emissions, and human health effects including accidents. Chapter 2, Section 2.3.2, and Appendix C, Section C.2.4, describe operational activities. Chapter 4 describes the environmental impacts of the operational activities.

1.5.4 Transportation

Transportation impacts include those related to air emissions, human health, and ecological risk. This *Mercury Storage EIS* analyzes the transport of mercury from potential source locations to the designated DOE mercury storage facility(ies), including potential transport of DOE mercury from existing storage at Y–12.

This *Mercury Storage EIS* considers transportation of mercury by truck and rail. Appendix D describes transportation activities in detail, including transportation accidents. Chapter 4 describes the environmental impacts of transportation activities.

1.5.5 Closure of Mercury Storage Facility(ies)

For a complete life-cycle analysis, DOE considered the possibility that the facility(ies) could be no longer needed. If the mercury storage facility(ies) is no longer needed, DOE would close it, as described in Chapter 4, Section 4.10. More-detailed analysis of closure activity impacts is not possible at this time because DOE has not yet developed plans for future use or closure of this building(s). Reuse or closure plans would be subject to additional environmental analysis, as appropriate.

1.6 PUBLIC INVOLVEMENT IN DEVELOPING THE SCOPE OF THIS EIS

As a preliminary step in the development of an EIS, regulations established by the CEQ (40 CFR 1501.7) and DOE require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action." The purpose of this scoping process is: (1) to inform the public about a proposed action and the alternatives being considered and (2) to identify and clarify issues relevant to the EIS by soliciting public comments.

On July 2, 2009, DOE published a "Notice of Intent to prepare an *Environmental Impact Statement for the Long-Term Management and Storage of Elemental Mercury*" in the *Federal Register* (74 FR 31723). Publication of the Notice of Intent (NOI) initiated a 45-day public scoping period; the scoping period was later extended to 52 days.

Between July 2, 2009, and August 24, 2009, DOE solicited comments from Federal, state, and local agencies; stakeholders; tribal nation representatives; and the general public to assist in defining the scope of the *Mercury Storage EIS*. DOE hosted eight meetings to obtain public comments on the proposed scope of this EIS. Public scoping meetings were held on the following dates at the following eight locations:

- July 21, 2009 – Grand Junction, Colorado
- July 23, 2009 – Kansas City, Missouri
- July 28, 2009 – Richland, Washington
- July 30, 2009 – North Augusta, South Carolina
- August 4, 2009 – Hawthorne, Nevada
- August 6, 2009 – Andrews, Texas
- August 11, 2009 – Idaho Falls, Idaho
- August 13, 2009 – Portland, Oregon

A total of approximately 300 people attended these meetings, at which DOE provided information on the Mercury Export Ban Act of 2008 and DOE's proposed mercury management program. Each meeting began with a short DOE presentation on the NEPA process and the proposed scope of this EIS. Following the presentation, attendees were invited to provide comments. Oral comments were recorded by a court reporter; written comments were also accepted. In addition, the public was provided with the opportunity to discuss issues directly with DOE management and technical specialists who staffed an exhibit area. Additional public meetings will be conducted after the draft EIS is published.

For those individuals who could not attend one of the public scoping meetings, DOE provided other methods to submit comments: (1) the *Mercury Storage EIS* website (http://www.mercurystorageeis.com), (2) a toll-free fax (1-877-274-5462), and (3) the U.S. mail.

DOE received 507 comment documents containing a total of 1,244 comments during the scoping period. DOE considered all public comments in refining the scope of this EIS.

This section summarizes the comments received during the public scoping period. The comments have been grouped into the following topics (the order of appearance here roughly corresponding to that in the EIS: Elemental Mercury, Candidate Site Selection, Alternatives, Storage, Transportation, Health and Safety, Facility Accidents, Land Use, Environment, Socioeconomics and Environmental Justice, Cultural Resources and American Indian Issues, Regulatory Compliance, Public Participation, Cost, and Other. A response is provided for each comment summary.

Elemental Mercury

Commentors asked how much elemental mercury would be stored, where it would come from, and who would own it. Commentors expressed concern that the elemental mercury storage facility(ies) would be expanded to accept other mercury compounds and other hazardous materials in the future.

Response: *Section 1.3.1 describes the major sources of mercury in the United States and the quantity of mercury that is estimated to be excess and available for storage over a 40-year period of analysis. As described in Section 1.3.1, DOE estimates that up to approximately 10,000 metric tons (11,000 tons) of mercury may be received for storage. This includes mercury (1) from closure of chlor-alkali plants or conversion to non-mercury-cell technology, (2) from waste reclamation and recycling facilities, (3) generated as a byproduct of gold mining; it is assumed to also include mercury currently in storage at Y–12. DOE would take title to all mercury accepted for storage in the facility(ies).*

As described in Section 1.3.1, Section 4 of the Act required that EPA publish—no later than 1 year after the date of enactment—a report on other mercury compounds that may currently be used in significant *quantities in products or processes. The report, dated October 14, 2009, provides information on sources, amounts, and uses of mercury compounds; assesses the potential for these compounds to be processed into elemental mercury after export; and provides information for Congress to consider in determining whether to extend the mercury export prohibition to include one or more of these mercury compounds (EPA 2009). If certain mercury compounds are eventually added to the mercury export ban, DOE would complete additional environmental review as necessary.*

Candidate Site Selection

Commentors expressed opinions that mercury should not be stored at various candidate sites. Reasons given for unsuitability of specific sites include inconsistency with site mission and cleanup activities; private ownership; proximity to population centers, surface water, and groundwater; and natural hazards, such as tornadoes and earthquakes. Commentors also expressed a preference at one or more of the candidate sites, citing (1) proximity to mercury generation sites or to existing or planned mercury storage, (2) large site size, and (3) remote location. Commentors suggested that one or more of the candidate locations are not consistent with DOE's evaluation criteria listed in the NOI and questioned why other U.S. Department of Defense and DOE facilities were not evaluated, including Y–12 and the Oak Ridge Reservation.

Response: *Section 5 of the Act requires the Secretary of Energy to "designate a facility or facilities of the Department of Energy...for the purpose of long-term management and storage of elemental mercury generated within the United States." DOE has interpreted Section 5 of the Act to authorize DOE to designate existing and/or new storage facilities at property either owned or leased by DOE. Chapter 2, Section 2.4, describes the alternative sites that are evaluated in this EIS. Chapter 2, Figure 2–4, shows the locations across the United States of the seven candidate sites for mercury storage. Therefore, DOE has analyzed a range of alternatives and their associated impacts for storing mercury in locations across much of the United States. These include sites near mercury source locations, small and large sites, and sites with large and small surrounding population densities. Section 1.5.1 describes the methods used to solicit sites interested in hosting the mercury storage facility and the evaluation criteria used to determine if the potential sites were reasonable alternatives for mercury storage. DOE used reasonable methods to identify, screen, and evaluate the candidate sites and believes that these sites represent a reasonable range of siting alternatives. Chapter 2, Section 2.6, describes candidate site and building options considered but eliminated from detailed analysis. The Act specifies that the DOE-designated mercury storage facility(ies) shall not include Y–12 or any other portion or facility of the Oak Ridge Reservation in Oak Ridge, Tennessee (42 U.S.C. 6939f(a)(1)). DOE may sometimes include reasonable alternatives that are outside the scope of what Congress has approved. However, in the case of this action, where Congress has expressly prohibited a potential alternative, DOE finds that it is reasonable to forego its consideration. Accordingly, DOE has eliminated this option as an action alternative.*

In the 2004 DLA Final Mercury Management Environmental Impact Statement (MM EIS), *DLA and DOE, as a cooperating agency, evaluated mercury storage at seven sites across the United States. Four of these sites were DLA sites that are scheduled for closure. Two of the other sites were former U.S. Department of Defense sites scheduled for redevelopment. The final site was the Hawthorne Army Depot, the site eventually selected by DLA for consolidated storage of the 4,436 metric tons (4,890 tons) of DLA mercury. DOE has included the Hawthorne Army Depot as one of the seven candidate locations evaluated in this* Mercury Storage EIS. *The DLA mercury is not part of the inventory considered in this* Mercury Storage EIS.

Alternatives

Commentors expressed opinions on the advantages and disadvantages of the various alternatives. Commentors suggested that DOE evaluate storage at sites that are located in close proximity to the major sources of mercury. Other commentors requested that DOE evaluate the impacts of multiple-site storage alternatives. Commentors questioned what would happen after the storage period, suggested that the impacts of indefinite storage be analyzed, and expressed concern that mercury storage would become de facto disposal. Commentors suggested that DOE evaluate treatment of the mercury to render it safer for long-term storage, and that DOE should consider treatment and disposal as an alternative to long-term storage.

Response: *Chapter 2, Section 2.4, describes the alternative sites that are evaluated in this EIS. Chapter 4 of this* Mercury Storage EIS *contains analyses of potential impacts on the natural and manmade environment appropriate to the alternatives being evaluated. Chapter 2, Section 2.7, summarizes the analyses in Chapter 4 and provides a comparison of the impacts of the alternatives. This allows a comparison of the environmental strengths and weaknesses of each alternative. Chapter 2, Section 2.6, describes candidate site and building options considered but eliminated from detailed analysis, including multiple-site storage alternatives and treatment alternatives. There currently is no approved method for the treatment of high-purity elemental mercury wastes for disposal. Therefore, DOE is not considering treatment and disposal options for detailed evaluation in this* Mercury Storage EIS. *Section 1.3.1 describes the basis for selection of the 40-year period of analysis. The Act contemplates indefinite storage at the DOE-designated storage facility(ies). For the purposes of analysis in this* Mercury Storage EIS, *it was assumed the mercury storage facility(ies) would operate over a 40-year timeframe. This corresponds to the 40-year planning projection for receipt into storage of up to 10,000 metric tons (11,000 tons) of mercury. These are estimates with a degree of uncertainty; therefore, it is possible that more or less than 10,000 metric tons (11,000 tons) of mercury could eventually require storage for a period longer or shorter than 40 years. Additional NEPA analysis may be required to expand the facility(ies) to accept more than 10,000 metric tons (11,000 tons) of mercury or extend its operations beyond the 40-year period of analysis. Chapter 4, Section 4.10, describes the environmental impacts of the potential future closure of the mercury storage facility(ies).*

Storage

Commentors expressed interest in a detailed description of how the mercury would be stored, including spill containment systems and spill cleanup, air flow and filtration, and monitoring systems. Commentors requested that the storage facility be air conditioned to reduce mercury vapor emissions. Commentors stated that the facility should have adequate security to protect the mercury from terrorist attack, sabotage, and vandalism.

Response: *Chapter 2 and Appendix C of this* Mercury Storage EIS *provide a summary description of the features of a mercury storage facility. Pursuant to the Mercury Export Ban Act of 2008, Section 5, the* U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury (Interim Guidance) (*DOE 2009a*) *contains more detail regarding the requirements for storage of mercury, including preliminary design elements and emergency response procedures for a mercury storage facility. A mercury storage facility(ies) would be a weather-tight structure with a reinforced concrete floor, strong enough to withstand the heavy loads from mercury storage. The floors would also be curbed and treated with a sealant to add strength and spill containment properties. Lighting, ventilation, fire suppression, and security systems would be incorporated into the facility design. Monitoring would include leak detection and mercury vapor monitors. The facility(ies) would be RCRA regulated and would require regular inspection of stored materials, strict record-keeping, and periodic reporting. Due to the nature of mercury storage in sealed containers, air-conditioned buildings and filtered air are not required. However, the air exiting the Handling Area would be filtered to support operations that may require handling of open mercury storage containers.*

As described in Appendix C, Section C.2.1, the facility would be permitted under Subtitle C of RCRA and would be located in an area under the control and authority of DOE that would include appropriate fencing and security. Remote surveillance may also be employed, where necessary. As described in the *sections on intentional destructive acts in Chapter 4, a mercury storage facility is not expected to be an attractive target for a terrorist attack.*

Transportation

Commentors expressed interest in a detailed description of how the mercury would be transported, and by whom, and suggested that DOE describe how a mercury spill would be prevented and cleaned up if it occurred. Other commentors recommended development of a transportation plan. Commentors expressed concern about the potential for spills in populated areas and into water bodies during transportation accidents and asked if transportation security would be provided to prevent hijacking, sabotage, or terrorist attack. Another commentor expressed concern about the cumulative impacts of transportation.

Response: *Transportation of mercury would be in accordance with applicable RCRA hazardous waste and U.S. Department of Transportation hazardous material shipping requirements. As described in Appendix D, Section D.2.7, mercury shipments to the DOE storage facility(ies) are estimated to range from approximately 100 shipments per year between 2013 and 2020 to 50 shipments per year thereafter. Appendix C, Section C.1, of this* Mercury Storage EIS *provides a brief description of the shipping modes and containers that would be used to transport mercury from the existing storage and generation sites to the new DOE storage facility(ies). Pursuant to the Mercury Export Ban Act of 2008, Section 5, the DOE* Interim Guidance *(DOE 2009a) contains more-detailed information on transportation. Commercial trucking companies and rail lines are typically used to ship hazardous wastes, and would be expected to be used to ship mercury to the DOE storage facility(ies). As is currently the case for the transport of mercury and other hazardous materials and wastes, in the event of a serious transportation accident, the local fire department has the primary first-response responsibility. Fire department personnel would be responsible for assessing the significance of any accident and determining if the evacuation of nearby residents is warranted. If the release of mercury is detected, hazardous materials response teams may be called in to assess, contain, and clean up the contamination. Commercial hazardous waste shipping companies are required to carry insurance to cover accident cleanup. DOE would take title to the mercury when received at the storage facility(ies).*

The transportation risk sections in Chapter 4 of this Mercury Storage EIS *describe the risks from transportation of mercury by truck and rail, including accident risk along with the expected emergency response activities. Risks related to crossing water bodies during transportation are also discussed. Appendix D contains a detailed description of the transportation risk assessment. Mercury has been transported for many years and continues to be transported today as an industrial commodity and hazardous waste. Thus, the risks related to transportation of mercury to the DOE storage facility(ies) are not unique.*

Because there would few employees and 50 to 100 truck shipments of mercury each year, the impacts of transportation would be negligible. Therefore, transportation activities related to construction and operation of the mercury storage facility(ies) would not substantially add to cumulative transportation impacts.

Health and Safety

Commentors expressed concern about the health risks to workers and the public, including sensitive populations such as children, pregnant women, and the elderly. Commentors expressed concern about mercury storage near populated areas.

Response: *The sections on human health risks and facility accident risks in Chapter 4 of this* Mercury Storage EIS *describe the risks from exposure to mercury from normal operations and accidents. Appendix D contains a detailed description of the human health risk assessment. Risks are considered for* *reasonable exposure routes, including breathing air and ingesting soil. As described in Chapter 4 and summarized in Chapter 2, Section 2.7, of the EIS, risks to workers and the public from normal operations would be negligible to low at any of the candidate sites. As described in Appendix D, the reference dose and reference concentrations used in estimating human health risk from long-term exposure to mercury include consideration of sensitive groups such as children, pregnant women, and the elderly. Likewise the Acute Exposure Guideline Level used in estimating human health risk from short-term exposure resulting from an accident, AEGL-2, is believed to be protective of all except a few extremely susceptible members of the population.*

Facility Accidents

Commentors expressed concern about the potential for adverse human health and ecological effects as a consequence of facility accidents (e.g., small spills and leaks of mercury or larger releases due to fire or other natural disasters such as earthquakes, sinkholes, tornadoes, and floods). Commentors also expressed concern about impacts of a terrorist act or act of sabotage, including a bombing or a deliberate plane crash, and about impacts of accidents at nearby facilities. Commentors expressed concern about emergency response in the event of an accident, including who would respond, the difficulty and expense of cleaning up mercury, who would pay for the cleanup, and how the public would be compensated.

Response: *The facility accident risks sections in Chapter 4 of this* Mercury Storage EIS *describe the risks from exposure to mercury during accidents as well as the emergency response and cleanup actions that are likely to take place in the event of an accident. As discussed in these sections and summarized in Chapter 2, Section 2.7, risks to workers from mercury released during facility accidents would be low. Mercury vapors that might escape from the storage facility(ies) after an accident would be diluted to low concentrations before reaching the public. Therefore, risks to the public would be negligible to low. These sections also include an assessment of intentional destructive acts that addresses terrorist acts and acts of sabotage. As discussed in Chapter 4, a mercury storage facility is not expected to be an attractive target for a terrorist attack. Appendix D contains a detailed description of the human health risk assessment for accidents.*

As discussed in the water resources sections of Chapter 4, the mercury storage sites would have approved spill prevention control and countermeasures plans to ensure that the appropriate response to a spill is made. As discussed in the facility accidents sections of Chapter 4, small leaks would be managed on site by trained technicians. The large sites, including Hanford, Hawthorne Army Depot, INL, SRS, and WCS, have onsite emergency response teams. In addition, these sites have mutual aide agreements with nearby county and/or municipal emergency response agencies. In the event of a serious accident at GJDS, or KCP, the county or municipal fire department would have primary first-responder responsibilities. In the event of an accident with release of mercury, the immediate concern for emergency responders would be to contain the mercury and minimize exposure to those on the scene. Emergency response personnel would be responsible for assessing the significance of any accident and determining if the evacuation of nearby residents is warranted. If the release of mercury is detected, additional hazardous materials response teams may be called in to help assess, contain, and clean up the contamination. DOE or the contractor responsible for operating the facility(ies) would be responsible for the costs of accident cleanup and any payments of damages to affected parties.

Land Use

Commentors expressed the opinion that mercury storage would not be compatible with existing or future missions of the candidate site or with local, regional, or tribal land use plans. Commentors suggested that construction and operation of a mercury storage facility(ies) would divert funds and interfere with ongoing site cleanup. Commentors also expressed concern about proximity to parks and wilderness areas.

Response: *The compatibility with candidate site missions and applicable land use plans is described in the land use sections in Chapter 4. Construction and operation of a mercury storage facility(ies) would be a separately funded item that would not divert funds from, nor interfere with, ongoing site cleanup. The proximity to parks and wilderness areas is described in the land use sections in Chapter 3.*

Environment

Commentors expressed concern about the extent of the regions of influence (ROIs) and the impacts on the environment, including impacts on air, soil, surface water, groundwater, ecosystems, critical habitats, wildlife, threatened and endangered species, global climate change, and cumulative impacts. Commentors requested that DOE analyze mitigation of environmental impacts. Commentors suggested that the U.S. Geological Survey should do an independent study to define the boundaries of the Ogallala Aquifer near WCS. Commentors stated that baseline surveys for mercury contamination should be performed.

Response: *As described in the introduction to Chapter 3, DOE evaluated the environmental impacts of the proposed actions within defined ROIs. These ROIs are specific to the resource area evaluated; encompass geographic areas within which any meaningful impact is expected to occur; and can include the areas within which the proposed action would take place, the sites as a whole, or nearby or distant offsite areas.*

As described in Appendix B, methods for assessing environmental impacts vary for each resource area (discipline). In addition, disciplines are analyzed in a manner commensurate with their importance and the expected level of impact on them under a specific alternative—the sliding-scale assessment approach. This is consistent with DOE guidance contained in its Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements *(known as* The Green Book*) (DOE 2004a:1, 2, 19, 20), in which DOE expands on CEQ instructions for preparing EISs (40 CFR 1502.2) by stating that impacts should be discussed in proportion to their significance and specifically recommending the use of the sliding scale for impact identification and quantification.*

Chapter 4 of this Mercury Storage EIS *contains the results of analyses of potential impacts on the natural and manmade environment appropriate to the alternatives being evaluated. Impacts are evaluated for land use and visual resources; geology, soils, and geologic hazards; water resources; air quality and noise; ecological resources; cultural resources; site infrastructure; waste management; occupational and public health and safety; ecological risk; socioeconomics; and environmental justice. Cumulative impacts, including global climate change, are presented in Section 4.11. Measures that could be used to mitigate adverse impacts are described in Section 4.12.*

As described in the WCS site discussion in Chapter 3, Section 3.8.3.2, the dry line, the southern limit of saturated conditions in the High Plains Aquifer (Ogallala Aquifer), is located just on the northern border of the current WCS facilities area. DOE believes this to be an accurate representation of the boundary of the Ogallala Aquifer near WCS.

Existing data on mercury concentrations in environmental media (e.g., air, soil, surface water, and groundwater) are sufficient to support a mercury storage facility(ies) siting decision. Future sampling requirements would be addressed in site permits.

Socioeconomics and Environmental Justice

Commentors asked about the economic benefits of construction and operation of the mercury storage facility(ies). Commentors expressed concern about impacts on traffic and the transportation infrastructure (e.g., bridges and highways). Commentors expressed the opinion that locating the mercury storage facility(ies) near a particular site could discourage future development and have adverse effects on property values, agriculture, retirement, recreation, tourism, and overall quality of life. Commentors also expressed concern about environmental justice impacts.

Response: *The socioeconomics sections in Chapter 3 describe existing socioeconomic conditions at the candidate sites. As discussed in the corresponding sections of Chapter 4 and summarized in Chapter 2, Section 2.7, the alternatives would likely have negligible socioeconomic impacts at the candidate sites and in the affected ROIs in terms of employment levels and population trends. Impacts on traffic are expected to be negligible to minor during the 6-month construction period for a new facility(ies); they are expected to be negligible during operations because few new employees would be hired to operate the facility(ies) and few shipments of mercury would be delivered to the facility(ies) each day. As described in Appendix B, Section B.10.2, although publicity regarding the mercury storage facility(ies) may produce some short-term impacts on home sales and property values near the candidate sites, long-term impacts of perception and stigma are not expected. The existing distribution of minority and low-income populations within 16 kilometers (10 miles) and 3.2 kilometers (2 miles) of the candidate sites is described in Chapter 3. The environmental justice sections in Chapter 4 include an analysis of potential environmental justice impacts, defined as disproportionately high and adverse impacts on minority or low-income populations.*

Cultural Resources and American Indian Issues

Commentors expressed concern about impacts on historic and archaeologic resources and American Indian interests. Commentors stated that DOE needs to perform required government-to-government consultations with tribal groups and that the tribes expect to be involved in the review and decisionmaking process. Commentors expressed concern that mercury storage is not compatible with the lifestyles of many tribal members or with tribal policies, which envision a site that is clean and restored. Commentors expressed concern that DOE's methodology for estimating human health risk and environmental justice impacts does not account for the unique habits and lifestyles of tribal members.

Response: *As indicated in Chapter 5, Section 5.4.3, DOE is committed to performing its responsibilities regarding government-to-government consultations. DOE has initiated informal consultations with potentially affected tribes and believes that DOE and the tribes can effectively collaborate to ensure that Congress's vision for a mercury storage facility(ies) is achieved. The land use sections in Chapter 4 describe the compatibility of the mercury storage with site missions and applicable land use plans. As described in the appropriate sections of Chapter 4 and summarized in Chapter 2, Section 2.7, construction and operation of a mercury storage facility(ies) are expected to have little or no environmental, socioeconomic, and cultural resources impacts. As described in the human health risks sections in Chapter 4 and Appendix D, human health risk from normal operations would be negligible. Therefore adverse impacts on American Indians are not expected. As described in the cultural resources sections of Chapter 4, if American Indian remains or cultural resources are discovered during construction, land-disturbing activities would be suspended and DOE would contact the appropriate tribal representative and State Historic Preservation Officer.*

Decisions on mercury storage will be based on the environmental analyses presented in this Mercury Storage EIS *and other factors, such as cost, schedule, strategic objectives, public input, and consultations with potentially affected American Indian tribal governments. DOE will announce its decision and approach for storage of the mercury in the Record of Decision (ROD), which will be published no earlier than 30 days after publication of the* Final Mercury Storage EIS *Notice of Availability.*

Regulatory Compliance

Commentors asked if mercury would be considered a commodity or an RCRA-regulated hazardous waste. Commentors expressed concern that the DOE mercury storage facility(ies) would be able to operate under the interim status provision of the Act before a state hazardous waste permit is granted, and that this would preclude the public involvement steps that normally occur in the permitting process. Commentors expressed concern that mercury storage may violate existing agreements with DOE and that long-term storage may be considered a disposal activity.

Response: *As described in Section 1.3.1, mercury must meet the acceptance criteria for the DOE storage facility and must be at least 99.5 percent pure. The mercury storage facility(ies) would be an RCRA-regulated hazardous waste storage facility. Mercury that is shipped to the DOE mercury storage facility(ies) would be managed as hazardous waste. Chapter 5 of this* Mercury Storage EIS *describes the environmental laws, regulations, permits, and other requirements applicable to mercury management and storage. Section 5 of the Act includes a provision to allow the mercury storage facility(ies) to operate under interim status provided it is in existence on or before January 1, 2013, until a final decision on a permit application is made. The mercury storage facility(ies) would be RCRA permitted and therefore would need to go through the EPA or state review and approval process. The RCRA permitting process includes additional opportunities for public involvement.*

In 1996, DOE and the Mesa County Board of Commissioners (Mesa County) entered into a Memorandum of Understanding (1996 MOU) (DOE and Mesa County 1996) to provide meaningful consultation with and participation of Mesa County in DOE's use of GJDS. The position of Mesa County, a cooperating agency for purposes of this EIS, is that use of GJDS is restricted per the 1996 MOU between DOE and Mesa County, and that the 1996 MOU governs any proposed mercury storage at GJDS. Mesa County believes the agreement is clear and that GJDS is only to be used for uranium mill tailings, almost exclusively of local origin. Mesa County further asserts that DOE assured the citizens of Mesa County that the disposal site would never be used to store any wastes other than mill tailings. Mesa County believes DOE is obligated to honor this agreement.

DOE acknowledges that the 1996 MOU stipulates that DOE must consult with Mesa County regarding decisions related to operations at the site. DOE will evaluate the applicability of the 1996 MOU to the long-term management and storage of elemental mercury at GJDS to determine whether the 1996 MOU would affect the viability of this site as a reasonable alternative.

Activities at SRS are regulated under the National Defense Authorization Act (P.L. 107-107, Section 3155 [December 28, 2001]). This law includes a provision [Section 3155(c)(4)] that requires a "Plan for Disposition" that is to specify a "means by which all such defense plutonium and defense plutonium materials will be removed in a timely manner from the [SRS] for storage or disposal elsewhere". The law does not include provisions that would regulate the storage of mercury within the proposed mercury storage facility(ies).

Public Participation

Commentors stated that DOE should have provided notification of the public scoping meetings farther in advance of meeting dates and that the public scoping period should have been extended. Commentors also suggested that additional scoping meetings should have been held, and a scoping meeting should have been held closer to KCP. Commentors asked if there would be additional opportunities for public comment. Commentors requested that all public scoping transcripts and EIS reference documents be made available.

Response: *As described in Section 1.6, public scoping meetings were held at eight locations near candidate mercury storage sites. CEQ NEPA regulations require a minimum of 15 days between* *publication of the NOI in the* Federal Register *and the first scoping meeting. DOE's first scoping meeting was in compliance with these requirements. In response to public comments, DOE extended the public scoping period from 45 days to 52 days. DOE conducted public scoping meetings in the vicinity of each candidate mercury storage site because these areas are more likely to be directly affected by DOE's decision on mercury storage. In response to public requests, DOE held an additional meeting in Portland, Oregon. For those individuals who could not attend one of the public meetings, DOE provided other methods to submit comments: (1) the* Mercury Storage EIS *website (http://www.mercurystorageeis.com), (2) a toll-free fax line (1-877-274-5462), and (3) the U.S. mail. Additional public hearings will also be held during the comment period on this draft EIS. DOE has added a public hearing in Eunice, New Mexico.*

DOE announced the dates and times of the public scoping meetings in the NOI in the Federal Register*, on the project website, and in display advertisements prominently placed in local newspapers. Although display advertisements were prominently placed in one weekday and one weekend edition of local newspapers, DOE realizes that some individuals may not have seen the scoping meeting advertisements. Therefore, DOE is mailing notices for the draft EIS public hearings directly to persons on the* Mercury Storage EIS *mailing list. Meeting transcripts and reference documents will be a part of the administrative record for this* Mercury Storage EIS. *Reference documents are also available in the public reading rooms.*

<u>Cost</u>

Commentors suggested that life-cycle costs should be provided for each storage alternative. Commentors expressed concern that adequate fees must be collected by DOE to run the storage facility. Commentors suggested that DOE provide funding for state permitting and oversight.

Response: *Costs are not presented in the draft EIS. Section 5 of the Act authorizes DOE to assess and collect a fee at the time of delivery of mercury to the DOE storage facility to cover the costs of long-term management and storage. These costs include operations and maintenance, security, monitoring, reporting, personnel, administration, inspections, training, fire suppression, closure, and other costs required for compliance with applicable laws. Section 5 of the Act states that such costs shall not include costs associated with land acquisition or permitting.*

<u>Other</u>

A commentor expressed concern that the Act could result in more foreign mercury mining and recycling, resulting in more releases of mercury to the environment. Another commentor believed the Act could result in higher costs for the domestic mercury reclamation and recycling industry and therefore less recycling. A commentor suggested that DOE consider the need to fund research into mercury treatment and stabilization technologies while another commentor suggested implementation of a 50-year research program before mercury storage decisions are made.

Response: *In the Act, Congress mandates the preparation of two important studies. Section 5 of the Act requires DOE to submit to Congress no later than July 1, 2014, the results of a study to determine the impacts of the long-term mercury storage program on mercury recycling, including proposals to mitigate any negative impacts. Section 6 of the Act requires EPA to report on the global supply and trade of mercury no later than January 1, 2017; this report must include the amount of mercury traded globally that originates from primary mining, where such mining is conducted, and whether additional primary mining has occurred as a consequence of this Act. Funding for research into mercury treatment and stabilization technologies is outside the scope of this EIS. The Act contains specific near-term milestones for creation of a mercury storage facility(ies). A 50-year research program before mercury storage decisions are made would not be consistent with the Act.*

1.7 OTHER RELEVANT NATIONAL ENVIRONMENTAL POLICY ACT REVIEWS

The proposed mercury management actions described in this *Mercury Storage EIS* would require coordination with other NEPA activities at each of the candidate sites. Ongoing and future hazardous waste management activities are particularly relevant. This section includes brief summaries of other activities that are occurring or planned at the seven candidate locations for long-term storage of mercury and at the current DOE mercury storage location at Y–12. The *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997) is applicable to all the candidate DOE sites and therefore, is described in this section.

Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (Final WM PEIS) **(DOE/EIS-0200)** (DOE 1997)**.** In May 1997, DOE issued *the Final WM PEIS*, which examined the potential environmental and cost impacts of strategic management alternatives for managing low-level radioactive waste (LLW), mixed low-level radioactive waste (MLLW), transuranic (TRU) waste, high-level radioactive waste, and nonwastewater hazardous waste resulting from activities at DOE sites around the United States. DOE published four initial RODs from this EIS, one each for TRU waste, hazardous waste, high-level radioactive waste, and LLW, and mixed waste. In the second ROD, published in the *Federal Register* on August 5, 1998 (63 FR 41810), DOE decided to continue using offsite facilities for the treatment of major portions of the nonwastewater hazardous waste generated at DOE sites. The *Final WM PEIS* is relevant because it evaluates the management of hazardous waste within the DOE complex.

1.7.1 Grand Junction Disposal Site

Final Environmental Impact Statement, Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado **(DOE/EIS-0126)** (DOE 1986). This EIS evaluated alternatives for cleanup of contaminated material at the Climax Uranium Company mill site and associated vicinity properties in Grand Junction, Colorado. Six alternatives were evaluated, including disposal at the Cheney Reservoir Site, now known as GJDS. In the ROD for this EIS (DOE 1988), DOE selected disposal at GJDS of contaminated material from the mill site and associated properties. This EIS is relevant because it provides environmental information and evaluates the environmental impacts of GJDS operation.

As described in Section 1.6, DOE and Mesa County entered into the 1996 MOU (DOE and Mesa County 1996) to provide meaningful consultation with and participation of Mesa County in DOE's use of GJDS. The position of Mesa County, a cooperating agency for purposes of this EIS, is that use of GJDS is restricted per the 1996 MOU between DOE and Mesa County, and that the 1996 MOU governs any proposed mercury storage at GJDS. Mesa County believes the agreement is clear and that GJDS is only to be used for uranium mill tailings, almost exclusively of local origin. Mesa County further asserts that DOE assured the citizens of Mesa County that the disposal site would never be used to store any wastes other than mill tailings. Mesa County believes DOE is obligated to honor this agreement.

DOE acknowledges that the 1996 MOU stipulates that DOE must consult with Mesa County regarding decisions related to operations at the site. DOE will evaluate the applicability of the 1996 MOU to the long-term management and storage of elemental mercury at GJDS to determine whether the 1996 MOU would affect the viability of this site as a reasonable alternative.

1.7.2 Hanford Site

Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement (Hanford Comprehensive Land-Use Plan EIS) **(DOE/EIS-0222)** (DOE 1999). As a result of public comments and changes in DOE's policies regarding the integration of NEPA; the Comprehensive Environmental

Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601 et seq.); and RCRA, DOE prepared this EIS to evaluate the potential environmental impacts associated with implementing a comprehensive land use plan for Hanford. Working with Federal, state, and local agencies and tribal governments, DOE evaluated six land use alternatives. In the ROD for this EIS (64 FR 61615), DOE decided to adopt a comprehensive land use plan for Hanford. The purpose of this land use plan and its implementing policies and procedures is to facilitate decisionmaking about the site's uses and facilities over at least the next 50 years. As part of this plan, the 200 Areas were designated Industrial-Exclusive and the 400 Area was designated Industrial. Hazardous waste storage activities, as described in this *Mercury Storage EIS*, are consistent with the Industrial-Exclusive land use designation selected for the 200 Areas in the *Hanford Comprehensive Land-Use Plan EIS.*

***Supplement Analysis, Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE/EIS-0222-SA-01)** (DOE 2008). DOE completed a supplement analysis (SA) to help determine whether the existing *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999) remains adequate, or whether a new EIS or a supplement to the existing EIS should be prepared. In the SA, DOE did not identify significant changes in circumstances or substantial new information that has evolved since 1999 that would affect the basis for its decision as documented in the *Hanford Comprehensive Land-Use Plan EIS* ROD. DOE does not plan to prepare a new EIS or a supplement to the existing EIS at this time.

***Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Washington (HSW EIS)* (DOE/EIS-0286F)** (DOE 2004b). The scope of the *HSW EIS* covers management of LLW, MLLW, and post-1970 TRU waste at Hanford. Although hazardous waste was not within the scope of the *HSW EIS*, a new mercury storage building could be constructed in proximity to the existing radioactive waste storage buildings in the Central Waste Complex. Therefore, the *HSW EIS* provides environmental information on the Central Waste Complex, and analyses of operation of the radioactive waste storage buildings provide information related to land disturbance and ecological and cultural resource impacts to inform the decision on storage of mercury at Hanford.

DOE, the Washington State Department of Ecology, and the Washington State Attorney General's Office signed a Settlement Agreement ending the NEPA litigation related to the *HSW EIS* (*State of Washington v. Bodman*, Civil No. 2:03-cv-0518-AAM) on January 6, 2006. The agreement was intended to resolve the Department of Ecology's concerns about *HSW EIS* groundwater analyses and to address other concerns about the *HSW EIS*. The agreement called for an expansion of the "Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, Washington" (DOE/EIS-0356), which had been under development since the issuance of an NOI in January 2003 (68 FR 1052). In fulfillment of the agreement, a new analysis, the *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* was prepared to provide a single, integrated set of analyses that includes all waste types that were analyzed in the *HSW EIS*. The *TC & WM EIS* is discussed in more detail in the next section.

Pending finalization of the *TC & WM EIS*, the *HSW EIS* remains in effect to support ongoing waste management activities at Hanford in combination with other applicable Hanford NEPA and CERCLA documents, permits, and approvals. However, DOE will not rely on the groundwater analyses in the *HSW EIS* for decisionmaking.

***Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* (DOE/EIS-0391)** (DOE 2009b). The *TC & WM EIS* analyzes the potential health and environmental impacts of storing, retrieving, treating, and disposing of waste generated during defense production years and stored in underground tanks at Hanford. This EIS also evaluates the potential health and environmental impacts of ongoing solid waste management operations at Hanford and the final disposition of the Fast Flux Test Facility. The *Draft TC & WM EIS* was issued for public comment on October 30, 2009 (74 FR 56194). The *TC & WM EIS* analyzes mercury as a constituent of concern but the specifics of a mercury storage facility(ies) are not analyzed. The *TC & WM EIS* analyzes environmental impacts of the Radioactive Waste Management Program at Hanford, and it is anticipated that many of the characteristics such as building size, resource use, and labor hours related to construction and operation of a mercury storage facility(ies) would be similar to facilities used to store radioactive waste.

The Settlement Agreement (as amended on June 5, 2008) also stipulates that, when complete, the *TC & WM EIS* will supersede the *HSW EIS*. Until that time, DOE will not import offsite LLW, MLLW, or TRU waste to Hanford for disposal, apart from certain limited exemptions as specified in the agreement.

Based on a recent draft consent decree (DOE 2009c), the *TC & WM EIS* Preferred Alternative also includes limitations and exemptions on offsite waste importation to Hanford, at least until the Waste Treatment Plant is operational, as those limitations and exemptions are defined in DOE's January 6, 2006, Settlement Agreement with the State of Washington (as amended on June 5, 2008) regarding *State of Washington v. Bodman* (Civil No. 2:03-cv-0518-AAM). This prohibition against importation of certain offsite wastes does not apply to the storage of hazardous materials and waste at Hanford.

1.7.3 Hawthorne Army Depot

Final Mercury Management Environmental Impact Statement (MM EIS) (DLA 2004). DLA prepared the *MM EIS* to help determine how to manage the Defense National Stockpile Center's (DNSC's) 4,436 metric tons (4,890 tons) of surplus mercury because it was no longer needed for national defense. The *MM EIS* evaluated three alternatives to manage DNSC mercury over the long term. It described the potential environmental, human health, and socioeconomic effects of each alternative. The alternatives evaluated were (1) No Action, in which mercury would continue to be stored at then-current locations; (2) consolidation and storage of mercury at one site; and (3) sale of the mercury. The *MM EIS* concluded that most of the environmental and socioeconomic impacts of alternatives for mercury management would be small (referred to as "negligible" to "minor" in the analysis) under each of the three alternatives and that differences among them would not be sufficient in themselves to support selection of one alternative over the others. In the ROD (69 FR 23733), DNSC selected consolidation and storage of mercury at one site. Later, DNSC announced that mercury would be consolidated for storage at the Hawthorne Army Depot in Hawthorne, Nevada. Consolidating the 4,436 metric tons (4,890 tons) of excess DNSC mercury at one site was not predicted to result in significant environmental impacts at that site. The *MM EIS* is relevant because it examines long-term mercury storage at the Hawthorne Army Depot.

1.7.4 Idaho National Laboratory

Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (SNF PEIS) **(DOE/EIS-0203)** (DOE 1995a). In April 1995, DOE and the U.S. Department of the Navy, acting as a cooperating agency, issued the *SNF PEIS*. Volume 1 analyzed alternatives for managing existing and reasonably foreseeable inventories of DOE's spent nuclear fuel through the year 2035. Volume 2 presented a detailed analysis of environmental restoration and waste management activities at INL [formerly known as Idaho National Engineering Laboratory], including activities related to hazardous waste. The analysis supported facility-specific decisions regarding new, continued, or discontinued environmental restoration and waste management operations through the year 2005. The term "1995 EIS" refers to only Volume 2 of the 1995 EIS unless specifically noted. The *SNF PEIS* is relevant because it evaluates the environmental impacts of management of hazardous waste at INL.

DOE issued an SA in November 2002 (2002 SA). A second SA (2005 SA) (DOE 2005a) examined the changes in activities at INL since the 2002 SA. The 2005 SA concluded that the 1995 EIS is still adequate for informing DOE decisionmakers and the public of the environmental risks and impacts of actions taken within the scope of the 1995 EIS and for existing environmental restoration and waste management operations at INL.

1.7.5 Kansas City Plant

Environmental Assessment for the Modernization of Facilities and Infrastructure for the Non-nuclear Production Activities Conducted at the Kansas City Plant **(DOE/EA-1592)** (GSA and NNSA 2008). The U.S. General Services Administration (GSA), as the lead agency, and National Nuclear Security Administration (NNSA), as a cooperating agency, issued this final environmental assessment (EA) on April 21, 2008, and a Finding of No Significant Impact (FONSI) on April 29, 2008 (73 FR 23244), on their proposal to construct a new facility to house NNSA's operations concerning nonnuclear components. Under the selected alternative, GSA would lease a new facility from a private developer on NNSA's behalf, and NNSA would relocate its operations from the existing Bannister Federal Complex in Kansas City, Missouri, to the new facility. The new facility would reduce the environmental footprint of KCP operations, including improved energy efficiency, lower emissions, and a reduction in waste generation. Because no significant environmental impacts were identified in this EA, NNSA and GSA issued a FONSI and are moving forward with this project. This EA is relevant because it provides recent, relevant environmental information and supported a FONSI in which DOE decided to move NNSA operations to a new location away from the Bannister Federal Complex.

1.7.6 Savannah River Site

Savannah River Site Waste Management Final Environmental Impact Statement (SRS WM EIS) **(DOE/EIS-0217)** (DOE 1995b). DOE issued the *SRS WM EIS* to provide a basis for selection of a sitewide approach to managing present and future (through 2024) wastes generated at SRS, including hazardous waste. These wastes come from ongoing operations and potential actions, new missions, environmental restoration, and decontamination and decommissioning programs. The *SRS WM EIS* is relevant because it evaluates the environmental impacts of management of hazardous waste at SRS.

1.7.7 Waste Control Specialists, LLC

Supplement Analysis for Transportation, Storage, Characterization, and Disposal of Transuranic Waste Currently Stored at the Battelle West Jefferson Site near Columbus, Ohio **(DOE/EIS-0200-SA-02)** (DOE 2005b). This SA analyses shipment of TRU (radioactive) waste to WCS for storage before characterization and shipment to the Waste Isolation Pilot Plant in New Mexico for disposal.

West Valley Demonstration Project, Waste Management Environmental Impact Statement Supplement Analysis **(DOE/EIS-0337-SA-01)** (DOE 2006). This SA evaluates shipping LLW from the West Valley Demonstration Project in New York State to WCS for disposal.

These SAs are relevant because they analyze shipment of wastes to WCS.

1.7.8 Y–12 National Security Complex

Final Site-Wide Environmental Impact Statement for the Y–12 National Security Complex **(DOE/EIS-0309)** (DOE 2001). This EIS documents a baseline for Y–12 mission operations and evaluates the reasonable alternatives for implementing the programmatic decisions previously announced in the RODs for the *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (61 FR 68014) and the *Storage and Disposition of Weapons-Usable Fissile Materials*

Programmatic Environmental Impact Statement (63 FR 43386). In these RODs, DOE determined that the current NNSA missions would remain at Y–12. This EIS is relevant because it includes management of the 1,200 metric tons (1,300 tons) of mercury currently stored at Y–12.

***Draft Site-Wide Environmental Impact Statement for the Y–12 National Security Complex* (DOE/EIS-0387)** (NNSA 2009). The new draft Y–12 sitewide EIS was issued in October 2009. This EIS evaluates alternatives for the continued operation of Y–12 and considers the continued storage of 1,200 metric tons (1,300 tons) of mercury at Y–12.

1.8 ORGANIZATION OF THIS *MERCURY STORAGE EIS*

This *Mercury Storage EIS* consists of the main volume and a standalone summary. A brief description of Chapters 1 through 9 of the main volume is provided below:

Chapter 1, "Introduction and Purpose and Need for Agency Action," outlines the proposed action and provides background information on the Mercury Export Ban Act of 2008 and the Nation's mercury inventory. It also describes the scope of this EIS and other relevant NEPA documents.

Chapter 2, "Facility Descriptions, Alternatives, and Comparison of Environmental Consequences," describes the existing and new mercury storage buildings analyzed in this EIS, the alternatives for management of the mercury, how the alternatives were developed, the activities that would take place under each alternative, and alternatives that initially were considered and subsequently eliminated from detailed study in this EIS. This chapter also provides a summary of impacts of the alternatives and a description of DOE's Preferred Alternative.

Chapter 3, "Affected Environment," describes the potentially affected environments at the candidate sites and the approach taken in describing these affected environments. The level of detail presented for each resource (e.g., air quality, water resources) depends on the likelihood that the resource would be affected by mercury management activities.

Chapter 4, "Environmental Consequences," describes the potential impacts on the affected environments of the proposed mercury management alternatives, including cumulative impacts and unavoidable adverse impacts. It also discusses potential future closure activities, irreversible and irretrievable commitments of resources, the relationship between short-term uses of the environment and long-term productivity, and mitigation.

Chapter 5, "Environmental Laws, Regulations, Permits, and Other Potentially Applicable Requirements," describes the environmental and health and safety compliance requirements governing implementation of the alternatives, a summary of permit requirements, and the status of consultations with Federal and state agencies and American Indian tribal governments.

Chapters 6, 7, 8, and 9 are the "Glossary," "List of Preparers," "Distribution List," and "Index," respectively.

The appendices include descriptions of methods used to estimate environmental impacts of the alternatives and the detailed information to support the impact analyses. The appendices are as follows:

- Appendix A – "The Mercury Export Ban Act of 2008, *Federal Register* Notices, and Other Public Notices"
- Appendix B – "Impact Assessment Methodology"
- Appendix C – "Storage Facility Construction and Operations Data"
- Appendix D – "Human Health and Ecological Risk Assessment Analysis"
- Appendix E – "Common and Scientific Names of Plant and Animal Species"

- Appendix F – "Cooperating Agency Agreements"
- Appendix G – "Contractor and Subcontractor National Environmental Policy Act Disclosure Statements"

1.9 REFERENCES

DLA (Defense Logistics Agency), 2004, *Final Mercury Management Environmental Impact Statement*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DNSC (Defense National Stockpile Center), 2006, "Defense Stockpile Announces the Selection of the Mercury Consolidation Storage Location," News Release, Fort Belvoir, Virginia, February 2.

DOE (U.S. Department of Energy), 1986, *Final Environmental Impact Statement, Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado*, DOE/EIS-126-F, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, New Mexico, December.

DOE (U.S. Department of Energy), 1988, *Record of Decision for Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Colorado*, Office of Assistant Secretary for Nuclear Energy, August 4.

DOE (U.S. Department of Energy), 1995a, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho Falls, Idaho, April.

DOE (U.S. Department of Energy), 1995b, *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, Savannah River Operations Office, Aiken, South Carolina, July.

DOE (U.S. Department of Energy), 1997, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, D.C., May.

DOE (U.S. Department of Energy), 1999, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, DOE/EIS-0222-F, Richland Operations Office, Richland, Washington, September.

DOE (U.S. Department of Energy), 2001, *Final Site-Wide Environmental Impact Statement for the Y–12 National Security Complex*, DOE/EIS-0309, Oak Ridge Y–12 Area Office, Oak Ridge, Tennessee, September.

DOE (U.S. Department of Energy), 2004a, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, Second Edition, Office of NEPA Policy and Compliance, December.

DOE (U.S. Department of Energy), 2004b, *Final Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Washington*, DOE/EIS-0286F, Richland Operations Office, Richland, Washington, January.

DOE (U.S. Department of Energy), 2005a, *2005 Supplement Analysis of the INL Site Portion of the April 1995 "Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs, Final Environmental Impact Statement,"* DOE/EIS-0203F-SA-02, Idaho Operations Office, Idaho Falls, Idaho, June.

DOE (U.S. Department of Energy), 2005b, *Supplement Analysis for Transportation, Storage, Characterization, and Disposal of Transuranic Waste Currently Stored at the Battelle West Jefferson Site near Columbus, Ohio*, DOE/EIS-0200-SA-02, Office of Environmental Management, Washington, D.C., October.

DOE (U.S. Department of Energy), 2006, *West Valley Demonstration Project, Waste Management Environmental Impact Statement Supplement Analysis*, DOE/EIS-0337-SA-01, West Valley Demonstration Project, West Valley, New York, June 7.

DOE (U.S. Department of Energy), 2008, *Supplement Analysis, Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, DOE/EIS-0222-SA-01, Richland Operations Office, Richland, Washington, June.

DOE (U.S. Department of Energy), 2009a, *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury*, November 13.

DOE (U.S. Department of Energy), 2009b, *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391, Office of River Protection, Richland, Washington, October.

DOE (U.S. Department of Energy), 2009c, "Energy Secretary Chu, EPA Administrator Jackson, Washington State Governor Gregoire and Oregon Governor Kulongoski Join Elected Officials in Announcing Agreement on New Commitments for Hanford Cleanup," Richland, Washington, August 11.

DOE and Mesa County (U.S. Department of Energy and Mesa County), 1996, Memorandum of Understanding Between the United States Department of Energy and The Mesa County Board of Commissioners, April 22.

EPA (U.S. Environmental Protection Agency), 1997, *Mercury Study Report to Congress*, Vol. III, *Fate and Transport of Mercury in the Environment*, EPA-452/R-97-005, Office of Air Quality Planning & Standards and Office of Research and Development, December.

EPA (U.S. Environmental Protection Agency), 2000, *Mercury Research Strategy*, EPA/600/R-00/073, Office of Research and Development, Washington, D.C., September.

EPA (U.S. Environmental Protection Agency), 2007, *Mercury Storage Cost Estimates*, Office of Pollution Prevention and Toxics and Office of Solid Waste and Emergency Response, Washington, D.C., November.

EPA (U.S. Environmental Protection Agency), 2009, *Report to Congress, Potential Export of Mercury Compounds from the United States for Conversion to Elemental Mercury*, Office of Pollution Prevention and Toxic Substances, Washington, D.C., October 14.

Fed Biz Opps (*Federal Business Opportunities*), 2009, *Request for Expressions of Interest Long-Term Management and Storage of Elemental Mercury*, Solicitation No. DE-SOL-0000415, U.S. Department of Energy, March 17.

GSA and NNSA (U.S. General Services Administration and National Nuclear Security Administration), 2008, *Environmental Assessment for the Modernization of Facilities and Infrastructure for the Non-nuclear Production Activities Conducted at the Kansas City Plant*, DOE/EA-1592, Kansas City, Missouri, April 21.

NNSA (National Nuclear Security Administration), 2009, *Draft Site-Wide Environmental Impact Statement for the Y–12 National Security Complex*, DOE/EIS-0387, Y–12 Site Office, Oak Ridge, Tennessee.

Triay, I.R., 2009, *Assistance Required to Identify a Storage Facility for Elemental Mercury*, Washington, D.C., March 30.

UNEP (United Nations Environment Programme), 2002, *Draft UNEP Chemicals Global Mercury Assessment*, Geneva, Switzerland, April 25.

UNEP (United Nations Environment Programme), 2009, *Draft Technical Guidelines on the Environmentally Sound Management of Mercury Wastes*, 4th Draft, Geneva, Switzerland, April.

USGS (U.S. Geological Survey), 2000, *Mercury in the Environment*, Fact Sheet 146-000, accessed through http://www.usgs.gov/themes/factsheet/146-00/, October.

USGS (U.S. Geological Survey), 2009, *Mineral Commodity Summaries 2009*, Reston, Virginia, January 29.

Utah (Utah Department of Environmental Quality), 2009, *Atmospheric Transport of Mercury*, accessed through http://www.mercury.utah.gov/atmospheric_transport.htm, August 11.

<u>Code of Federal Regulations</u>

10 CFR 1021, U.S. Department of Energy, "National Environmental Policy Act Implementing Procedures."

40 CFR 1500–1508, Council on Environmental Quality, Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.

40 CFR 1501.7, Council on Environmental Quality, NEPA and Agency Planning: Scoping.

40 CFR 1502.2, Council on Environmental Quality, Environmental Impact Statement: Implementation.

40 CFR 1506.10, Council on Environmental Quality, Other Requirements of NEPA: Timing of Agency Action.

49 CFR 171–178, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, Regulations Relating to Hazardous Materials Transport; Shipments and Packagings; Carriage by Rail, Aircraft, Vessel, and Highway; and Packaging Specifications."

<u>Federal Register</u>

61 FR 68014, U.S. Department of Energy, 1996, "Record of Decision *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*," December 26.

63 FR 41810, U.S. Department of Energy, 1998, "Record of Decision for the Department of Energy's Waste Management Program: Treatment of Non-wastewater Hazardous Waste," August 5.

63 FR 43386, U.S. Department of Energy, 1998, Notice of an Amended Record of Decision, "Storage and Disposition of Weapons-Usable Fissile Materials," August 13.

64 FR 61615, U.S. Department of Energy, 1999, "Record of Decision: *Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)*," November 12.

68 FR 1052, U.S. Department of Energy, 2003, "Notice of Intent to Prepare an Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, WA," January 8.

69 FR 23733, Defense Logistics Agency, Defense National Stockpile Center, 2004, "Record of Decision for the *Final Mercury Management Environmental Impact Statement*," April 30.

73 FR 23244, U.S. General Services Administration and U.S. Department of Energy National Nuclear Security Administration, 2008, "Finding of No Significant Impact; *Modernization of Facilities and Infrastructure for the Non-nuclear Production Activities Conducted at the National Nuclear Security Administration's Kansas City Plant Environmental Assessment* (DOE/EA-1592)," April 29.

74 FR 11923, U.S. Department of Energy, 2009, "Request for Expressions of Interest in Hosting a Facility or Facilities for the Long-Term Management and Storage of Elemental Mercury," March 20.

74 FR 31723, U.S. Department of Energy, 2009, "Notice of Intent to Prepare an *Environmental Impact Statement for the Long-Term Management and Storage of Elemental Mercury*," July 2.

74 FR 56194, U.S. Department of Energy, 2009, "Notice of Availability of the *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, WA*," October 30.

United States Code

33 U.S.C. 1251 et seq., Federal Water Pollution Control Act of 1948, as amended (Clean Water Act).

42 U.S.C. 4321 et seq., National Environmental Policy Act of 1969, as amended.

42 U.S.C. 6901 et seq., Resource Conservation and Recovery Act of 1976, as amended.

42 U.S.C. 7401 et seq., Clean Air Act of 1970, as amended.

42 U.S.C. 9601 et seq., Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended.

U.S. Public Laws

P.L. 107-107, National Defense Authorization Act.

P.L. 110-414, Mercury Export Ban Act of 2008.

CHAPTER 2
FACILITY DESCRIPTION, ALTERNATIVES, AND COMPARISON OF ENVIRONMENTAL CONSEQUENCES

Chapter 2 provides descriptions of basic design requirements for new and existing facilities that may be used for the long-term management and storage of elemental mercury; the alternative locations that are being considered; and alternatives that were considered but eliminated from detailed analysis in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement*. The chapter concludes with a comparison and summary of impacts.

2.1 INTRODUCTION

As previously discussed in Chapter 1, Section 1.2, "Purpose and Need for Agency Action," the U.S. Department of Energy (DOE) estimates that up to approximately 10,000 metric tons (11,000 tons) of excess elemental mercury may be eligible for long-term management and storage in a DOE-designated facility(ies) based on a 40-year period of analysis.[1, 2] DOE's selection of a mercury storage facility(ies) would comply with the requirements of Section 5(a) of the Mercury Export Ban Act of 2008 (referred to hereafter as "the Act"), entitled "Designation of a Facility." Specifically, Section 5(d) of the Act, entitled "Management Standards for a Facility," requires DOE to construct and operate the facility(ies) in accordance with the Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.). A designated facility in existence on or before January 1, 2013, would be authorized to operate under interim status in accordance with the SWDA until a final decision is made on a permit application. No later than January 1, 2015, the Administrator of the U.S. Environmental Protection Agency (EPA) (or authorized state) must issue a final decision on the permit application (P.L. 110-414). The mercury to be stored at the DOE facility(ies) must be elemental with a purity of 99.5 percent or greater by volume (DOE 2009).[3]

Potential sources of excess mercury in the United States that may require long-term storage in a DOE facility(ies) include (1) that resulting from closure of chlor-akali plants or conversion to non-mercury-cell technology; (2) that generated as a byproduct of the gold-mining process; (3) that reclaimed from recycling and waste recovery activities; (4) DOE mercury at the Y–12 National Security Complex (Y–12); and (5) other relatively minor sources.

In March 2004, the Defense Logistics Agency (DLA) Defense National Stockpile Center (DNSC) issued the *Final Mercury Management Environmental Impact Statement (MM EIS)* (DLA 2004), which analyzed alternatives for managing the U.S. Department of Defense stockpile of mercury. The *MM EIS* analyzed

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[1] Unless indicated otherwise, elemental mercury is referred to hereafter simply as "mercury" in this environmental impact statement.

[2] The Mercury Export Ban Act of 2008 does not require that mercury be stored in a DOE mercury storage facility(ies), nor does the Act specify how long such a facility(ies) would need to be operated. The U.S. Environmental Protection Agency projected in the report *Mercury Storage Cost Estimates* (EPA 2007), that, in addition to governmental stockpiles of mercury, 7,500 to 10,000 metric tons (8,300 to 11,000 tons) of mercury may become excess over the next 40 years. In preparing this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement*, DOE has reexamined these estimates. For purposes of analysis, DOE assumes the operation of a mercury storage facility(ies) with a capacity of 10,000 metric tons (11,000 tons) over a 40-year period of analysis. These are estimates with a degree of uncertainty; therefore, it is possible that more or less than 10,000 metric tons (11,000 tons) of mercury could eventually require storage for a period longer or shorter than 40 years. Additional National Environmental Policy Act analysis may be required to expand the facility(ies) to accept more than 10,000 metric tons (11,000 tons) of mercury or extend its operations beyond the 40-year period of analysis.

[3] The treatment standard for wastes containing high concentrations of mercury (greater than 260 parts per million) is recovery through roasting or retorting, which is performed at various commercial waste recovery facilities. This process yields high purity (e.g., elemental mercury that is at least 99.5 percent pure by volume) that is generally acceptable for reintroduction back into commerce and is analogous to the materials proposed to be stored in a DOE facility(ies). Therefore, only mercury with greater than 99.5 percent purity by volume would be accepted for long-term storage in a DOE facility(ies).

consolidated long-term storage at several candidate DNSC and non-DNSC sites. In the Record of Decision, DLA amended its selection of consolidated storage at one location (69 FR 23733) and DLA selected the Hawthorne Army Depot in Nevada, a non-DNSC candidate site analyzed in the *MM EIS*, for storage of approximately 4,400 metric tons (4,900 tons) of mercury. This quantity of defense-related mercury is not included in the estimates of excess mercury that may require long-term storage in a DOE-designated facility(ies), although, as previously noted, the Hawthorne Army Depot site is evaluated in this environmental impact statement (EIS) for storage of the additional mercury for which DOE would be responsible.

2.2 MERCURY STORAGE FACILITY(IES)

As required by Section 5 of the Act (P.L. 110-414), DOE has developed guidance, entitled *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury (Interim Guidance)* (DOE 2009) establishing basic standards and procedures for the receipt, management, and long-term storage of mercury at a DOE facility(ies). The guidance is based on laws, regulations, DOE Orders, and best management practices. The *Interim Guidance* discusses DOE's anticipated waste acceptance criteria for discarded mercury to be stored at the facility(ies). All mercury to be stored at the facility(ies) must meet these requirements. Further, it describes the procedures DOE would use to receive, store, and monitor the mercury. In addition, spill and emergency response procedures are described.

Major characteristics of DOE's mercury storage facility(ies) would include, but would not necessarily be limited to, the following (74 FR 31723; DOE 2009):

- RCRA-regulated/permitted with proper spill containment features and emergency response procedures
- Security and access control
- Fire suppression systems
- Ventilated storage and handling area(s)
- Fully enclosed weather-protected building
- Reinforced-concrete floors able to withstand structural loads of mercury storage

Additionally, as described in Appendix C, Section C.2.1, the mercury storage facility(ies) would have the following functional areas: Receiving and Shipping Area, Handling Area, Storage Area, and an Office Administration Area. The Office Administration Area is likely to be in a separate building, where all the management, operations, training, and other administrative functions would be conducted. If necessary, transfer of mercury from failed containers into new containers would occur in the Handling Area.

A typical mercury storage facility would be dominated by the Storage Area, which would constitute approximately 90 percent of the floor space. The Storage Area would generally be a large open space similar to a warehouse, where storage, inspection, and monitoring could be effectively performed. The other functional areas would occupy the remaining 10 percent of the facility(ies).

The mercury storage facility(ies) would accept two types of mercury containers: 3-liter (3-L) (34.6-kilogram [76-pound]) flasks and 1-metric-ton (1-MT) (1.1-ton) containers. Other types of containers would be considered on a case-by-case basis.

Figure 2–1 shows the typical 3-L flask and 1-MT container that are used to store and transport mercury. These containers are typically made of carbon steel or stainless steel and also satisfy the U.S. Department of Transportation hazardous materials regulations for mercury transport (49 CFR 172.101). A DOE storage facility with a capacity to store 10,000 metric tons (11,000 tons) of mercury could store up to approximately 116,000 of the 3-L flasks and 6,000 of the 1-MT containers. The numbers of containers are based on an assumed 40:60 percent split between the amount of mercury that is expected to be stored in 3-L flasks (4,000 metric tons [4,400 tons]) and the amount that is expected to be stored in 1-MT containers (6,000 metric tons [6,600 tons]) (DOE 2009).

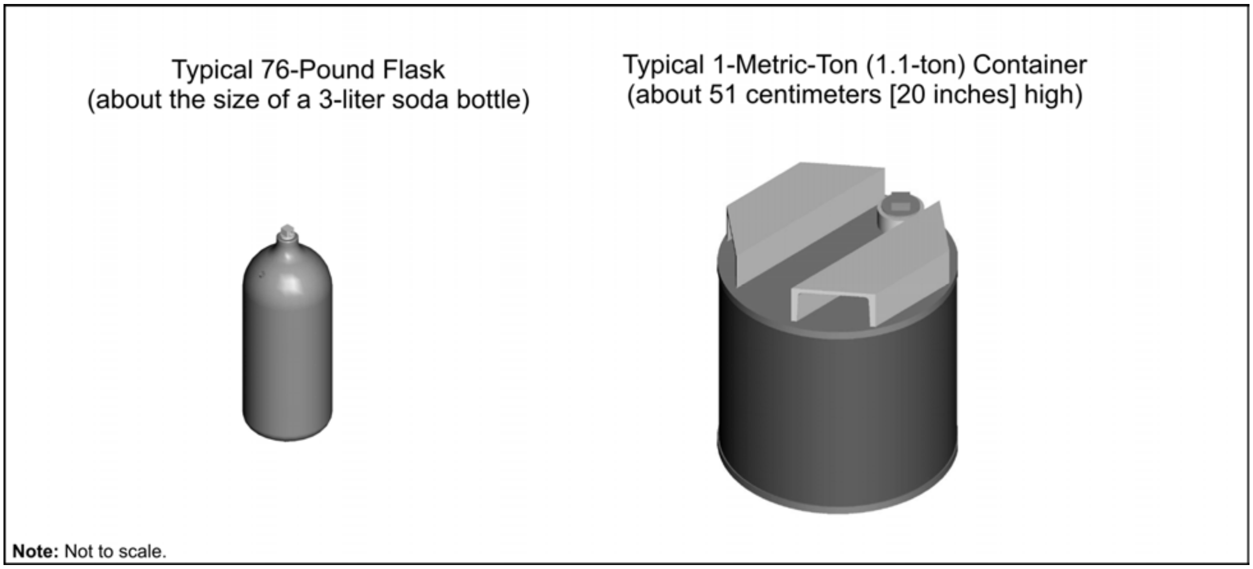


Figure 2–1. Typical Elemental Mercury Storage Containers

2.2.1 New Facility

If constructed, a new mercury storage facility would be designed and built for the specific purpose of providing the safe and secure long-term storage of mercury. Figure 2–2 provides an illustration of what the exterior of a new mercury storage facility might look like, and Figure 2–3 provides a conceptual layout of the interior of a full-size facility (i.e., with a storage capacity of 10,000 metric tons [11,000 tons]) and how the mercury containers might be stored. Appendix C provides additional details and data related to requirements for construction and operation of a new facility.

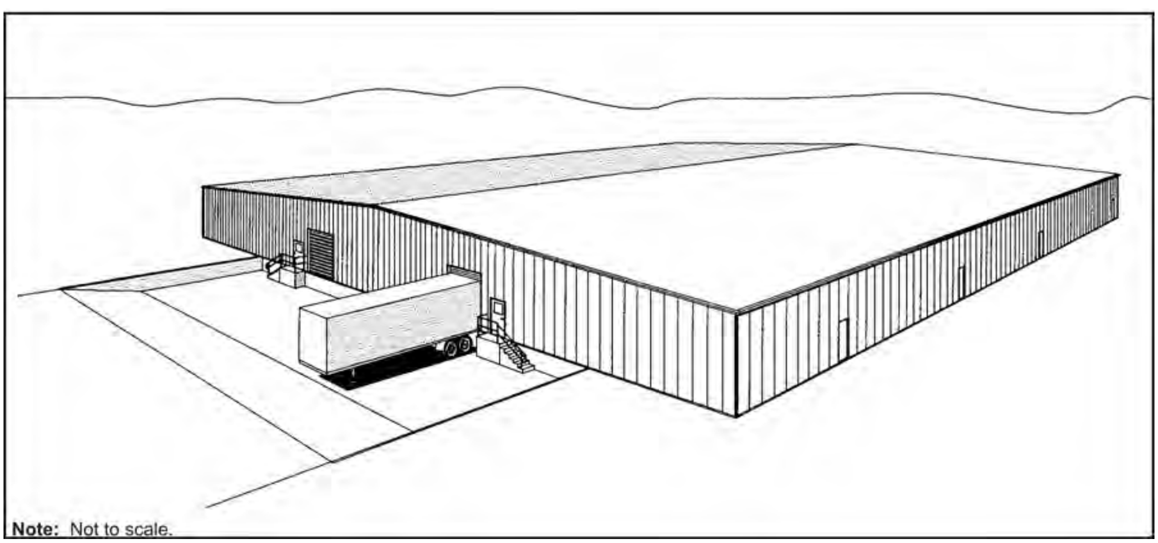


Figure 2–2. Exterior Representation of a New Mercury Storage Facility

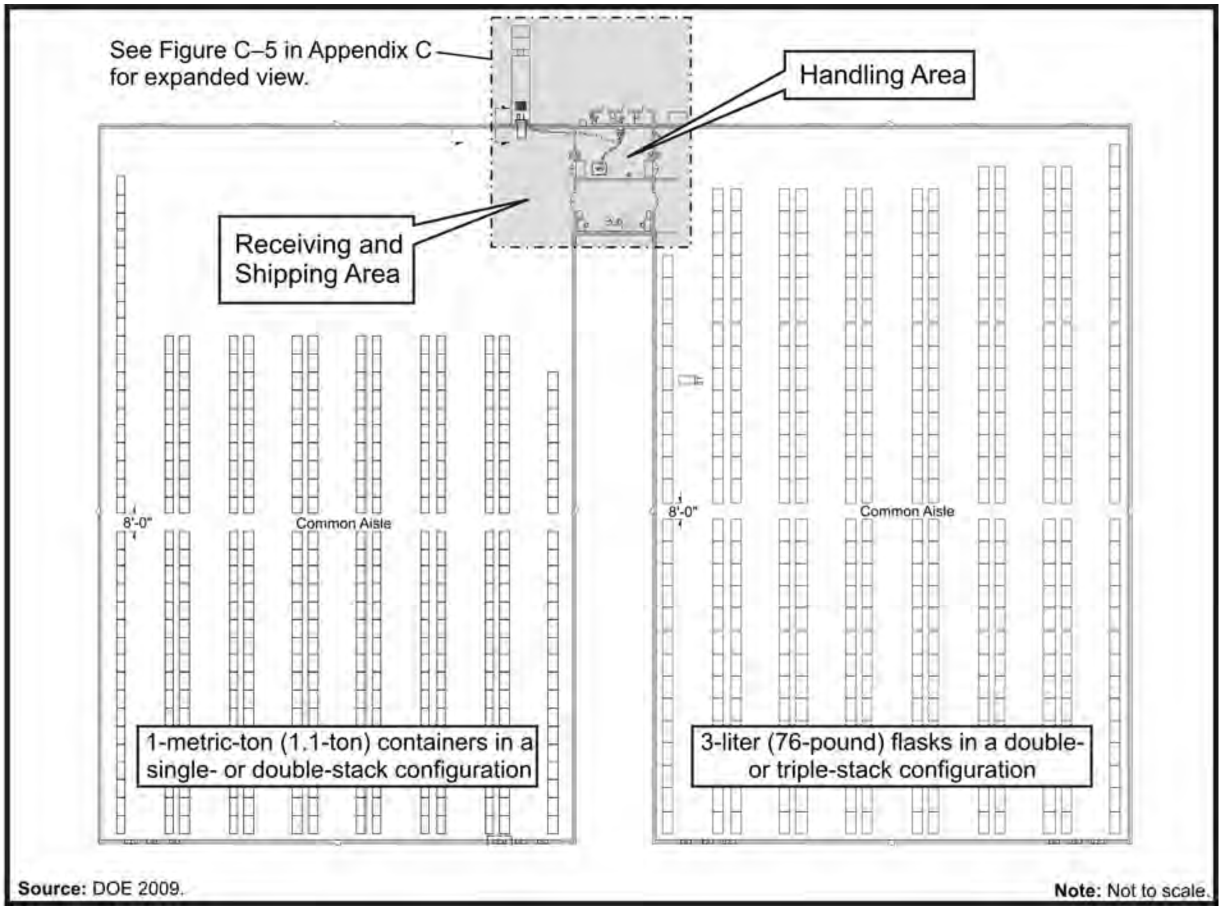


Figure 2–3. Potential Conceptual Layout of a New Mercury Storage Facility

If built, a new mercury storage facility with a 10,000-metric-ton (11,000-ton) capacity would require approximately 13,610 square meters (146,500 square feet) of storage space. The 1-MT containers may be single- or double-stacked and the 3-L flasks may be single-, double-, or triple-stacked, depending on seismic and safety considerations, as well as the requirements of a state-issued RCRA permit. If constructed, the height of the building would be approximately 6.1 meters (20 feet) to accommodate the potential triple stacking of 3-L flasks. The new facility would have a reinforced-concrete floor, strong enough to withstand the heavy loads from mercury storage. The floors would also be treated with an epoxy sealant to add strength and make them impervious to mercury leaks and spills and water from fire suppression systems. Mercury containers would be stored in spill trays designed to contain at least 10 percent of the volume of mercury stored in each spill tray in the unlikely event one of the containers were to leak. The exterior of the storage facility would likely be sheet metal panels fastened to structural steel supports and connected together to form a weather-protected structure. The Receiving and Shipping Area would have a loading dock with large rollup doors. Lighting, ventilation, fire suppression, and security monitoring systems would be incorporated into the facility design. Monitoring systems could include security alarms and surveillance cameras. A new facility boundary would encompass approximately 3.1 hectares (7.5 acres) and would include a paved area for delivery truck access and vehicle parking. The facility would also need to be RCRA regulated and permitted, and thus would require, among other things, secondary containment (e.g., curbing), regular inspection of stored materials, strict record-keeping, and periodic reporting.

2.2.2 Existing Facilities

Existing facilities proposed and selected for the storage of mercury would also be required to comply with the functional and performance standards as defined in the *Interim Guidance* (DOE 2009). Existing facilities would need to be modified, where necessary, to meet the requirements of the *Interim Guidance* and the terms of an RCRA permit. Alternative locations with existing facilities that have been proposed and analyzed in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement (Mercury Storage EIS)* include storage buildings at the Hawthorne Army Depot, the Radioactive Waste Management Complex (RWMC) at Idaho National Laboratory (INL), the Main Manufacturing Building at Kansas City Plant (KCP), and the Container Storage Building (CSB) at the Waste Control Specialists, LLC (WCS), site. Descriptions of the existing facilities proposed as candidate sites, and of any minor modifications that may be necessary, are specific to each location and are discussed in detail in Section 2.4, "Alternative Sites Evaluated." Existing facilities were considered only if their former use is consistent with the storage of hazardous waste.

2.3 CONSTRUCTION AND OPERATIONS REQUIREMENTS

2.3.1 Construction Requirements

Construction of a new mercury storage facility(ies) with a 10,000-metric-ton (11,000-ton) capacity would require the disturbance of approximately 3.1 hectares (7.5 acres) of land for building construction and equipment laydown areas. When completed, the building footprint would be approximately 1.6 hectares (3.9 acres). Construction of a full-size storage facility would require approximately 6 months; however, due to the uncertainty regarding the timing of the availability of mercury that would require long-term storage, a new facility could be constructed in a modular fashion to accommodate storage of mercury on an as-needed basis. The ability to build the storage facility in a modular fashion would also ensure that the facility is sized correctly for the amount of mercury that would eventually require storage. For example, the Storage Areas of the facility could be built in two sections, one section at a time, with each section capable of storing 5,000 metric tons (5,500 tons) of mercury.

Construction would entail leveling and grading an area large enough to accommodate the storage building or an area large enough to accommodate each module, which would be built as necessary to meet anticipated storage needs. The foundation would consist of heavily compacted aggregate stone overlain with a reinforced-concrete slab approximately 30 centimeters (12 inches) thick. With the exception of small trenches for connecting to utilities or installing concrete footers, excavation for preparing the site and laying the foundation is not expected to exceed a depth of 0.6 meters (2 feet). Electricity during construction would be provided by portable generators. Complete construction of a full-size facility would require an average of 18 full-time construction workers during a 6-month construction period. Resource requirements for construction of a new mercury storage facility with a 10,000-metric-ton (11,000-ton) capacity are discussed in Chapter 4, Section 4.13.2, and Appendix C, Section C.2.3.

Modifications to existing facilities that may be used for the long-term storage of mercury would likely not require any new disturbance of land. However, minor modifications to candidate existing facilities might include the reconfiguration of space. Examples of possible modifications include installing security monitoring systems, fire suppression systems, and equipment in the Handling Area; upgrading ventilation systems; and implementing spill prevention and containment measures. Descriptions of the existing facilities proposed as candidate sites, and of any minor modifications that may be necessary, are specific to each location and are discussed in detail in Section 2.4.

2.3.2 Operations Requirements

Worker activity levels at the storage facility(ies) would increase or decrease with the receipt of mercury shipments. If DOE elects to transfer any excess mercury stored at Y–12, it is assumed that this mercury would be shipped to the designated storage facility(ies) within the first 2 years of operation. Closure of the four chlor-alkali plants that use mercury-cell technology, or conversion to mercury-free processes, is expected to be completed by 2020. However, the timing of these closures and/or conversions is difficult to predict; therefore, the frequency of these mercury shipments to the storage facility(ies) is uncertain. Projected shipments to the new storage facility(ies), based on estimated mercury inventories that may become available for long-term storage, are discussed in Appendix D, Section D.2.7. The amount of mercury in each shipment could vary, ranging from a single container up to the maximum load allowable by transportation regulations.

Operations personnel would include management and administrative staff, facility technicians, facility maintenance staff, subject matter experts, and security staff. Administrative staff would be responsible for permit maintenance, fee collection, record-keeping, and reporting. The Office Administration Area would require heating, ventilating, and air conditioning for occupants. The Handling Area would be ventilated through the use of a high-negative draw system for removing high-concentration vapors from mercury "sources" (e.g., container residues, open containers, small spills). The exhaust air would pass through a mercury vapor filter (e.g., sulfur) and be discharged to the outside. An air conditioning unit would be available for maintaining interior temperatures below 21 degrees Celsius (70 degrees Fahrenheit) during times when mercury is being handled to keep its volatility low. The Storage Area would be ventilated using low-vacuum, high-volume, industrial-sized roof- or wall-mounted fans sized to provide multiple air exchanges over a short period of time and to evacuate low-concentration vapors that may accumulate in the storage spaces over time. These fans would operate on an as-needed basis prior to and during occupancy. Facility technicians would be responsible for inspections and leak and small-spill response. Facility maintenance staff would be responsible for maintaining the operability of the building. Subject matter experts would prepare health and safety plans and quality assurance plans and perform industrial hygiene duties. Security provided for the facility(ies) would reduce the threat of inadvertent or deliberate unauthorized access to the facility(ies) and the Storage Area(s). Security measures might include fences, barriers, gates, locks, television monitoring, or surveillance with guards. During the first 7 years of operations, when the facility(ies) is receiving the highest frequency of shipments, approximately eight full-time workers would be required. During the later years of operations, when the frequency of shipments is expected to be much lower, approximately five full-time workers would be required. Appendix C, Section C.1, discusses in more detail the projected timing of shipments to the DOE facility(ies).

Resource requirements for the operation of a mercury storage facility with a 10,000-metric-ton (11,000-ton) capacity are discussed in Chapter 4, Section 4.13.2, and Appendix C, Section C.2.4.

Operations would include tasks such as facility security, shipping and receiving, inspections, monitoring and long-term storage of mercury, record-keeping, and emergency and small-spill response, as described below (DOE 2009).

- **Facility Security.** The mercury storage facility(ies) would be within a fenced and secure area with controlled access to the premises. Only authorized vehicles and personnel would be allowed access within the facility boundary. It is conservatively assumed for labor estimates that security personnel would guard the facility 24 hours per day, 7 days per week, although this level of security may not be required at all times. Security alarms and surveillance cameras may also be used.

- **Shipping and Receiving.** Mercury containers (3-L flasks and 1-MT containers) would be inspected and prepared for "ready storage" at the originating facility prior to shipment to the mercury storage facility(ies). All containers shall have sufficient integrity to be transported and placed into long-term storage. Shipments of mercury would most likely be conducted by third-party transportation companies in accordance with regulations governing the transportation of hazardous waste. See Appendix C, Section C.1, for a detailed discussion of shipping containers and methods. After arriving at the facility, if visible mercury contamination or leaking containers are observed, the mercury may be immediately moved to the Handling Area for emergency overpacking or reflasking and may subsequently be returned to the generator, at the generator's expense.

- **Inspections.** Upon arrival at the mercury storage facility(ies), concentrations of mercury vapor would be measured and verified to be below any actionable levels. A visual inspection would follow to detect any obvious problems that may have occurred while on the truck or railcar. If the initial inspections and manifest documentation are acceptable, then the mercury would be moved to the Shipping and Receiving Area, where additional visual inspections would be performed to check for leaks, structural integrity of pallets and containers, approved container types, corrosion, etc. The mercury would then be moved to the Handling Area for any additional verification that it meets waste acceptance criteria (e.g., 99.5 percent purity). The containers and pallets that pass the acceptance/verification process would be placed into long-term storage and location data would be recorded.

- **Monitoring and Long-Term Storage.** Regular inspections of the mercury containers would be performed in accordance with RCRA regulations within the Storage Area to ensure that no containers are corroding or leaking. Prior to and during occupancy, the Storage Area would be ventilated using low-vacuum, high-volume industrial-sized roof- or wall-mounted vent fans. Monitoring would include testing the airspace for elevated concentrations of mercury vapors.

- **Record-Keeping.** Manifests, inspection records, training logs, and required reports would need to be completed and maintained in accordance with RCRA regulations. These documents would be stored in the Office Administration Area.

- **Emergency and Small-Spill Response.** Spill response would be handled in accordance with the facility's RCRA contingency plan. The Handling Area would be used for transferring mercury from corroding or leaking containers or from containers that have failed inspection upon arrival at the facility to new containers. The likelihood of these types of occurrences is considered small. When technicians are working with open containers in the Handling Area, the area would be negatively ventilated using a hooded duct system equipped with a filter (e.g., sulfur) designed to remove mercury vapors from the air. Filtered air would be vented to the outside via a small exhaust stack. Personal protective equipment, rags, and spent filters would be placed in 55-gallon (208-liter) drums, characterized, and disposed of off site at an appropriate facility.

2.4 ALTERNATIVE SITES EVALUATED

As discussed in Chapter 1, Section 1.5.1, DOE selected the seven action alternative sites, listed below, to be evaluated in this *Mercury Storage EIS*. The names and locations of the action alternative sites are presented in Figure 2–4; the No Action Alternative is discussed separately in Section 2.4.1. This *Mercury Storage EIS* also analyzes the potential impacts associated with the No Action Alternative. Potential alternative sites considered but eliminated from further consideration are discussed in Section 2.6.

- New construction at the Grand Junction Disposal Site (GJDS)
- New construction at the Hanford Site (Hanford) in the 200-West Area
- Existing storage buildings at the Hawthorne Army Depot in the Central Magazine Area[4]

[4] DOE has interpreted Section 5 of the Act to authorize DOE to designate existing and/or new storage facilities at property owned or leased by DOE. Accordingly, if DOE decides to designate a facility that currently is owned by a commercial entity or by another Federal agency, DOE would acquire an appropriate ownership or leasehold interest in that facility to comply with Section 5 of the Act. DOE would ensure that any such facility currently owned by a commercial entity or by another Federal agency would afford DOE the same level of responsibility and control over stored mercury as a facility owned by

- New construction at INL's Idaho Nuclear Technology and Engineering Center (INTEC)
- Existing storage buildings at INL's RWMC
- Existing building at the Bannister Federal Complex's KCP
- New construction at the Savannah River Site (SRS) E Area
- New construction at WCS

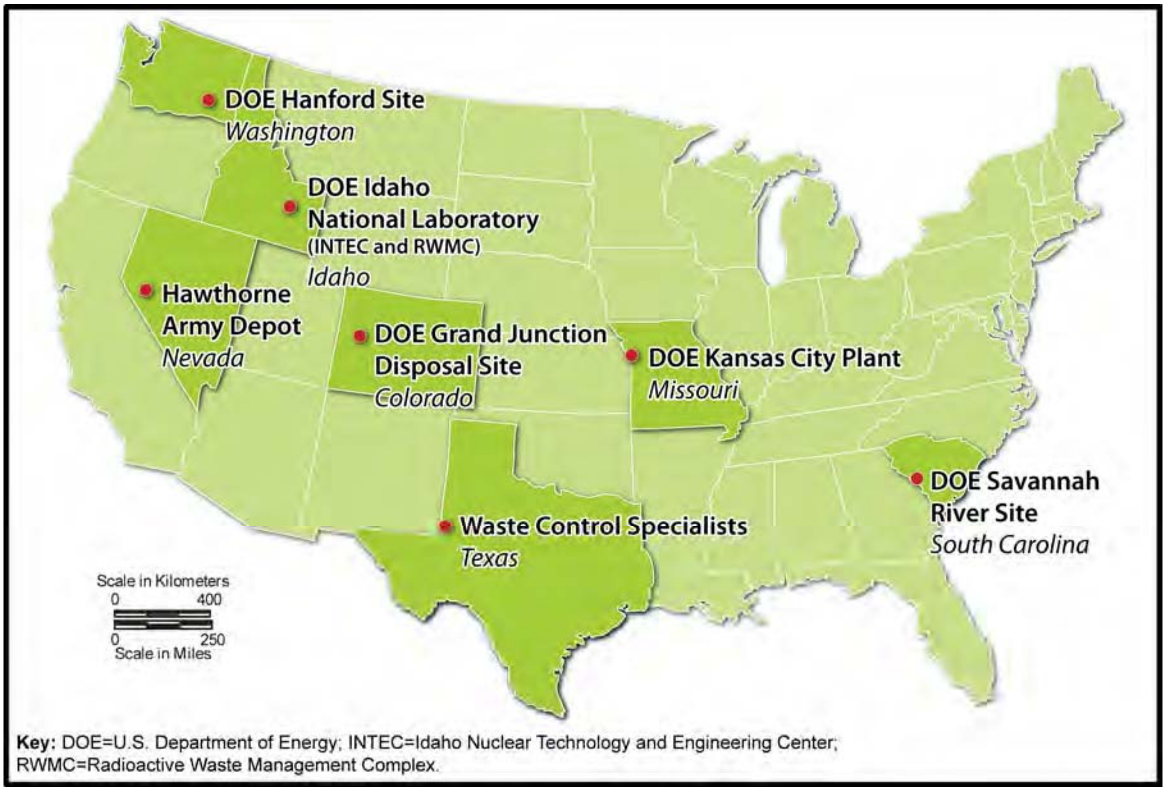


Figure 2–4. Alternative Sites for Long-Term Storage of Mercury

GJDS, the 200-West Area of Hanford, INTEC at INL, E Area at SRS, and WCS would involve construction of a new facility. Hawthorne Army Depot, RWMC at INL, and KCP would involve the use of existing buildings. WCS may also involve the use of an existing RCRA-permitted storage building (i.e., the CSB) until construction of a new mercury storage facility with up to a 10,000-metric-ton (11,000-ton) capacity could be completed elsewhere on the site. The CSB could store up to 2,000 metric tons (2,200 tons) of mercury.

2.4.1 No Action Alternative

As discussed in Chapter 4, Section 4.2, under the No Action Alternative, DOE would not designate a facility(ies) for the long-term management and storage of mercury. Potential U.S. sources of excess mercury that could require long-term storage are illustrated in Figure 2–5 and include (1) mercury resulting from closure of chlor-akali plants or conversion to mercury-free processes; (2) mercury generated as a byproduct of the gold-mining process; (3) mercury reclaimed from recycling and waste recovery activities; (4) DOE mercury at Y–12; and (5) other relatively minor sources. Only

DOE. This would apply to the proposed buildings at Hawthorne Army Depot and the proposed new facility at WCS, as well as interim use of the existing CSB at WCS.

four chlor-alkali plants are expected to still be using mercury-cell technology beyond 2010: Ashta Chemical in Ohio, PPG Industries in West Virginia, and Olin Corporation in Tennessee and Georgia (Chlorine Institute 2008). Mining in the state of Nevada accounts for more than 80 percent of gold production and produces almost all of the byproduct mercury in the United States, although South Dakota reportedly generates small amounts (less than 1 metric ton [1.1 tons]) of byproduct mercury (Miller and Jones 2005; Townsend 2009). Comparatively, the latest available data for Nevada in 2002 report the generation of approximately 97 metric tons (107 tons) of byproduct mercury (Miller and Jones 2005). Alaska, California, Colorado, and Utah are active gold-mining states; however, the mines located in these states reportedly do not generate byproduct mercury (Clinkenbeard 2009; Krahulec 2009; Mannon 2009; Szumigala 2009). As reported by the U.S. Geological Survey in 2009, the six reclamation and recycling companies shown on the map in Figure 2–5 account for the majority of secondary mercury reclamation and recycling efforts (USGS 2009). However, virtually all commodity-grade (e.g., elemental) mercury used in the United States is ultimately supplied by Bethlehem Apparatus Company in Pennsylvania or DFG Mercury Corporation in Illinois. These two companies have the high-level purification equipment necessary for producing commercial-grade mercury (EPA 2005).

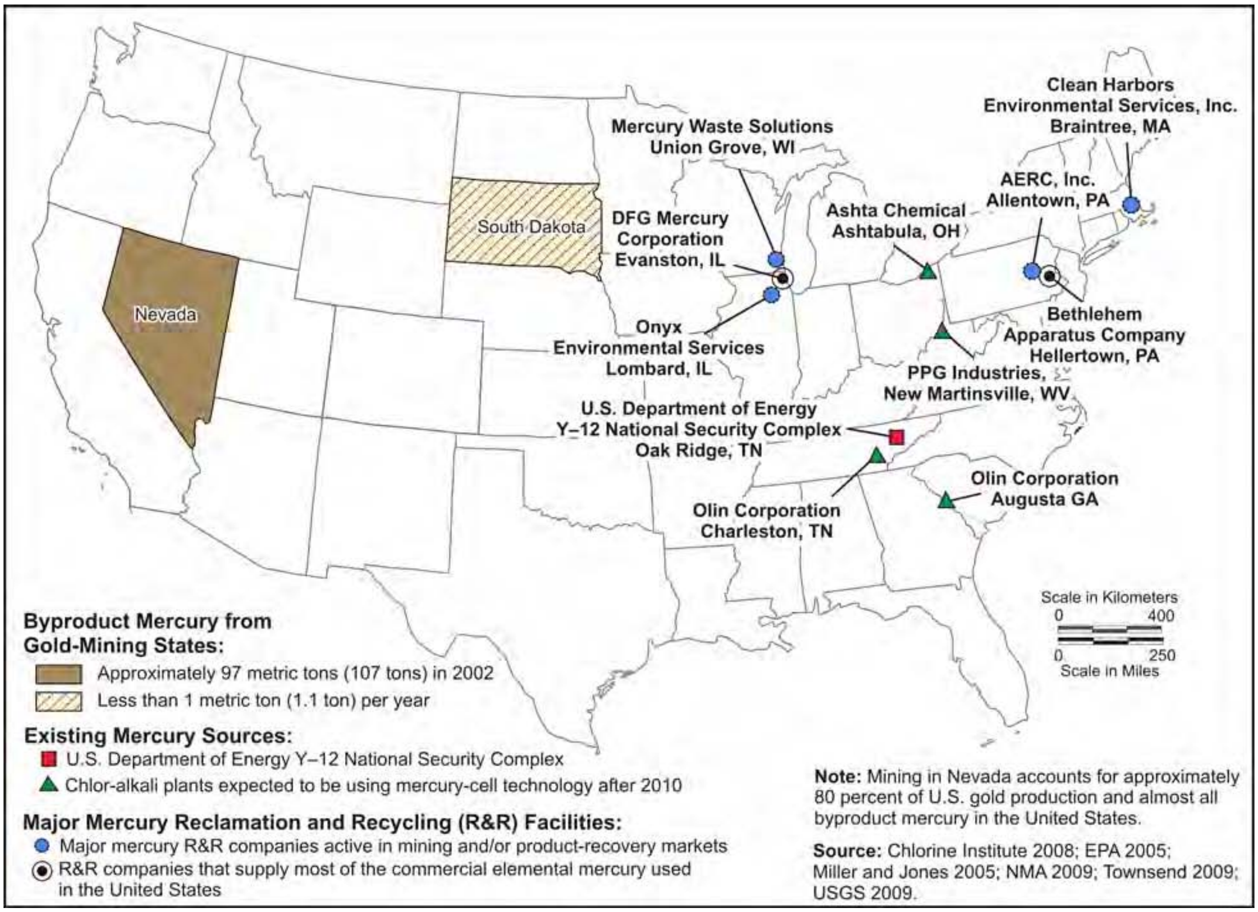


Figure 2–5. Potential Sources of Mercury in the United States

The No Action Alternative would affect all sources of mercury. Excess mercury that could not be sold would be stored as a commodity to the extent allowed by law. Some mercury would likely be considered waste and would be stored in accordance with law. Such storage would not necessarily occur at the sites identified as potential sources of excess mercury. This storage service might be provided by a commercial waste management company(ies).

Approximately 1,200 metric tons (1,300 tons) of DOE mercury would continue to be stored at Y–12. This DOE mercury is currently stored in approximately 35,000 of the 3-L flasks at Y–12.

2.4.2 Long-Term Mercury Management and Storage at Grand Junction Disposal Site

GJDS is located approximately 29 kilometers (18 miles) southeast of Grand Junction, Colorado. The 146-hectare (360-acre) site is owned by DOE and managed by DOE's Office of Legacy Management. Currently, the site has a 38-hectare (94-acre) area used to dispose of uranium mill tailings. There are several small administrative and maintenance buildings on site that support disposal operations. The entire site is surrounded by a perimeter fence and accessed via a gated entrance. This site currently has truck access, but has no direct rail access. An aerial photograph of the site is presented in Figure 2–6.

Figure 2–6. Grand Junction Disposal Site in State of Colorado

This alternative involves construction of a new facility, as described in Sections 2.2.1 and 2.3.1 and Appendix C. The new facility would be located in the northwestern corner of the site, as illustrated in Figure 2–7. A full-size mercury storage facility with a 10,000-metric-ton (11,000-ton) capacity would essentially occupy all of the available (approximately 3.1-hectare [7.5-acre]) area proposed for locating the facility.

As discussed in Chapter 1, Section 1.7.1, DOE and the Mesa County Board of Commissioners (Mesa County) entered into a Memorandum of Understanding (1996 MOU) (DOE and Mesa County 1996) to provide meaningful consultation with and participation of Mesa County in DOE's use of GJDS. Mesa County's position is that the use of GJDS is restricted per the 1996 MOU and that DOE is obligated to honor this agreement. DOE currently is evaluating the applicability of the 1996 MOU to determine whether it would affect the viability of this site as a reasonable alternative.

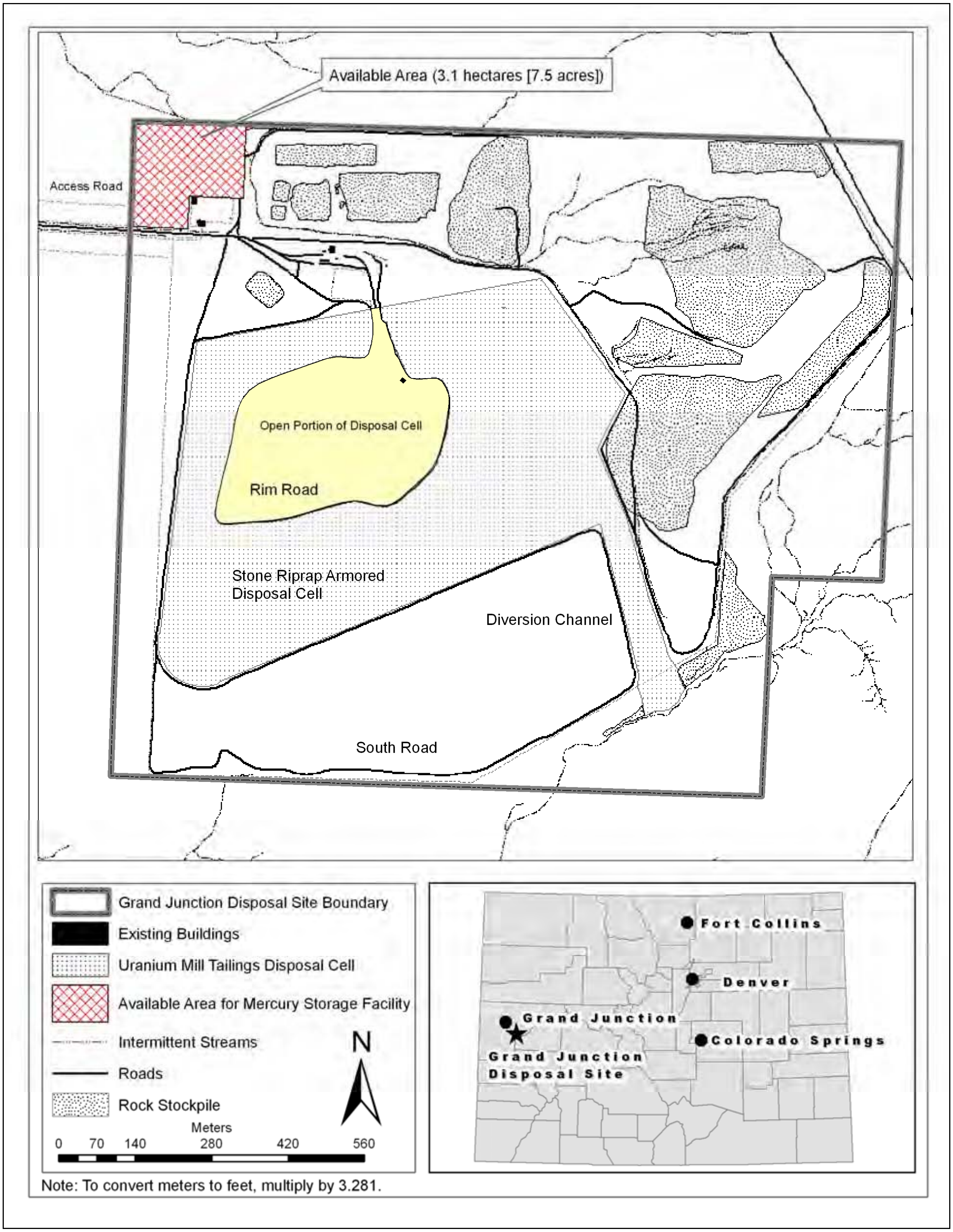
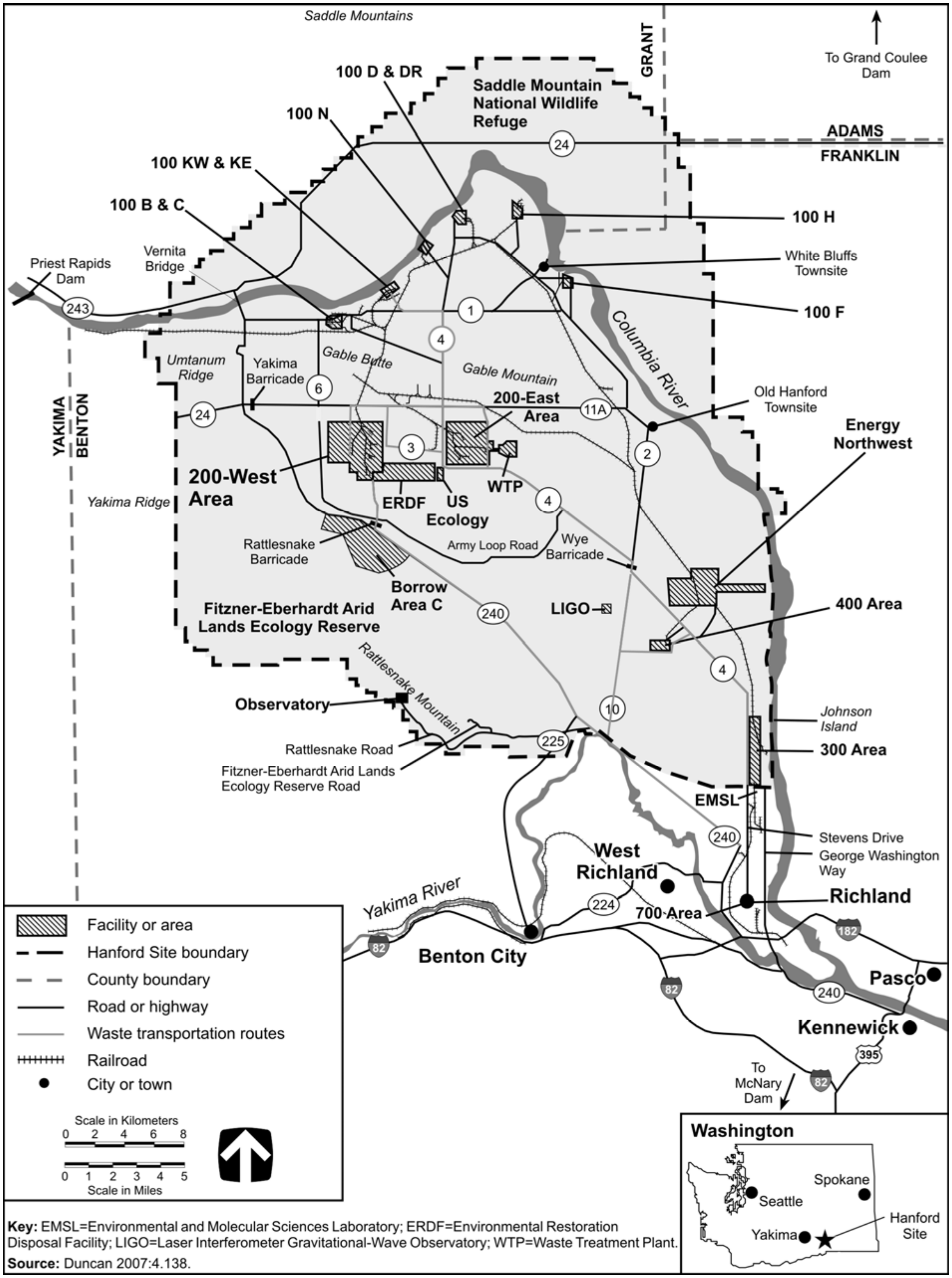


Figure 2–7. New Facility at Grand Junction Disposal Site in State of Colorado

2.4.3 Long-Term Mercury Management and Storage at Hanford Site

Hanford occupies 151,775 hectares (375,040 acres) along the Columbia River in the southeastern portion of the state of Washington. Hanford is owned by the Federal Government and is managed by DOE. A general map of Hanford is illustrated in Figure 2–8.

This alternative involves construction of a new facility, as described in Sections 2.2.1 and 2.3.1 and Appendix C. The new facility would be located in the 200-West Area of Hanford at the Central Waste Complex (CWC). Figure 2–9 presents an aerial photograph of the CWC; Figure 2–10 illustrates the proposed location of the new facility at the CWC. A full-size mercury storage facility with a 10,000-metric-ton (11,000-ton) capacity would occupy 3.1 hectares (7.5 acres) of the available (approximately 22-hectare [54-acre]) area proposed for locating the facility.



Key: EMSL=Environmental and Molecular Sciences Laboratory; ERDF=Environmental Restoration Disposal Facility; LIGO=Laser Interferometer Gravitational-Wave Observatory; WTP=Waste Treatment Plant.
Source: Duncan 2007:4.138.

Figure 2–8. Hanford Site in State of Washington

The 200 Areas, which include the 200-East and 200-West Areas, are on the Central Plateau of Hanford. Together, these two areas cover about 5,064 hectares (12,513 acres). Historically, these areas were devoted to nuclear fuel processing; plutonium processing, fabrication, and storage; and waste management and disposal. Located in the 200-West Area, the CWC receives, stores, and distributes solid radioactive and nonradioactive waste. The CWC includes multiple storage structures that provide interim storage for solid waste awaiting appropriate treatment and final disposal that are dedicated to other Hanford cleanup activities. Truck and rail access are available in the 200-West Area.

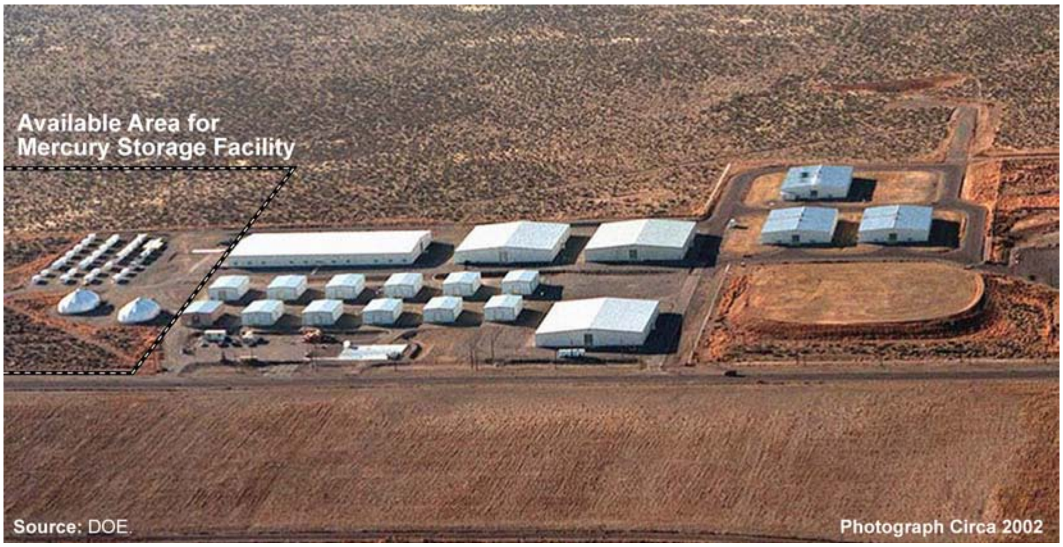


Figure 2–9. Central Waste Complex at the Hanford Site

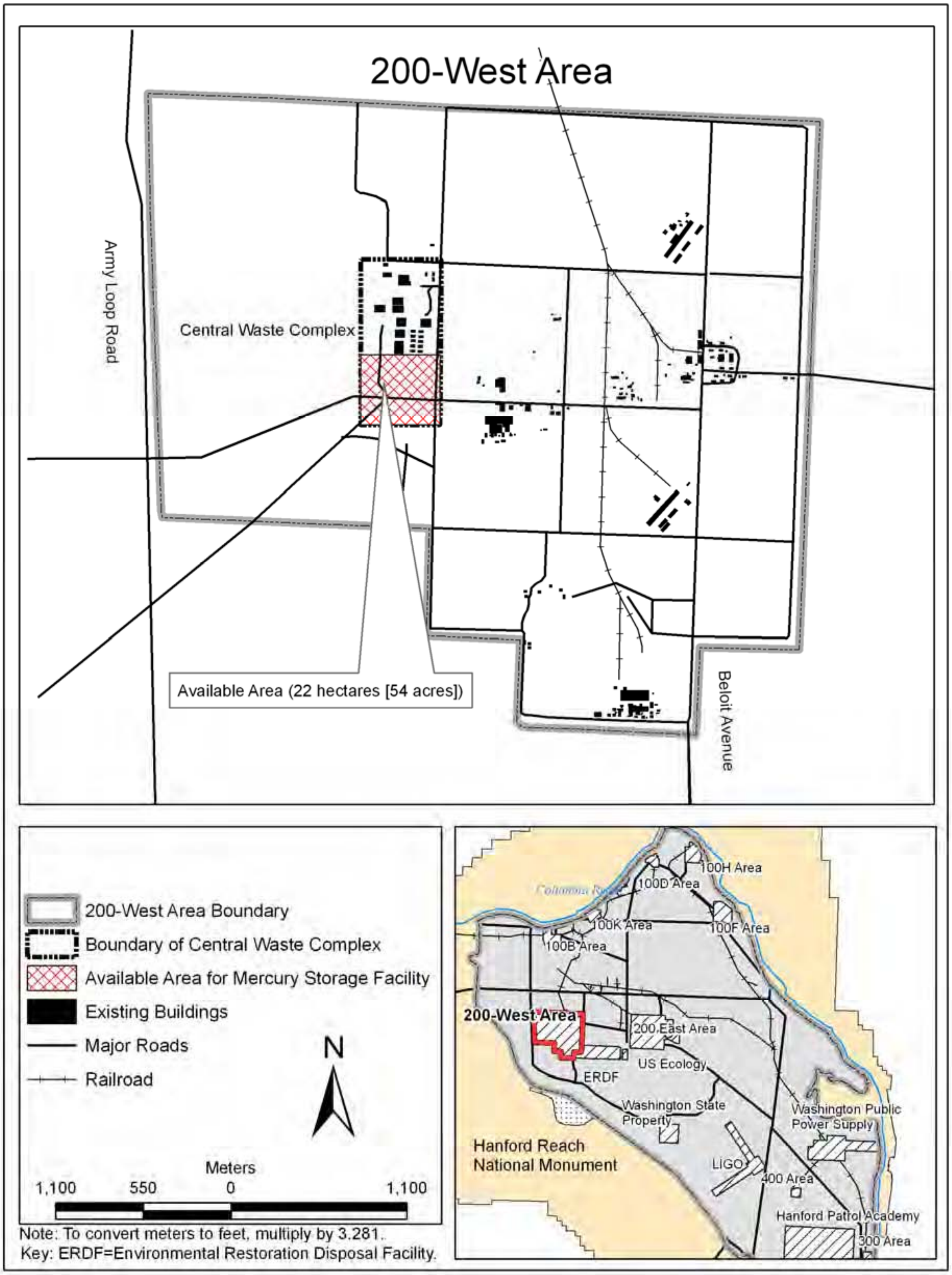


Figure 2–10. New Facility in 200-West Area at the Central Waste Complex at the Hanford Site

2.4.4 Long-Term Mercury Management and Storage at Hawthorne Army Depot

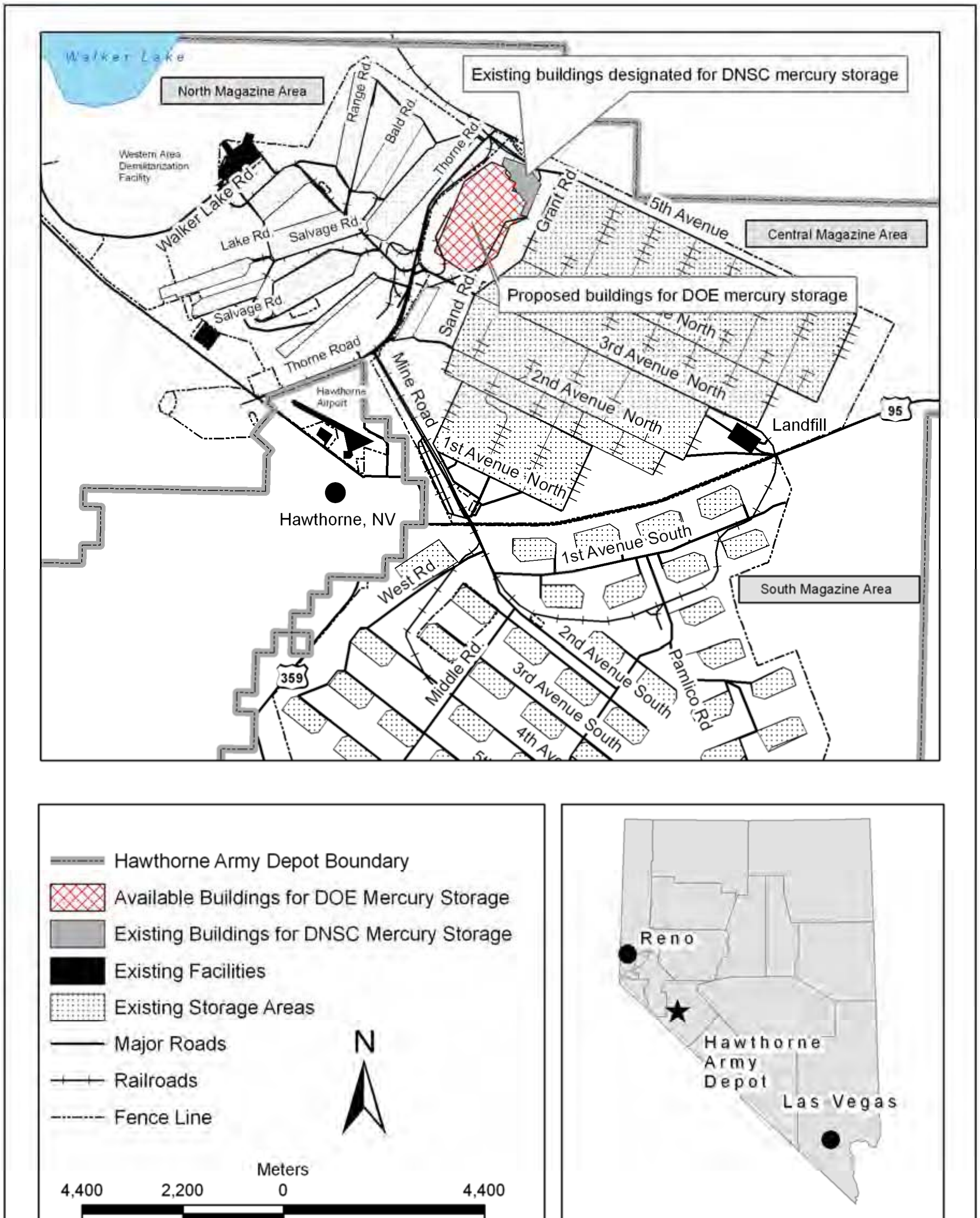
The Hawthorne Army Depot is located approximately 16 kilometers (10 miles) from Hawthorne, Nevada. The 59,500-hectare (147,000-acre) site is owned and managed by the U.S. Department of Defense. The Hawthorne Army Depot contains 2,427 magazines and 488 buildings with a combined storage capacity of 714,000 square meters (7,685,000 square feet). A general photograph of the Hawthorne Army Depot is presented in Figure 2–11. Fourteen of these buildings have been designated and modified for the consolidated storage of the DNSC mercury. The design of the 14 buildings consists of reinforced-concrete walls, floors, and foundations. The roof materials are steel truss systems covered with asbestos concrete (transite) roofing material.


Source: Defense National Stockpile Center

Photograph Circa 2005

Figure 2–11. Existing Storage Buildings at the Hawthorne Army Depot in State of Nevada

Under this alternative, DOE would designate a maximum of 29 buildings in the Central Magazine Area, the current location designated for DNSC mercury storage, which would provide up to approximately 27,000 square meters (290,000 square feet) of storage space for DOE storage of mercury. These 29 buildings are similar to the 14 buildings designated for DNSC storage of mercury before they were modified. Modifications to the proposed buildings would be required prior to DOE storage of mercury and might include reinforcing and epoxy-sealing the floor; installing spill control measures, utilities, and security monitors; and servicing the rail spur. Figure 2–12 illustrates the location of the 29 storage buildings in relation to the DNSC mercury storage buildings and other buildings within the Hawthorne Army Depot. Truck and rail access are available in the Central Magazine Area.



Note: To convert meters to feet, multiply by 3.281.

Key: DNSC=Defense National Stockpile Center, DOE=U.S. Department of Energy.

Figure 2–12. Existing Buildings in Central Magazine Area at Hawthorne Army Depot in State of Nevada

2.4.5 Long-Term Mercury Management and Storage at Idaho National Laboratory

The INL site is a 230,323-hectare (569,135-acre) area located in southeastern Idaho. INL consists of several facility areas situated on an expanse of otherwise undeveloped, cool desert terrain. Most buildings and structures at INL are within these developed site areas, which are typically less than a few square miles in size and separated from each other by miles of primarily undeveloped land. DOE owns and manages the land within INL. Two options for long-term storage of mercury at INL have been identified: (1) new construction at INTEC and (2) reuse of existing RWMC buildings. Figure 2–13 shows INL and the relative locations of INTEC and RWMC.

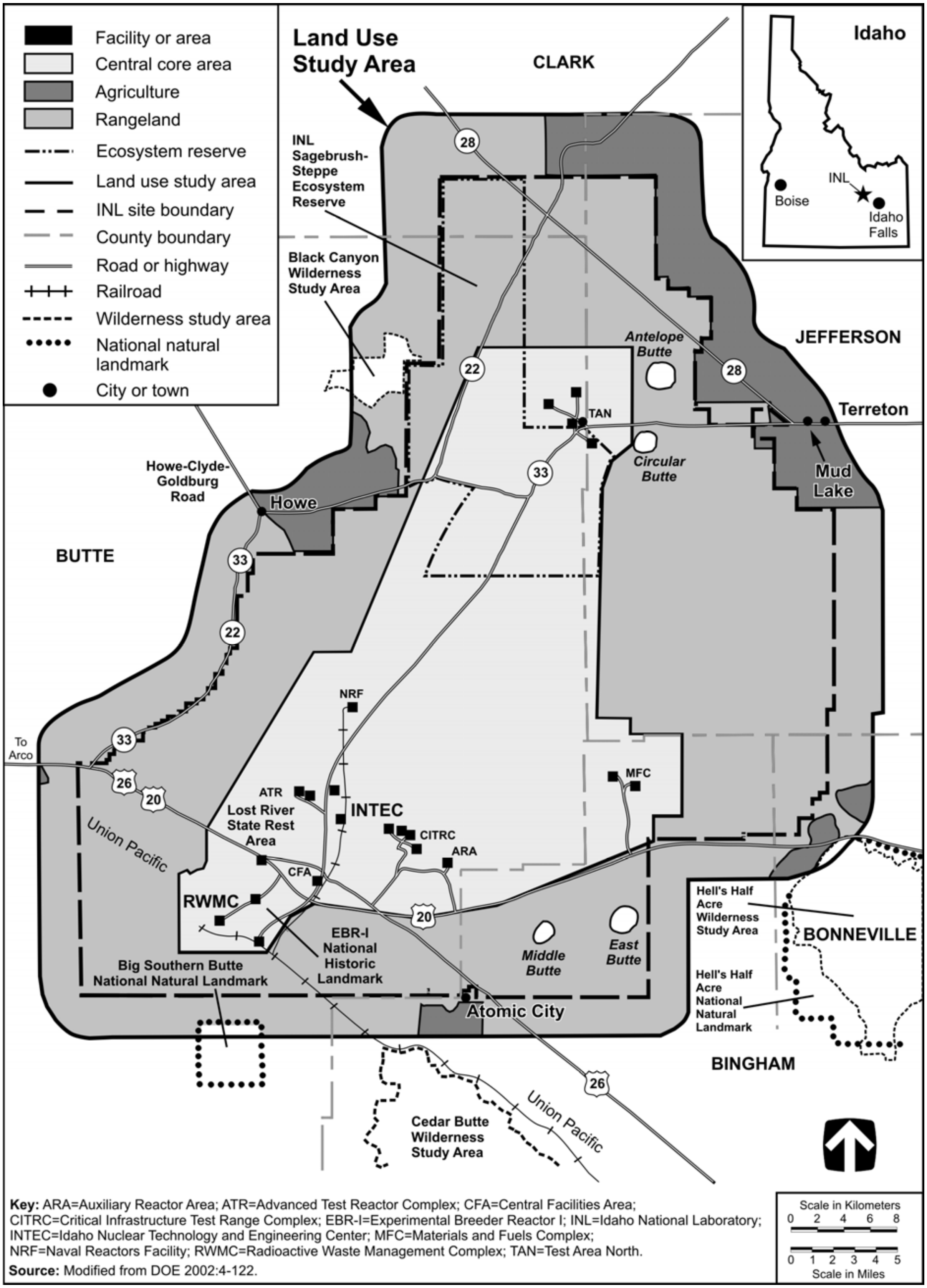


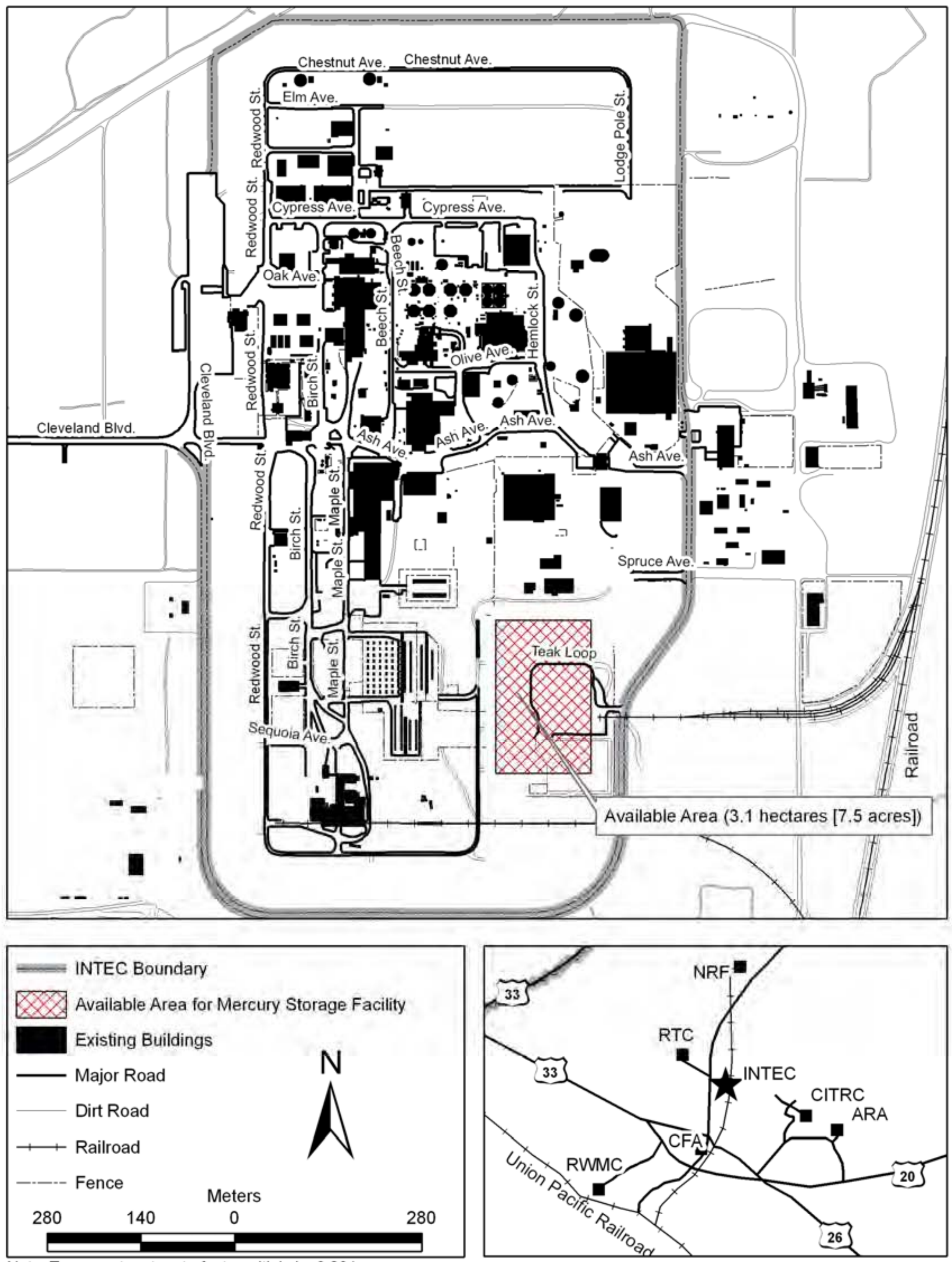
Figure 2–13. Idaho National Laboratory in State of Idaho

2.4.5.1 Idaho Nuclear Technology and Engineering Center Option

Known as the Idaho Chemical Processing Plant until 1998, INTEC was established in the 1950s to recover usable uranium from spent nuclear fuel used in DOE and U.S. Department of Defense reactors. Current operations at INTEC include management of sodium-bearing waste, special nuclear material disposition, spent nuclear fuel storage, nuclear material disposition, environmental remediation, and demolition of excess facilities (INL 2008). An aerial photograph of INTEC is presented in Figure 2–14.

Figure 2–14. Idaho Nuclear Technology and Engineering Center at Idaho National Laboratory

This alternative involves construction of a new facility, as described in Sections 2.2.1 and 2.3.1 and Appendix C. The new facility would be located at INTEC, as illustrated in Figure 2–15. Truck and rail access are available at INTEC. A full-size mercury storage facility with a 10,000-metric-ton (11,000-ton) capacity would essentially occupy all of the available (approximately 3.1-hectare [7.5-acre]) area proposed for locating the facility.



Note: To convert meters to feet, multiply by 3.281.
Key: ARA=Auxiliary Reactor Area; ATR=Advanced Test Reactor; CFA=Central Facilities Area; CITRC=Critical Infrastructure Test Range Complex; INTEC=Idaho Nuclear Technology and Engineering Center; NRF=Naval Reactor Facility; RWMC=Radioactive Waste Management Complex.

Figure 2–15. New Facility at Idaho Nuclear Technology and Engineering Center at Idaho National Laboratory

2.4.5.2 Radioactive Waste Management Complex Option

RWMC has a number of buildings in the Transuranic Storage Area currently dedicated to storage, staging, characterization, and shipping of transuranic (TRU) waste. This alternative involves using seven Type II storage modules for the DOE storage of mercury. These Type II storage modules are a series of buildings that are covered by an existing RCRA permit and were designed and built for hazardous waste storage. With each building providing approximately 2,700 square meters (29,000 square feet) of storage, a total of approximately 19,000 square meters (205,000 square feet) of storage space would be available for long-term mercury storage. While currently in use, the TRU waste mission is anticipated to be completed by 2015 pursuant to the provisions of the October 1995 Settlement Agreement among the State of Idaho, the U.S. Department of the Navy, and the U.S. Department of Energy.[5] One of the Type II storage modules could be made available starting in 2013 for DOE storage of mercury; the other six could be made available by 2015. These are prefabricated modular structures built on a sealed concrete foundation. An aerial photograph of the RWMC and the seven storage models is presented in Figure 2–16. Minor modifications to the existing buildings might include reapplying epoxy floor sealant, modifying some of the space to function as the Handling Area, installing security monitors, and servicing the rail spur. Figure 2–17 illustrates the location of the seven storage modules in relation to other buildings within RWMC. Truck and rail access are available at RWMC.

Figure 2–16. Radioactive Waste Management Complex at Idaho National Laboratory

[5] This agreement settles claims made in the cases *Public Service Co. of Colorado v. Batt* (Civil No. CV 91-0035-S-EJL) and *United States v. Batt* (Civil No. CV-91-0054-S-EJL).

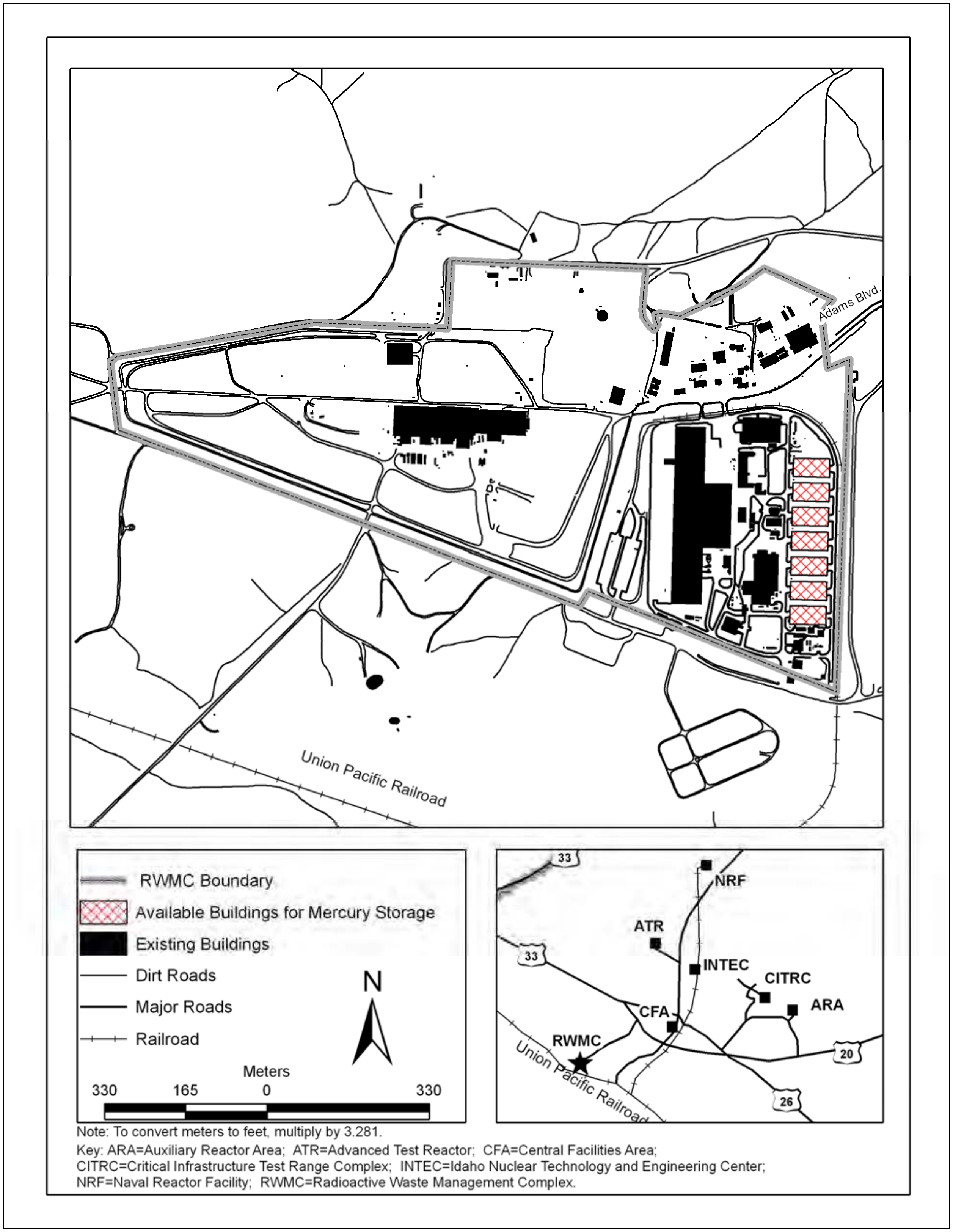


Figure 2–17. Existing Buildings in Radioactive Waste Management Complex at Idaho National Laboratory

2.4.6 Long-Term Mercury Management and Storage at Kansas City Plant

KCP is part of the 125-hectare (310-acre) Bannister Federal Complex located 13 kilometers (8 miles) south of downtown Kansas City, Missouri. KCP occupies 55 hectares (136 acres) of the complex and is under the custody and control of DOE's National Nuclear Security Administration (NNSA). KCP is contiguous with U.S. General Services Administration facilities, which are also part of the Bannister Federal Complex. KCP manufactures electrical, mechanical, plastic, and other nonnuclear components of nuclear weapons (GSA and NNSA 2008). Under the Kansas City Responsive Infrastructure Manufacturing and Sourcing Project, NNSA is in the process of relocating KCP operations to a new facility located approximately 13 kilometers (8 miles) south of the Bannister Federal Complex. The relocation is scheduled to begin in 2011 and be completed in 2013. Initially, approximately 14,000 square meters (150,000 square feet) of storage space could be available for the long-term storage of mercury. If NNSA operations move to another location as planned, additional space could become available (Holecek 2009). An aerial photograph of the Kansas City Plant is presented in Figure 2–18. Modifications to the storage building would be required prior to storage of mercury and might include reapplying epoxy floor sealant, upgrading ventilation systems, installing security monitors, and servicing the rail spur. Figure 2–19 illustrates the location of the proposed storage building within the Bannister Federal Complex. Truck and rail access are available at KCP.

Figure 2–18. Kansas City Plant in State of Missouri

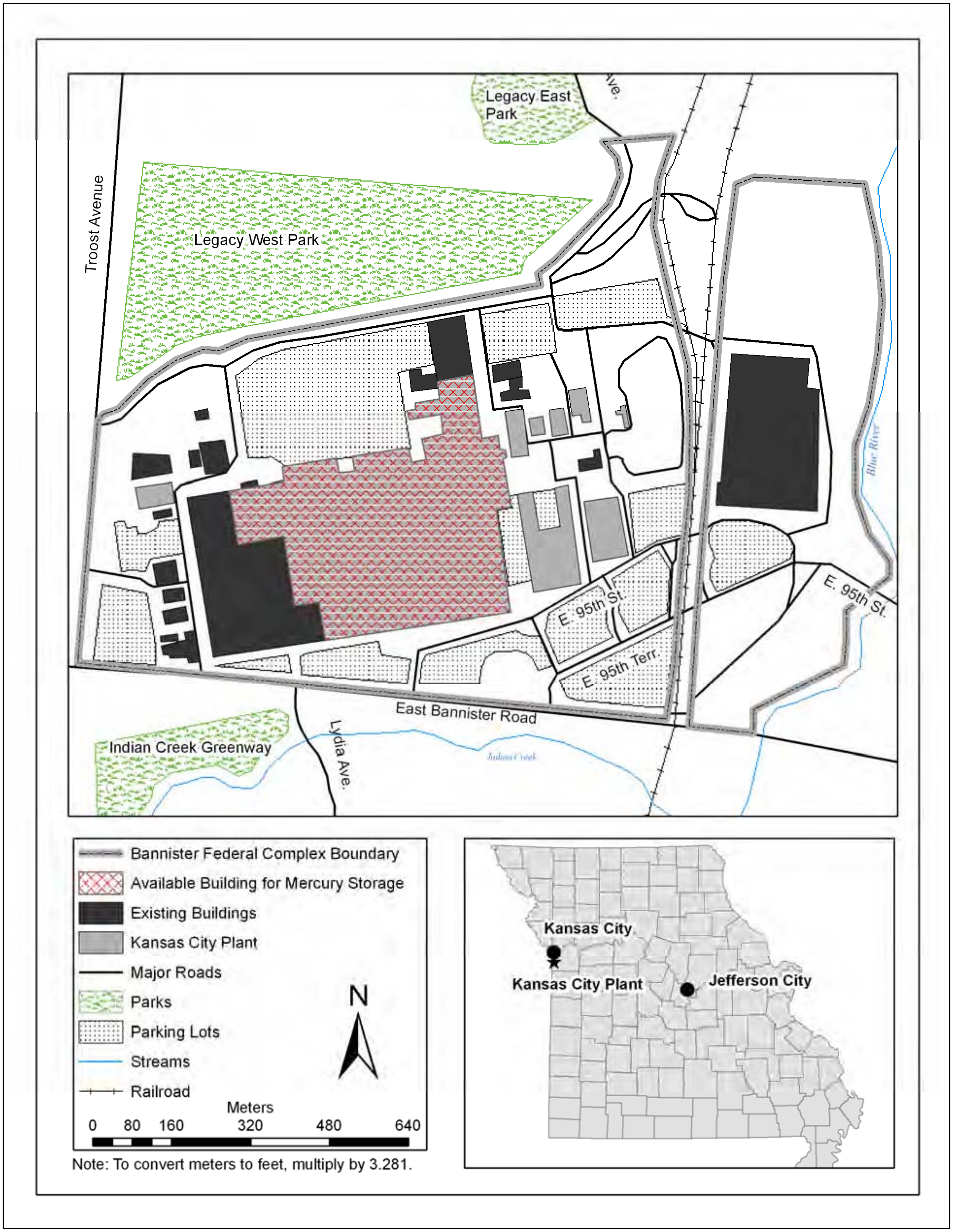


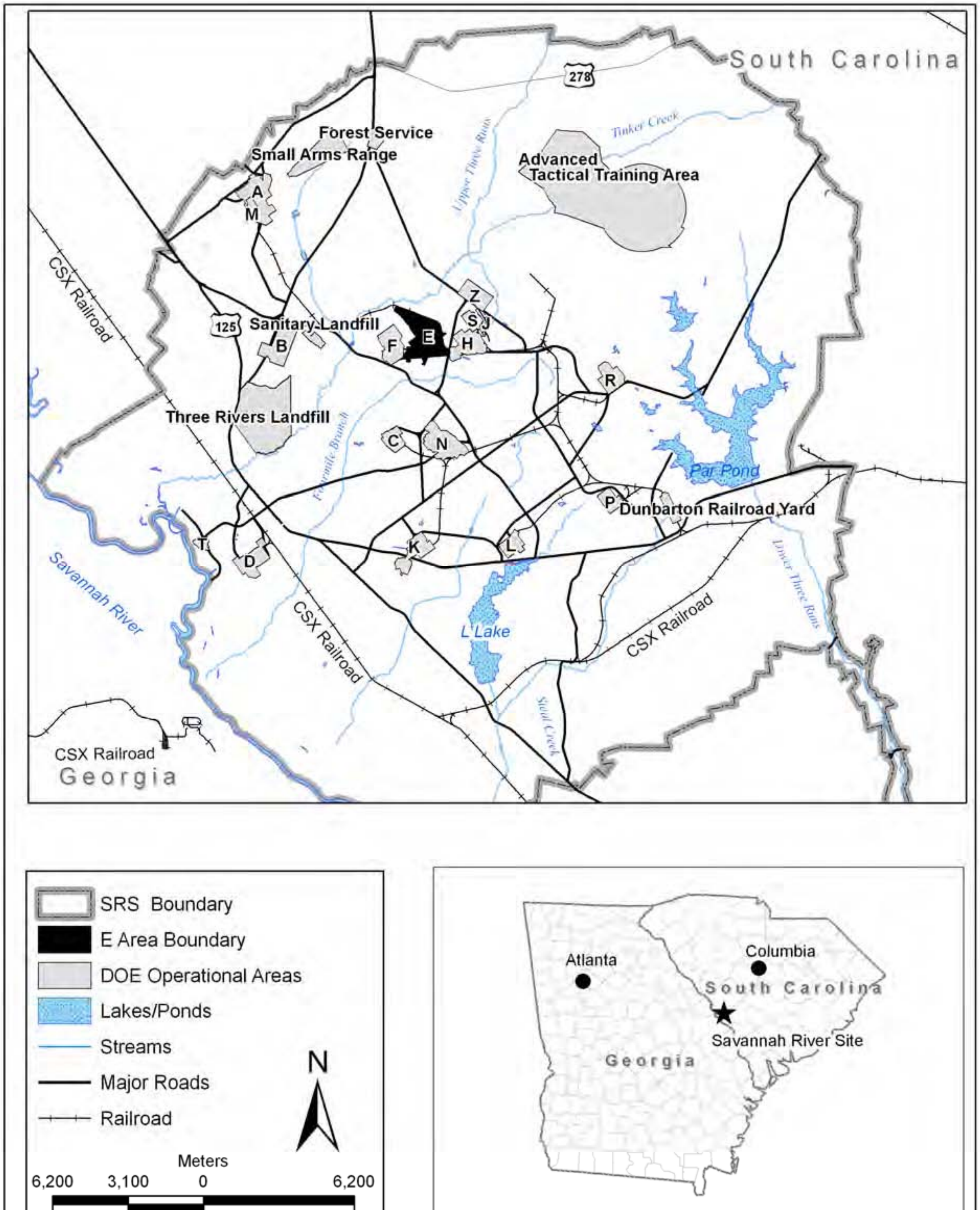
Figure 2–19. Existing Building at Kansas City Plant in State of Missouri

2.4.7 Long-Term Mercury Management and Storage at Savannah River Site

SRS is located in south-central South Carolina and occupies approximately 80,290 hectares (198,400 acres) in Aiken, Barnwell, and Allendale Counties. The site was established in 1950 and is approximately 24 kilometers (15 miles) southeast of Augusta, Georgia, and 19 kilometers (12 miles) south of Aiken, South Carolina. A general map of SRS is illustrated in Figure 2–20.

This alternative involves construction of a new facility, as described in Sections 2.2.1 and 2.3.1 and Appendix C. The new facility would be located in E Area of SRS. Figure 2–21 presents an aerial photograph of E Area; Figure 2–22 illustrates the proposed location of the new facility at E Area. A full-size mercury storage facility with a 10,000-metric-ton (11,000-ton) capacity would occupy 3.1 hectares (7.5 acres) of the available (approximately 32-hectare [78-acre]) area proposed for locating the facility.

E Area is located in the central part of SRS and covers approximately 134 hectares (330 acres). The current land use designation for E Area is Site Industrial Use. E Area, which includes the Old Burial Ground, Mixed Waste Management Facility, TRU waste pads, and E Area Vaults, receives low-level solid, TRU, and mixed waste from all site areas. Low-level radioactive waste is disposed of in the E Area Vaults or trenches. TRU waste is characterized and prepared for shipment to the Waste Isolation Pilot Plant for ultimate disposal (DOE 2005). Truck and rail access are available in E Area.



Note: To convert meters to feet, multiply by 3.281.
Key: DOE=U.S. Department of Energy.

Figure 2–20. Savannah River Site in State of South Carolina

Figure 2–21. E Area at the Savannah River Site

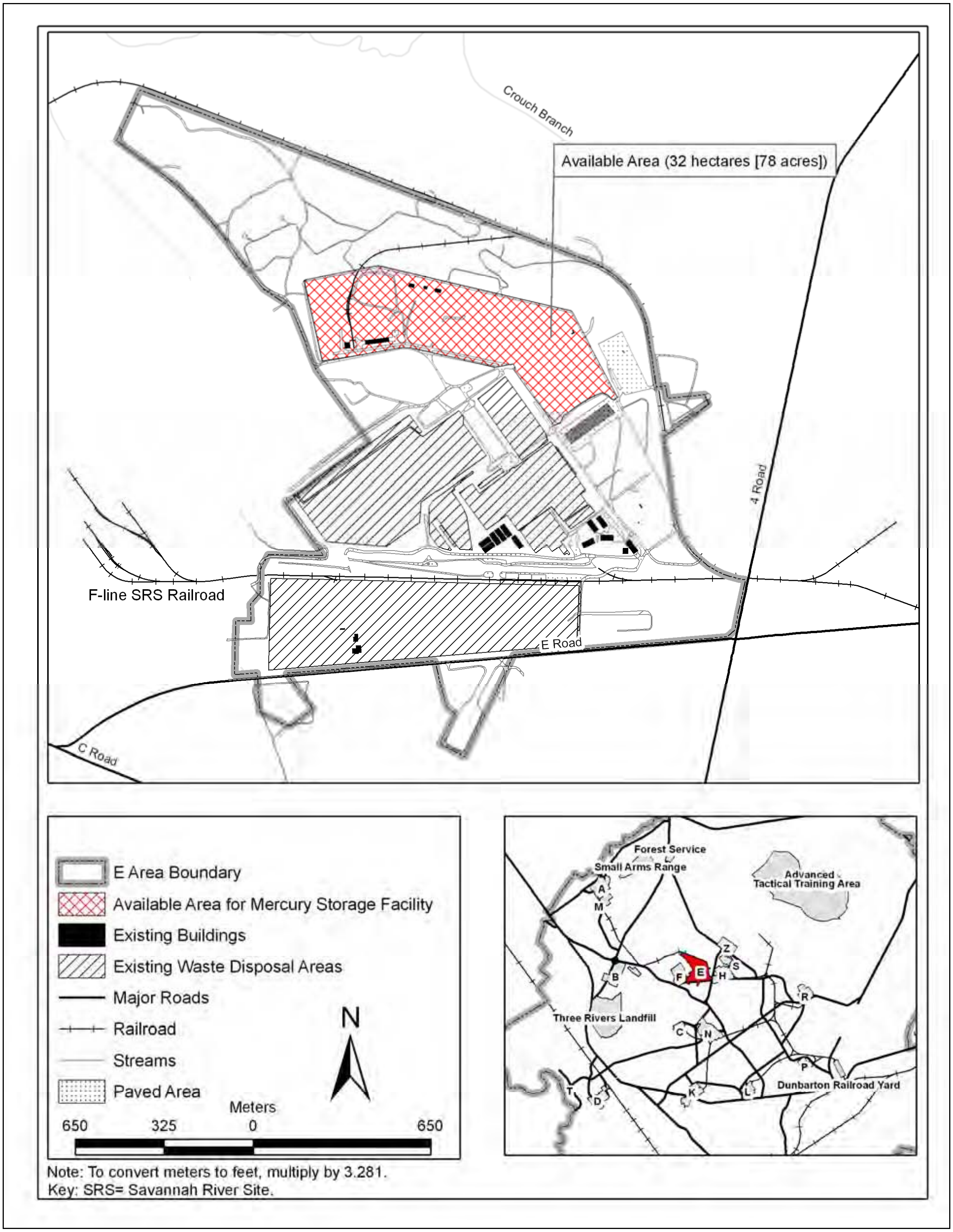


Figure 2–22. New Facility in the Savannah River Site E Area

2.4.8 Long-Term Mercury Management and Storage at Waste Control Specialists, LLC

WCS, a commercial entity, owns and operates a large 541-hectare (1,338-acre) site for the treatment, storage, and landfill disposal of various hazardous and radioactive wastes. The site is located approximately 50 kilometers (31 miles) west of Andrews, Texas, and 10 kilometers (6 miles) east of Eunice, New Mexico. The site is surrounded by a 5,460-hectare (13,500-acre) tract of land also owned by WCS. The WCS facility is RCRA permitted for storage of hazardous waste. The CSB, which is located within the WCS facility, is covered under the existing RCRA permit; the CSB is presently configured to store hazardous waste and could provide temporary storage of mercury. The CSB could provide approximately 2,650 square meters (28,500 square feet) of storage space. An aerial photograph of the site is presented in Figure 2–23.

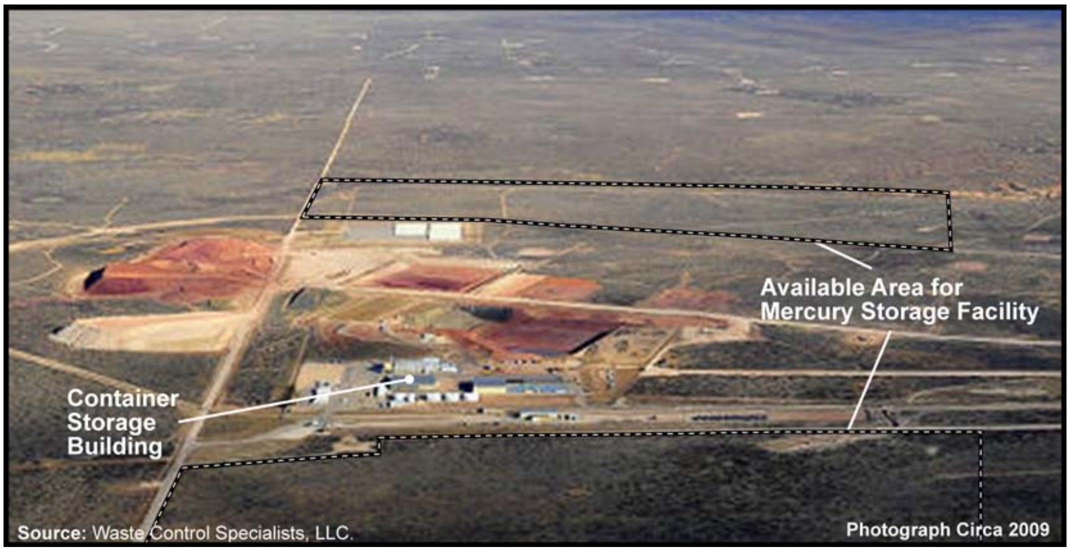


Figure 2–23. Waste Control Specialists in State of Texas

This alternative is the construction of a new facility, as described in Sections 2.2.1 and 2.3.1 and Appendix C. The new facility would be located within the areas illustrated in Figure 2–24. A full-size mercury storage facility with up to a 10,000-metric-ton (11,000-ton) capacity would occupy 3.1 hectares (7.5 acres) of the available (approximately 102-hectare [252-acre]) area proposed for locating the facility. The CSB could be used on an interim basis, if necessary, to store mercury until construction of a new facility is completed. The CSB would be capable of storing approximately 2,000 metric tons (2,200 tons) of mercury. Figure 2–24 also illustrates the location of the CSB within the WCS site. Truck and rail access are available at the site.

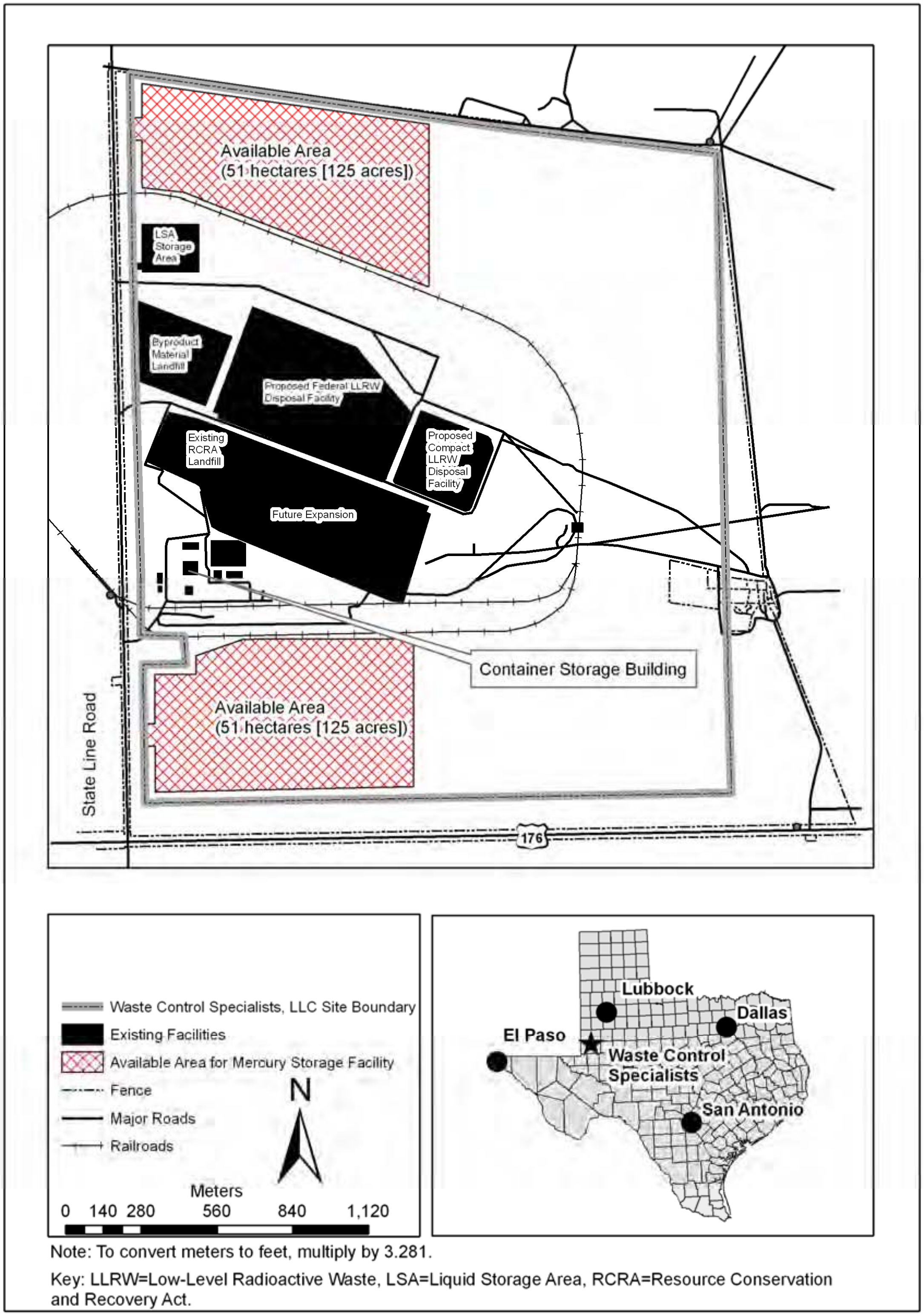


Figure 2–24. New and Existing Facilities at Waste Control Specialists, LLC, in State of Texas

2.5 PREFERRED ALTERNATIVE

DOE has identified long-term mercury storage at WCS of Andrews, Texas, as the Preferred Alternative. The WCS site is located near the New Mexico border and has been extensively characterized and studied due to the wide range of waste management activities that occur there. The area around this location has a very low population density. In addition, WCS is not located near any major surface-water bodies; the nearest surface-water body is more than 16 kilometers (10 miles) away. The site also has the benefit of an existing rail line. This mercury storage facility would be compatible with existing waste management activities at the site, as well as site land use plans and regulatory agreements.

2.6 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

A number of alternatives were considered but were not evaluated in detail. As required by Council on Environmental Quality regulations (40 CFR 1502.14(a)), this section discusses the reasons for elimination of the alternatives from detailed study. Alternatives may be eliminated from further consideration because of technical immaturity, regulatory unacceptability, or because they do not support the purpose and need for the proposed action.

2.6.1 Storage-Related Alternatives

The Act specifies that the DOE-designated mercury storage facility(ies) shall not include Y–12 or any other portion or facility of the Oak Ridge Reservation in Oak Ridge, Tennessee (42 U.S.C. 6939f(a)(1)). DOE may sometimes include reasonable alternatives that are outside the scope of what Congress has approved. However, in the case of this action where Congress has expressly prohibited a potential alternative, DOE finds that it is reasonable to forego its consideration. Accordingly, DOE has eliminated this option as an action alternative.

Veolia ES Technical Solutions, LLC, from Henderson, Colorado, and a business partnership from Knoxville, Tennessee, comprising Lowland Environmental Services; Sustainable Construction and Consulting; and 840, LLC, responded to the Request for Expressions of Interest that DOE published in the *Federal Register*. Both parties were interested in constructing a long-term mercury storage facility for DOE. However, neither party fulfilled the basic requirement to propose a specific location for siting such a facility. Veolia ES Technical Solutions, LLC, later withdrew itself from consideration for long-term storage of mercury. Because neither of these companies proposed a specific candidate site to be evaluated and because Veolia ES Technical Solutions, LLC, withdrew its Expression of Interest submission, both of these Expressions of Interest were eliminated from detailed study in this *Mercury Storage EIS*. Additionally, Meritex Enterprises, Inc., from Lenexa, Kansas, submitted a potential site in Cumberland Furnace, Tennessee, for consideration by DOE. This site is a commercial subterranean storage facility developed within a former limestone mine. Due to concerns about permitting and operating an underground facility for long-term storage of mercury and concerns about mercury storage being incompatible with storage of other materials, DOE has eliminated this option from further consideration.

DOE considered but eliminated from detailed study several other potential facilities, including the Fuels and Materials Examination Facility (FMEF), located in the 400 Area of Hanford; the CPP-691 Fuel Processing Restoration (FPR) Facility, located at INL's INTEC; and buildings in N Area and F Area at SRS. As noted in Chapter 1, Section 1.5.1, DOE developed criteria for screening proposed candidate facility locations. Among these criteria are: (1) the facility(ies) will not create significant conflict with any existing DOE site mission and will not interfere with future mission compatibility; (2) the candidate host location has an existing facility(ies) suitable for mercury storage with the capability and flexibility for operational expansion, if necessary; (3) the facility(ies) is, or potentially will be, capable of complying with RCRA permitting requirements; and (4) storage of mercury at the facility(ies) is compatible with local and regional land use plans. Another criterion is that the building will need to be available in a timely fashion such that the facility will be ready to accept mercury for long-term storage by January 1, 2013.

FMEF is located in the 400 Area of Hanford. Although land in the 400 Area is designated for industrial use, including reactor operations, manufacturing, warehousing, and related activities, FMEF currently has the following limitations: its design and internal configuration are not optimal for waste storage; it is not RCRA permitted; and it would require significant modifications to meet statutory and regulatory storage requirements. FPR is located in INL's INTEC. The facility was designed and constructed as a fuel reprocessing facility with heavily reinforced walls and multiple levels. Similar to FMEF, FPR is not RCRA permitted, and it would likewise require substantial modifications to meet RCRA standards for waste storage. Therefore, because these two options are not conducive to waste storage operations and would likely require significant modifications to meet RCRA requirements, DOE has eliminated FMEF at Hanford and FPR at INL from further consideration as potential sites.

SRS is accelerating cleanup and decommissioning of many of its buildings with funds received under the American Recovery and Reinvestment Act of 2009 (P.L. 111-5). SRS has a stated objective to reduce its footprint up to 40 percent by 2011. SRS plans to consolidate waste storage operations from B and N Areas into E Area (Belencan 2009). Pursuant to these objectives, Buildings 645-N, 645-4N, and 645-2N are scheduled for decontamination and demolition. If these buildings were considered in this EIS as a potential alternative site, the scheduled decontamination and demolition of these buildings would have to be significantly delayed until a final decision is made regarding the location of a long-term mercury storage facility. Therefore, because this option is not compatible with future site missions, these buildings were removed from further consideration.

DOE also considered SRS Buildings 221-12F, 221-21F, and 221-22F in F Area as potential storage sites for mercury. However, these buildings have previously been committed to support the Mixed Oxide Fuel Program and would not be available to support the long-term storage of mercury. Therefore, because these buildings are committed to another future DOE mission, these buildings were eliminated from further consideration.

DOE considered the possibility of using a "hybrid" or multiple-site strategy composed of candidate sites being evaluated in this *Mercury Storage EIS*. DOE eliminated such a strategy from further evaluation because the duplicative resources that would be required would not be cost-effective.

2.6.2 Treatment Alternatives

EPA regulates the treatment and disposal of mercury-containing wastes through waste management regulations under RCRA. The intent of these regulations is to encourage the recovery of mercury for reuse from wastes that contain high concentrations of mercury. The treatment standard for mercury wastes with concentrations greater than 260 milligrams per kilogram is roasting or retorting of mercury and subsequently condensing the volatilized mercury for reclamation, yielding high-purity elemental mercury (40 CFR 268).

EPA issued an Advanced Notice of Proposed Rulemaking on May 28, 1999 (64 FR 28949), declaring its intent to consider revisions to the "Land Disposal Restrictions," treatment standards applicable to mercury-bearing wastes (40 CFR 268). With this notice, EPA also stated its intent to conduct a comprehensive reevaluation of the treatment standards for mercury-bearing hazardous wastes, as well as various options, issues, and data needs related to potential mercury treatment standards.

On January 29, 2003, EPA published a Notice of Data Availability in the *Federal Register* (68 FR 4481**)** making available two studies conducted on mercury waste treatment. The results of the two studies are provided in the following reports: (1) *Technical Background Document: Mercury Wastes–Evaluation of*

Treatment of Mercury Surrogate Waste and (2) *Technical Background Document: Mercury Wastes–Evaluation of Treatment of Bulk Elemental Mercury*. The studies were intended to help EPA determine whether it could propose treatment and disposal alternatives to the current land disposal restrictions for mercury-bearing wastes. The studies were performed to assess conditions that affect the stability of waste residues resulting from the treatment of high-concentration mercury and elemental mercury wastes destined for disposal. Based on these studies and the general lack of technological maturity, EPA concluded that it could not establish new national treatment standards for disposal of high-concentration mercury and elemental mercury wastes. As of 2009, no further action has been taken by EPA to establish alternative treatment and disposal requirements for mercury-bearing wastes exceeding concentrations of 260 milligrams per kilogram (high-concentration mercury subcategory wastes) or elemental mercury. Therefore, DOE is not considering treatment options for detailed evaluation in this *Mercury Storage EIS*.

2.6.3 Transportation Methods Not Considered in Detail

Transportation by air or barge is not analyzed in this *Mercury Storage EIS*. Air transport is not considered a reasonable option because of the additional cost and handling that would be required to move the mercury by truck or rail to and from the airports. The weight of the mercury would also limit the amount of mercury that could be transported per trip. The movement of mercury within the continental United States by barge is not a reasonable option due to the limited number of barge routes and the additional handling that would be required to move the mercury by truck or rail to and from the barge route.

2.7 COMPARISON OF ALTERNATIVES

This section presents a comparison of alternatives analyzed in this *Mercury Storage EIS*, including the No Action Alternative. Table 2–1 presents a comparison of key physical setting and location factors, i.e., those factors that provide some means of discerning the differences among action alternative sites regarding their surroundings, operational experience, or land use compatibility. These factors, among others, are discussed in more detail in Chapter 3.

Depending on the resource area, environmental consequences would be negligible, similar with no discernible differences between alternatives, or vary from one alternative to another. Table 2–2 presents a summary comparison of environmental consequences across action alternatives for some resource areas. Those resource area environmental consequences that are projected to be negligible or very low under all action alternatives have not been included in Table 2–2. Resource areas not included in this table are water, noise, ecological, cultural and paleontological, waste management, and socioeconomics. Environmental consequences for all resource areas are summarized in Section 2.7.1 and discussed in detail in Chapter 4.

Because of the various sites and circumstances in which mercury would be stored under the No Action Alternative, environmental consequences would be highly speculative and are not readily quantifiable or comparable to the individual storage sites analyzed under the action alternatives. Mercury storage locations under the No Action Alternative are largely undefined; thus, the potential environmental consequences of storage could be greater or smaller than those presented for the action alternatives. Environmental consequences to land use and visual resources, geology and soils, ecological resources, and cultural and paleontological resources are dependent on the affected environment disturbed and amount of land disturbance that might occur. Because the No Action Alternative could involve expansion and/or modification of storage capacities at multiple locations, it is possible that more or less land, or land with more-or-less sensitive resources than those analyzed under the action alternatives, could be affected. Potential environmental consequences to water resources would depend on the specific location and proximity to surface-water bodies and groundwater aquifers and the current use of these water resources. Therefore, the environmental consequences to water resources could be more or less than under the action alternatives.

Impacts on infrastructure and waste management would depend on the specific infrastructure and waste management capabilities available to support the mercury storage facility(ies). Impacts on socioeconomics and environmental justice would be related to the changes in employment due to changes in mercury storage and the minority and low-income composition of the communities near the mercury storage facility(ies). Because impacts on infrastructure, waste management, socioeconomics, and environmental justice are indeterminate for the No Action Alternative, impacts could be more or less than under the action alternatives.

Under the No Action Alternative, the management and storage of mercury may or may not be conducted in accordance with RCRA regulations. As such, it would be reasonable to conclude that there could be a heightened risk associated with facility accidents and the inconsistent management and storage of mercury containers. This could lead to greater environmental consequences associated with air quality, occupational and public health and safety, and ecological resources. In contrast, because much of the excess mercury would remain at the generating facilities and would not be transferred to a DOE long-term storage facility, it is reasonable to expect that environmental consequences associated with transportation would be somewhat less than those predicted to occur under the action alternatives.

There would be no environmental consequences under the No Action Alternative at any of the candidate sites because a DOE-operated mercury storage facility(ies) would not be constructed and/or operated. Conversely, under any of the action alternatives, there would be beneficial environmental consequences at the various locations where excess mercury is currently stored, including Y–12, because the mercury would be transferred to a DOE facility(ies) for long-term storage.

Action alternatives that involve using existing buildings would result in construction-related impacts that would be very low when compared to action alternatives that involve construction of a new mercury storage facility. In other words, action alternatives in which new construction occurs would likely show higher impacts than those in which an existing facility(ies) is modified with respect to certain resource areas, e.g., land use, visual resources, air quality, short-term impacts, and commitment of resources.

Table 2–1. Comparison of Action Alternatives – Physical Setting and Location Factors

Site/Resource Factor	Alternatives That Use Existing Buildings			Alternatives That Require New Construction				
	INL RWMC	Hawthorne Army Depot	KCP	GJDS	Hanford 200-West Area	SRS E Area	WCS	INL INTEC
Site size in hectares (acres)	INL: 230,323 (569,135) RWMC: 76 (187)	59,500 (147,000)	55 (136)	146 (360)	Hanford: 151,775 (375,040) 200 Areas: 5,064 (12,513)	SRS: 80,290 (198,400) E Area: 134 (330)	Entire site: 5,460 (13,500) Facilities: 541 (1,338)	INL: 230,323 (569,135) INTEC: 107 (264)
Compatible with land use plans?	Yes	Yes; facility use agreement between DoD and DOE may be required.	Yes	Concern: 1996 MOU possible restriction on land use and current zoning – under evaluation.	Yes	Yes	Yes	Yes
Facility or site operates under existing RCRA storage permits.[a]	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Seismic risk[b]	0.12 *g*	0.57 *g*	0.05 *g*	0.14 *g*	0.18 *g*	0.17 *g*	0.12 *g*	0.12 *g*
Nearest surface-water feature	Big Lost River Channel 1.6 km (1 mile) northwest. Diversion spread areas (intermittent and seasonal) 1.6 km (1 mile) west.	Walker Lake 5.0 km (3.1 miles) northwest.	Blue River borders site to the east and Indian Creek borders site to the south.	Cheney Reservoir 0.6 km (1 mile) southeast.	Columbia River 10 km (6.2 miles) north. Cold Creek (ephemeral) 4.8 km (3 miles) south.	Upper Three Runs Creek 500 m (1,640 feet) north.	No perennial features within 16 km (10 miles). Ranch house drainage area (intermittent and seasonal) 0.4 km (0.25 miles) southeast.	Big Lost River channel 900 m (2,950 feet) northwest.
Site in 100-year floodplain?	No	No	Yes; flood protection system designed for 500-year flood event.	No	No	No	No	Yes; diversion dam designed for 300-year flood event.
Residential population within 16-km (10-mile) radius	257	3,561	700,041	2,119	0	7,103	2,900	201
Environmental justice within 16-km (10-mile) radius	No minority or low-income census block groups.	No minority or low-income census block groups.	172 minority only, 2 low-income only, and 74 that are both minority and low-income census block groups (out of 671 blocks).	No minority or low-income census block groups.	No minority or low-income census block groups.	Four minority and no low-income census block groups (out of 14 blocks).	One minority and no low-income census block groups (out of 8 blocks).	No minority or low-income census block groups.
Site employment	8,485 (INL)	500	2,400	7	9,759 (Hanford)	8,400 (SRS)	150	8,485 (INL)

[a] This factor does not imply that a permit already exists for the storage of mercury; rather, this factor is intended to establish a candidate site's experience operating under other RCRA storage permits.

[b] Seismic risk is based on predicted peak acceleration for an earthquake event expected to occur once in 2,500 years. Earthquake-produced ground motion is expressed in units of percent *g* (i.e., force of acceleration relative to that of Earth's gravity).

Note: Various mercury storage locations, many of which are undetermined, would be involved under the No Action Alternative; therefore, these locations are not presented in the above table. Section 2.7 presents a discussion comparing the potential environmental consequences of the No Action Alternative against those of the action alternatives.

Key: DoD=U.S. Department of Defense; DOE=U.S. Department of Energy; GJDS=Grand Junction Disposal Site; Hanford=Hanford Site; INL=Idaho National Laboratory; INTEC=Idaho Nuclear Technology and Engineering Center; KCP=Kansas City Plant; km=kilometers; m=meters; MOU=Memorandum of Understanding; RCRA=Resource Conservation and Recovery Act; RWMC=Radioactive Waste Management Complex; SRS=Savannah River Site; WCS=Waste Control Specialists, LLC.

Table 2–2. Comparison of Action Alternatives – Environmental Consequences

Resource/Site	Alternatives That Use Existing Buildings			Alternatives That Require New Construction				
	INL RWMC	**Hawthorne Army Depot**	**KCP**	**GJDS**	**Hanford 200-West Area**	**SRS E Area**	**WCS**	**INL INTEC**
Land use and visual resources	New land would not be disturbed nor would any of the proposed existing buildings have to be expanded to accommodate the long-term storage of mercury. Therefore, there would be no impacts on land use or visual resources.			Construction of a new mercury storage facility would disturb approximately 3.1 hectares (7.5 acres) of land, which represents 3 percent or less of each alternative site's overall size. Because of the low percentage of relative land disturbance and the low profile of a new storage building, there would be minimal impacts on land use and visual resources. (Note: For GJDS only; 1996 MOU possible restriction on land use and current zoning–under evaluation.)				
Geology and soils	None	May require minor trenching for utility connections.	None	Potentially would disturb and expose up to 3.1 hectares (7.5 acres) to a depth of approximately 60 centimeters (24 inches) for 6 months. Geologic resource commitments for construction of a new facility would include approximately 4,755 cubic meters (6,220 cubic yards) of concrete and 3,875 cubic meters (5,070 cubic yards) of crushed stone.				
Air quality	Negligible air emissions would occur for modification of existing buildings. Operation of a long-term mercury storage facility(ies) would not involve the treatment or processing of mercury; therefore, air emissions would be negligible and limited to employee vehicles, trucks, semiannual testing of emergency generators, and venting of residual mercury vapors. Truck and/or rail transport of mercury would result in negligible emissions of criteria and toxic air pollutants.			Minor short-term air quality impacts would occur during construction of a new storage facility, primarily due to dust generation and emissions from heavy equipment. Operation of a long-term mercury storage facility(ies) would not involve the treatment or processing of mercury; therefore, air emissions would be negligible and limited to onsite employee vehicles, trucks, semiannual testing of emergency generators, and venting of residual mercury vapors. Truck and/or rail transport of mercury would result in negligible emissions of criteria and toxic air pollutants.				
	Carbon dioxide would be generated from fuel-burning equipment used in construction of a new facility, if applicable, and from transportation of mercury to the storage facility; however, emissions (maximum of 3,699 metric tons [4,077 tons]) would be negligible compared with the annual worldwide generation of carbon dioxide (estimated at 26.4 billion metric tons [29.1 billion tons]) and would have a negligible effect on the global climate.							
Infrastructure	Negligible; capacity would meet increased demands.	Negligible; capacity would meet increased demands.	Negligible; capacity would meet increased demands.	Moderate; electrical capacity would have to be increased. No public water supply. No rail access.	Negligible; capacity would meet increased demands.	Negligible; capacity would meet increased demands.	Negligible; capacity would meet increased demands.	Negligible; capacity would meet increased demands.
Occupational and public health and safety[a]								
Normal operations[b, c]	SL-I consequences and negligible risk to involved workers, noninvolved workers, and members of the public at all sites.							
Facility accidents[c]	Consequences range from SL-I to -II with an associated negligible-to-low risk to involved workers and noninvolved workers from both inside and outside spills. Consequences of SL-I with an associated negligible risk to public receptors from inside and outside spills.							

Table 2–2. Comparison of Action Alternatives – Environmental Consequences *(continued)*

Resource/Site	Alternatives That Use Existing Buildings			Alternatives That Require New Construction				
	INL RWMC	**Hawthorne Army Depot**	**KCP**	**GJDS**	**Hanford 200-West Area**	**SRS E Area**	**WCS**	**INL INTEC**
Transportation[a, d]								
Truck kilometers (miles)	2,662,210 (1,654,297)	3,127,892 (1,943,672)	2,230,117 (1,385,795)	2,509,474 (1,559,387)	3,399,774 (2,112,620)	2,707,719 (1,682,577)	2,907,276 (1,806,581)	2,662,210 (1,654,292)
Annual truck accident fatalities[e]	9.2×10^{-4}	1.1×10^{-3}	7.8×10^{-4}	8.7×10^{-4}	1.2×10^{-3}	9.4×10^{-4}	1.0×10^{-3}	9.2×10^{-4}
Truck accident – human health[c]	For spillages of mercury onto the ground, consequences could be SL-II with a low risk under Truck Scenario 2 and a negligible risk under Truck Scenario 1. Consequences of these scenarios could also be SL-III, but with a negligible associated risk. For transportation accidents with fires, acute-inhalation consequences could be in the range from SL-I to -III with an associated low (SL-II) or negligible (SL-I or SL-III) risk under both truck scenarios. The corresponding consequences following deposition on the ground could be SL-I with an associated negligible risk. For direct spillages of mercury into water, the consequences could be SL-I or -II with an associated negligible-to-low risk (but with a large degree of uncertainty).							
Rail kilometers (miles)	600,133 (372,923)	635,564 (394,939)	403,890 (250,997)	510,579 (317,274)	729,541 (453,337)	489,769 (304,342)	634,260 (394,125)	600,133 (372,923)
Annual rail accident fatalities[e]	1.5×10^{-4}	1.6×10^{-4}	1.0×10^{-4}	1.3×10^{-4}	1.9×10^{-4}	1.2×10^{-4}	1.6×10^{-4}	1.5×10^{-4}
Rail accident – human health[c, f]	For spillages of mercury onto the ground, consequences could be SL-II with a negligible risk. Consequences could also be SL-III, but with a negligible associated risk. For transportation accidents with fires, acute-inhalation consequences could be in the range from SL-I to -III with an associated low (SL-II) or negligible (SL-I or SL-III) risk. The corresponding consequences following deposition on the ground could be SL-I with an associated negligible risk. For direct spillages of mercury into water, the consequences could be SL-I or -II with an associated negligible-to-low risk (but with a large degree of uncertainty).							
Ecological impacts[a, c]	For truck or railcar spills with a pallet fire, consequences could range from SL-I to -IV for both dry and wet deposition pathways, with wet deposition potentially having somewhat greater consequences. The associated risk to ecological receptors would range from negligible to high except in the case of wet deposition with rail transport, for which the risk would be negligible to all receptors. The highest ecological risk would be to sediment-dwelling biota and soil invertebrates in the case of truck transportation accidents with fires and dry deposition. In contrast, risk to the red-tailed hawk would be negligible in all transportation scenarios.							
Environmental justice	None	None	A transportation accident at or near the facility could disproportionately impact low-income and/or minority individuals.	None	None	A transportation accident at or near the facility could disproportionately impact minority individuals.	No disproportionate impacts on low-income and/or minority individuals.	None

a Risk is an assessment that is a function of the frequency of an event and the magnitude of its potential impact. See Chapter 4 and Appendix D for detailed discussion on the qualitative (i.e., negligible, low, moderate, and high) risk assessment.
b Negligible risk to involved workers, noninvolved workers, and public receptors.
c Consequences are presented by SLs, with SL-I representing negligible-to-very-low consequences and SL-IV representing the most severe consequences. SLs are defined in Appendix D, Section D.1.1.2.
d The greatest transportation impact under either Truck Scenario 1 or 2 is presented in this table; see Chapter 4 and Appendix D for more details.
e Annual fatalities for truck or rail transportation are due to mechanical impacts only and represent the predicted annual average occurrence of an accident involving a fatality over the 40-year analysis period of this environmental impact statement.
f Potential transportation impacts by rail to GJDS would involve intermodal transportation: rail transport to Grand Junction, transfer from rail to truck, and truck transport to GJDS.

Note: Various mercury storage locations, many of which are undetermined, would be involved under the No Action Alternative; therefore, these locations are not presented in the above table. Section 2.7 presents a discussion comparing the potential environmental consequences of the No Action Alternative against those of the action alternatives.

Key: GJDS=Grand Junction Disposal Site; Hanford=Hanford Site; INL=Idaho National Laboratory; INTEC=Idaho Nuclear Technology and Engineering Center; KCP=Kansas City Plant; MOU=Memorandum of Understanding; RWMC=Radioactive Waste Management Complex; SL=severity level; SRS=Savannah River Site; WCS=Waste Control Specialists, LLC.

2.7.1 Summary of Environmental Consequences

This section summarizes the potential impacts on resources under the *Mercury Storage EIS* alternatives. Detailed descriptions and in depth discussions of impacts on resources are provided in Chapter 4. The action alternatives evaluate the impacts on resource areas of the transportation, receipt, and long-term storage of mercury at a designated facility, whether the alternative involves new construction or modification to an existing building.

As described in Section 2.3.1, a new mercury storage facility could be built in a modular fashion by constructing sections of the Storage Area on an as-needed basis. The analysis in this EIS assumes that the entire facility (10,000-metric-ton [11,000-ton] capacity) would be constructed at the same time, thereby evaluating the maximum or peak impacts that could reasonably be expected. If the facility were to be constructed in a modular fashion, impacts would occur at different times; however, the peak of these impacts would be less.

The No Action Alternative would affect all sources of mercury. Excess mercury that could not be sold would be stored as a commodity to the extent allowed by law. Some mercury would likely be considered waste and would be stored in accordance with law. Such storage would not necessarily occur at the sites identified as potential sources of excess mercury. This storage service might be provided by a commercial waste management company or companies. In brief, such facilities could vary in location, size, natural and human environments, and in the nature of their operations. Therefore, the potential impacts of such storage are speculative. The approximately 1,200 metric tons (1,300 tons) of DOE mercury currently stored in 35,000 of the 3-L flasks at Y–12 would continue to be managed and stored in this location. No new construction would be required at Y–12, nor would any incremental increase in impacts on resource areas occur because storage operations at Y–12 would not change. Additional discussion on environmental consequences under the No Action Alternative is provided in Chapter 4.

2.7.1.1 Land Use and Visual Resources

Impacts on land use can be evaluated by comparing new land disturbance to the size of the proposed site that would have the potential to be impacted. Table 2–3 presents the size of each proposed site and the relative percentage of land at each site that would be affected under each alternative.

No impacts on land use or visual resources are expected under action alternatives involving the use of existing buildings because no new construction or substantial external modifications to the buildings would be required.

For the 200-West Area at Hanford, INTEC at INL, and E Area at SRS, the land required to construct a new facility would be negligible compared with the relative size of the candidate site. Therefore, the impacts on land use would be negligible.

Under all action alternatives involving construction of a new facility, the relative impacts on land use and visual resources are expected to range from negligible to minor and, in all cases, would not change the U.S. Bureau of Land Management visual resource management classifications.

Table 2–3. Relative Land Use Impacts

Alternative	Site Size in Hectares (Acres)	Percentage of New Land Disturbance[a]
Grand Junction Disposal Site	146 (360)	2.0 percent
Hanford Site, 200-West Area	Hanford: 151,775 (375,040) 200 Areas: 5,064 (12,513)	Negligible (Hanford) < 0.1 percent (200 Areas)
Hawthorne Army Depot	59,500 (147,000)	Not applicable (existing building)
Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center	INL: 230,323 (569,135) INTEC: 107 (264)	Negligible (INL) 3.0 percent (INTEC)
Idaho National Laboratory, Radioactive Waste Management Complex	INL: 230,323 (569,135) RWMC: 76 (187)	Not applicable (existing building)
Kansas City Plant	55 (136)	Not applicable (existing building)
Savannah River Site, E Area	SRS: 80,290 (198,400) E Area: 134 (330)	Negligible (SRS) 2.3 percent
Waste Control Specialists, LLC	Entire site: 5,460 (13,500) Facilities: 541 (1,308)	< 0.1 percent (entire site) 1.0 percent (facilities)

[a] No new land disturbance would occur under the action alternatives that propose to use existing buildings. New land disturbance would be 3.1 hectares (7.5 acres) under alternatives proposing to construct a new facility. Percentage of new land disturbance is the relative size of a new facility to the size of the candidate site.

Key: <=less than; Hanford=Hanford Site; INL=Idaho National Laboratory; INTEC=Idaho Nuclear Technology and Engineering Center; RWMC=Radioactive Waste Management Complex; SRS=Savannah River Site.

Under the remaining alternatives, the required land disturbance of 3.1 hectares (7.5 acres) would still represent only between 2 and 3 percent of each proposed site's overall size. Additionally, the low profile of a long-term mercury storage building, if it were to be constructed, would have minimal impacts on visual resources.

As discussed in Chapter 1, Section 1.7.1, DOE and Mesa County entered into the 1996 MOU (DOE and Mesa County 1996) to provide meaningful consultation with and participation of Mesa County in DOE's use of GJDS. Mesa County's position is that the use of GJDS is restricted per the 1996 MOU and that DOE is obligated to honor this agreement. DOE currently is evaluating the applicability of the 1996 MOU to determine whether it would affect the viability of this site as a reasonable alternative. Also, current zoning at GJDS is not compatible with the proposed action and would need to be modified.

2.7.1.2 Geology, Soils, and Geologic Hazards

The action alternatives involving use of existing buildings would have negligible impacts on geology and soils because these candidate sites have been previously developed, and modifications to existing buildings would not include any major earthmoving activities. However, at Hawthorne Army Depot, small trenches may need to be excavated to connect utilities to the proposed buildings.

Action alternatives involving construction of a new storage facility would expose surficial soils for a duration of up to 6 months. These activities would disturb up to 3.1 hectares (7.5 acres) at a depth less than 60 centimeters (24 inches) for the installation of a reinforced-concrete slab and asphalt-covered lots on a compacted gravel base. Some trenching may be required below 60 centimeters (24 inches) for the installation of utilities or concrete footers. Adherence to best management practices for erosion and sediment control would be implemented during periods of construction to mitigate impacts due to soil erosion and loss. Geologic resources would include approximately 4,755 cubic meters (6,220 cubic yards) of concrete and 3,875 cubic meters (5,070 cubic yards) of crushed stone. These resources are commonly available, and the quantities are relatively small for a construction project and would not impact regional supplies.

Geologic hazards from earthquakes would potentially have an adverse effect on a mercury storage facility(ies) and the surrounding area. The predicted peak ground acceleration from a seismic event with an annual probability of occurrence of once in 2,500 years for each candidate site and a qualitative description of predicted damage for such an event are presented in Table 2–4. The final design for construction of a new facility or modification to existing buildings would take seismic risk into consideration to protect the public, workers, and the environment from potential adverse effects of a significant seismic event. Therefore, facilities built in an area of higher seismic risk could involve additional design and construction considerations than facilities built in an area of lower seismic risk.

Table 2–4. Seismic Risk for Candidate Sites[a]

Alternative	Seismic Risk[b]	Qualitative Assessment
Grand Junction Disposal Site	0.14 *g*	Slight damage to ordinary structures; no damage to properly designed and constructed buildings
Hanford Site, 200-West Area	0.18 *g*	Slight to moderate damage to ordinary structures; no damage to properly designed and constructed buildings
Hawthorne Army Depot	0.57 *g*	Considerable damage to ordinary structures; slight damage to properly designed and constructed buildings
Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center	0.12 *g*	Slight damage to ordinary structures; no damage to properly designed and constructed buildings
Idaho National Laboratory, Radioactive Waste Management Complex	0.12 *g*	Slight damage to ordinary structures; no damage to properly designed and constructed buildings
Kansas City Plant	0.05 *g*	No damage to ordinary structures or properly designed and constructed buildings
Savannah River Site, E Area	0.17 *g*	Slight to moderate damage to ordinary structures; no damage to properly designed and constructed buildings
Waste Control Specialists, LLC	0.12 *g*	Slight damage to ordinary structures; no damage to properly designed and constructed buildings

a Seismic risk values represent predicted peak acceleration for an earthquake event expected to occur once in 2,500 years.

b Earthquake-produced ground motion is expressed in units of percent *g* (i.e., force of acceleration relative to that of Earth's gravity).

2.7.1.3 Water Resources

All ground-disturbing activities performed under action alternatives involving the construction of a new mercury storage facility (at GJDS, 200-West Area at Hanford, INTEC at INL, E Area at SRS, or WCS) would be conducted in accordance with current National Pollutant Discharge Elimination System and state general wastewater discharge permits. A stormwater pollution prevention plan would be developed and implemented. Construction of a new mercury storage facility would require approximately 1,270,000 liters (336,000 gallons) of water over the 6-month construction period for dust suppression and for potable and sanitary needs.

During operation of a mercury storage facility(ies) under all action alternatives, best management practices for storage of mercury would be employed to prevent spills and releases of mercury into the environment, including the use of spill trays under mercury containers, spill containment features, and regular inspections in accordance with RCRA regulations. Operation of a mercury storage facility(ies) under all action alternatives would require 88,500 liters (23,375 gallons) of water per year for potable and sanitary needs.

2.7.1.4 Air Quality and Noise

Minor short-term air quality impacts would occur under those alternatives involving construction of a new storage facility. These impacts would include a small increase in criteria and toxic air pollutant emissions from construction equipment and earth-disturbing activities in the immediate vicinity of the construction site that would occur only during working hours. Emissions would occur over a 6-month construction period and would not exceed any ambient air quality standard. Air emissions during modification of existing buildings for mercury storage would be negligible.

Operation of a long-term mercury storage facility(ies) would not involve the treatment or processing of mercury; therefore, air emissions are projected to be negligible and limited to employee vehicles, trucks, semiannual testing of emergency generators, and the occasional exhausting of air from the Storage Areas. Occasionally, mercury containers would need to be emptied and repackaged in the Handling Area. Repackaging of mercury in new containers would generate some mercury vapors. The Handling Area would be outfitted with a vacuum air exhaust and mercury vapor filter, which would maintain air emissions exhausted to the outside at negligible concentrations during repackaging operations.

Truck and/or rail transport of mercury from various facilities to the DOE long-term mercury storage facility(ies) would generate air emissions along routes of transport. The peak year of emissions from transport of mercury is expected to occur in 2013, the first year of facility operation. The frequency of truck and/or rail shipments is expected to decrease over time. Maximum air emissions from transporting the mercury would occur under the Hanford 200-West Area alternative; expected emissions are directly proportional to the number of miles required to transport the mercury to the facility. Truck transport to Hanford is predicted to yield the highest concentrations of carbon monoxide, nitrogen dioxide, volatile organic compounds, particulate matter, and carbon dioxide, and rail transport to Hanford is predicted to yield the highest concentrations of sulfur dioxide. Under the Hanford 200-West Area alternative, transport of mercury would require up to approximately 170,000 truck miles or 56,000 rail miles in 2013.

Carbon dioxide is a compound associated with global climate change. Carbon dioxide emissions generated from construction of a new facility, regardless of location, would be approximately 259 metric tons (286 tons). The amount of carbon dioxide generated from construction activities and transportation of mercury to the selected facility is presented in Table 2–5. Comparing these values with the 26.4 billion metric tons (29.1 billion tons) of global carbon dioxide emissions estimated to have occurred worldwide from fossil fuel use annually from 2000 through 2005 and U.S. carbon dioxide annual emissions of 5.98 billion metric tons (6.59 billion tons) in 2006 (IPCC 2007), it can be concluded that the addition of carbon dioxide from implementation of any of the action alternatives would have a negligible effect on the global climate.

Construction of a new facility or modification of existing buildings could increase noise levels for a short period of time at some sites that are close to a sensitive area (e.g., residences). The predicted maximum impact could be at KCP, where the nearest sensitive area is approximately 150 meters (500 feet) away. However, because these activities would be indoors, noise impacts on the public would be negligible. All action alternatives are not predicted to produce noise above background levels at the nearest sensitive area. Therefore, increased noise levels resulting from implementation of any of the action alternatives would be very small.

Operational activities associated with the long-term storage of mercury would not result in a measureable increase in noise above background levels. The receipt of mercury shipments by truck or rail during normal working hours would also not result in a significant increase in noise above current vehicular or rail activity.

Table 2–5. Total and Peak Annual Carbon Dioxide Emissions

Alternative	Carbon Dioxide Emissions in Metric Tons (Tons)			
	Construction[a]	Operations[b]	Total[c]	Peak Annual[d]
Grand Junction Disposal Site	259 (285)	2,540 (2,800)	2,799 (3,085)	259 (285)
Hanford Site 200-West Area	259 (285)	3,444 (3,796)	3,703 (4,082)	380 (419)
Hawthorne Army Depot	0	3,160 (3,483)	3,160 (3,483)	367 (405)
Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center	259 (285)	2,690 (2,965)	2,949 (3,251)	304 (335)
Idaho National Laboratory, Radioactive Waste Management Complex	0	2,690 (2,965)	2,690 (2,965)	304 (335)
Kansas City Plant	0	2,250 (2,480)	2,250 (2,480)	145 (160)
Savannah River Site, E Area	259 (285)	2,740 (3,020)	2,999 (3,306)	259 (285)
Waste Control Specialists, LLC	259 (285)	2,940 (3,241)	3,199 (3,526)	259 (285)

a Construction would occur for 6 months in year 2012.

b The greatest transportation impact under either Truck Scenario 1 or 2 is presented in this table; this impact would be higher than that associated with rail transport (see Chapter 4 and Appendix D for more details).

c Total emissions include the aggregate for construction and operations during the 40-year analysis period.

d Peak annual carbon dioxide emissions would occur during year 2013, the year when the maximum number of mercury transportation trips are projected to occur, except for the Grand Junction Disposal Site, Savannah River Site E Area, and Waste Control Specialists, LLC, for which the peak annual emissions would occur during construction.

2.7.1.5 Ecological Resources

No impacts on terrestrial resources are expected under the action alternatives involving the use of existing buildings because no new construction or external modifications to the buildings would be required. Alternatives requiring construction of a new facility are expected to have little to no impacts on terrestrial resources as well because these sites are characterized as consisting largely of previously disturbed land within a developed setting. However, under the GJDS and WCS alternatives, construction of a new facility may impact some areas that have not previously been disturbed, although none of these areas contain critical habitat or protected plant or animal species.

None of the alternatives proposed are expected to adversely impact wetlands or aquatic species. No threatened or endangered species are known or expected to occur within areas proposed under any of the alternatives. Therefore, none of the alternatives analyzed are expected to adversely affect any ecological resources.

2.7.1.6 Cultural and Paleontological Resources

No impacts on cultural or paleontological resources are expected under the action alternatives involving the use of existing buildings because no new construction or external modifications to the buildings would be required.

Although GJDS, Hanford, INL, and surrounding areas contain a high density of cultural and paleontological resources, there are no known cultural or paleontological resources existing on the proposed sites for construction of a new storage facility, thus impacts are not expected to occur. Hanford has various land features that are culturally important to American Indian tribes, such as those associated with Gable Mountain and Gable Butte, and INL is situated on the Shoshone-Bannock ancestral homeland.

However, in both cases the proposed location for construction of a new storage facility is not expected to have an impact on American Indian resources.

There are no known prehistoric, historic, American Indian, or paleontological resources in the vicinity of SRS's E Area or the WCS site. Therefore, under these alternative sites, no impacts on cultural or paleontological resources are expected to occur.

2.7.1.7 Site Infrastructure

Infrastructure impacts could occur if installation of new infrastructure is required where service does not currently exist, if project demands exceed or approach available capacity, or if implementation of the alternative would otherwise disrupt service. Infrastructure resources include roads and railways, electricity, fuel, and water supplies. Projected impacts on infrastructure under each of the alternatives are summarized in Table 2–6.

Table 2–6. Infrastructure Impacts

Alternative	Impacts Assessment
Grand Junction Disposal Site	Electric consumption would be approximately 2.5 times current capacity and would require upgrades to electrical distribution system. Public water not available at site; bottled water would be delivered to meet potable water needs. Direct rail access is not available at the site; this mode would require transfer of mercury to trucks and intermodal transport.
Hanford Site 200-West Area	Negligible impacts; existing infrastructure is sufficient to support a mercury storage facility.
Hawthorne Army Depot	Negligible impacts; existing infrastructure is sufficient to support a mercury storage facility. Transportation by rail is possible; however, permission would have to be obtained from the Walker River Paiute Reservation prior to shipment by rail through this area. Proposed existing buildings would need to be connected to the site's electrical distribution system.
Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center	Negligible impacts; existing infrastructure is sufficient to support a mercury storage facility.
Idaho National Laboratory, Radioactive Waste Management Complex	Negligible impacts; existing infrastructure is sufficient to support a mercury storage facility.
Kansas City Plant	Negligible impacts; existing infrastructure is sufficient to support a mercury storage facility.
Savannah River Site, E Area	Negligible impacts; existing infrastructure is sufficient to support a mercury storage facility.
Waste Control Specialists, LLC	Negligible impacts; existing infrastructure is sufficient to support a mercury storage facility.

The frequency of mercury shipments is projected to be very small compared with baseline truck and rail traffic; therefore, existing road and rail systems would be adequate for supporting the transfer of mercury. However, direct rail shipments to GJDS would not be possible; this mode of transportation would require rail transport to Grand Junction, transfer of mercury to trucks, and truck transport of mercury from the Grand Junction railhead to the DOE facility.

Action alternatives involving the use of existing buildings would have negligible impacts on infrastructure during the construction phase, in which minor modifications to the proposed buildings would be completed to accommodate the storage of mercury. However, at Hawthorne Army Depot, the existing buildings do not have electrical service and would need to be connected.

Action alternatives involving the construction of a new facility are projected to require 193,000 liters (51,000 gallons) of diesel fuel and 1,270,000 liters (336,000 gallons) of water over a 6-month construction period. Electricity would be supplied by a diesel-fired generator. Water and fuel would be delivered by tanker truck as needed. Therefore, construction of a new facility would have negligible impacts at any of the sites because the existing infrastructure would not be used to supply any of the necessary utility resources.

Regardless of whether the storage facility would be new construction or an existing building, operations are projected to consume equivalent utility resources. Impacts are measured by a site's current capacity to meet the increased demands on use. Annual operation of a mercury storage facility(ies) is projected to require 253 megawatt-hours of electricity, 606 liters (160 gallons) of diesel fuel, and 88,500 liters (23,400 gallons) of water. Diesel fuel would be delivered to the site as needed to meet demand and would not impact existing infrastructure.

Under all alternatives, with the exception of GJDS, the existing infrastructure and capacities would be sufficient to meet construction and/or operational demands. Operational requirements for electricity would exceed current capacities at GJDS; therefore, the tie-in to the regional power distribution system would have to be upgraded.

2.7.1.8 Waste Management

Action alternatives involving the use of existing buildings would produce small quantities of construction-related waste during the construction phase, when minor modifications to the proposed buildings would be completed to accommodate the storage of mercury.

Action alternatives involving the construction of a new facility are projected to generate approximately 271 cubic meters (355 yards) of nonhazardous solid waste construction debris and 9,841 liters (2,600 gallons) of sanitary liquid waste. These volumes are comparable to a typical construction site and are expected to have negligible impacts on regional facilities.

The operation of a mercury storage facility(ies) is expected to generate approximately 23 drums (208 liters [55 gallons] each) of hazardous waste and 59,000 liters (15,575 gallons) of sanitary liquid waste annually. The hazardous waste, consisting of cleaning rags, personal protective equipment, spill response materials, and mercury vapor filters, would be shipped for offsite treatment and/or disposal in a licensed facility. Since the mercury storage facility(ies) would not involve any treatment or processing of mercury, the rate of hazardous waste generation would remain very low. Existing sanitary systems at all of the alternative sites can meet the projected sanitary liquid waste volume.

Therefore, waste management impacts of new construction, modification of existing buildings, and operation of a mercury storage facility(ies) under all alternatives would be negligible.

2.7.1.9 Occupational and Public Health and Safety

This section provides a summary of human health consequences and associated risks to workers and members of the public. The analysis considers various scenarios. Scenarios were developed for the following activities: (1) normal operations, (2) facility accidents, (3) transportation, and (4) intentional destructive acts (IDAs). The respective sections of Chapter 4 discuss human health consequences and associated risk analysis in detail under each alternative, and Appendix D discusses the development of specific scenarios considered in this EIS. This summary presents the most conservative (i.e., maximum) consequence, and thus risk, to a human receptor that could be expected to occur under certain scenarios. Consequences are presented in terms of severity levels (SLs), with SL-I representing negligible-to-very-low consequences and SL-IV representing the most severe consequences. SLs are defined for various receptor scenarios in Appendix D, Section D.1.1.2. Overall risk is a function of the frequency at which an event might occur and the probable severity of the event.

Normal Operations

Normal operations for the long-term storage of mercury would not involve any processing or treatment of mercury. Normal operations would involve the receipt and storage of mercury for extended periods of time. Exposures could arise during normal operating conditions from small amounts of mercury vapor accumulating in the Storage Areas. This scenario can best be described as a chronic, slow release of mercury vapor within the storage building resulting from an undetected leaking container or external contamination of a container. Under all alternatives, the consequences and associated risks to involved workers, noninvolved workers, or members of the public are predicted to be negligible (e.g., SL-I).

Facility Accidents

Facility accidents are exposure scenarios initiated by failure of engineered systems or caused by human error. Accidents could include mercury spills inside or outside of the storage building. Of the various scenarios considered, those with the highest probability of occurring would likely be (1) a container or pallet drop during transfer from the transport vehicle to permanent storage (e.g., by forklift), (2) a collapse of storage racks, (3) an earthquake event, or (4) a flood event. The consequences of the flood event are bounded by the earthquake analysis.

The consequences and associated risks to human health receptors would be identical under all action alternatives evaluated and are summarized in Table 2–7.

Table 2–7. Summary of Consequences and Risks from All Onsite Mercury Spill Scenarios

Scenario	Consequence (Risk)
Spills Inside Building	
Involved worker	SL-I to -II (Negligible to low)
Noninvolved worker[a]	SL-I (Negligible)
Member of the public	SL-I (Negligible)
Spills Outside Building	
Involved worker	SL-I to -II (Negligible to low)
Noninvolved worker[a]	SL-I to -II (Negligible to low)
Member of the public	SL-I (Negligible)

[a] A noninvolved worker is nearby (outside the building) but still on site.
Key: SL=severity level.

Transportation

Transportation consequences under all alternatives are a function of the methods of transportation (i.e., truck or rail), the number of miles traveled, and the nature of the accident. Table 2–8 presents the number of kilometers that would be traveled under each alternative and the annual frequency of fatal accidents that are projected to occur. The greatest transportation impact under either Truck Scenario 1 or 2 is presented in the following two tables.

Table 2–8. Transportation Kilometers and Frequency Analysis for Transport Accidents

Alternative	Truck Kilometers[a] (miles)	Annual Frequency of Fatal Truck Accidents[b]	Rail Kilometers (miles)	Annual Frequency of Fatal Rail Accidents[b]
Grand Junction Disposal Site[c]	2,509,474 (1,559,387)	8.7×10^{-4}	510,579 (317,274)	1.3×10^{-4}
Hanford Site 200-West Area	3,399,774 (2,112,620)	1.2×10^{-3}	729,541 (453,337)	1.9×10^{-4}
Hawthorne Army Depot	3,127,892 (1,943,672)	1.1×10^{-3}	635,564 (394,939)	1.6×10^{-4}
Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center	2,662,210 (1,654,297)	9.2×10^{-4}	600,133 (372,923)	1.5×10^{-4}
Idaho National Laboratory, Radioactive Waste Management Complex	2,662,210 (1,654,297)	9.2×10^{-4}	600,133 (372,923)	1.5×10^{-4}
Kansas City Plant	2,230,117 (1,385,795)	7.8×10^{-4}	403,890 (250,977)	1.0×10^{-4}
Savannah River Site, E Area	2,707,719 (1,682,577)	9.4×10^{-4}	489,769 (304,342)	1.2×10^{-4}
Waste Control Specialists, LLC	2,907,276 (1,806,381)	1.0×10^{-3}	634,260 (394,129)	1.6×10^{-4}

a The greatest transportation impact under either Truck Scenario 1 or 2 is presented in this table.
b Fatality caused by mechanical impact, not exposure to mercury.
c The Grand Junction Disposal Site does not have direct rail access. Potential transportation impacts by rail to Grand Junction Disposal Site would involve intermodal transportation: rail transport to Grand Junction, transfer from rail to truck, and truck transport to Grand Junction Disposal Site.

In addition to fatal accidents due to mechanical impact, exposure to mercury from spills that could result from transportation accidents could impact human health. Table 2–9 summarizes the consequences and associated risk to human health receptors under certain scenarios evaluated for all action alternatives.

Table 2–9. Summary of Transportation Consequences and Risks to Human Receptors

Scenario	Truck[a]	Railcar
	Consequence (Risk)	
Spill onto ground	SL-I/-III (Negligible) or SL-II (Low)	SL-I to -III (Negligible)
Spill into water[b]	SL-I to -II (Negligible to low)	SL-I to -II (Negligible to low)
Spill with fire – inhalation	SL-I/-III (Negligible) or SL-II (Low)	SL-I/-III (Negligible) or SL-II (Low)
Spill with fire – dry deposition	SL-I (Negligible)	SL-I (Negligible)
Spill with fire – wet deposition	SL-I (Negligible)	SL-I (Negligible)

a The greatest transportation impact under either Truck Scenario 1 or 2 is presented in this table.
b Due to a large range of uncertainty, estimating the consequences of this scenario is difficult.
Key: SL=severity level.

Intentional Destructive Acts

The most plausible scenario for an IDA in the context of mercury would be the deliberate crash of a gasoline tanker into a truck or railcar carrying mercury with a subsequent fire. Other scenarios involving an attack on a storage facility other than during unloading of a truck or railcar are judged to be less likely because of the distribution of mercury within the facility, security measures, and facility design features that would mitigate the impacts of mercury releases into the environment. Therefore, the IDA analysis summarized below applies to all the action alternatives similarly.

Human exposure pathways from an IDA include atmospheric inhalation and dry or wet deposition. The most severe case for atmospheric exposure pathways would be those concentrations of mercury between Acute Exposure Guideline Levels 2 and 3 (AEGL)-2 and AEGL-3 that could occur between approximately 100 meters (330 feet) and 5.6 kilometers (3.5 miles) downwind of the release point. However, the deposition benchmark of 180 milligrams per kilogram would not be exceeded anywhere.

2.7.1.10 Ecological Impacts

Consequences and, hence, risks to ecological receptors would be negligible except if there is a fire. The frequency of onsite fires sufficient to cause a release of mercury at any of the storage sites is predicted to be negligible; consequently, the ecological risk would also be negligible. Ecological risk would be evident only in the event of a transportation accident with fire; thus, the ecological risk would be similar under all action alternatives. Table 2–10 presents the ecological risk to various sensitive receptors.

Table 2–10. Summary of Consequences and Risk to Ecological Receptors – Transportation Accident with Pallet Fire

	Truck[a]		Railcar	
	Deposition Pathway			
	Dry	Wet	Dry	Wet
Receptor	Consequence (Risk)			
Sediment-dwelling biota	SL-IV (High)	SL-IV (Moderate)	SL-IV (Moderate)	b (Negligible)
Soil invertebrates	SL-IV (High)	SL-IV (Moderate)	SL-IV (Moderate)	b (Negligible)
Plants	SL-II (Low)	SL-IV (Moderate)	SL-II (Low)	b (Negligible)
American robin	SL-II (Low)	SL-IV (Moderate)	SL-II (Low)	b (Negligible)
River otter	SL-II (Low)	SL-II (Low)	SL-II (Low)	b (Negligible)
Aquatic biota	SL-I (Negligible)	SL-II (Low)	SL-II (Low)	b (Negligible)
Short-tailed shrew	SL-I (Negligible)	SL-II (Low)	SL-I (Negligible)	b (Negligible)
Great blue heron	SL-I (Negligible)	SL-II (Low)	SL-I (Negligible)	b (Negligible)
Red-tailed hawk	SL-I (Negligible)	SL-I (Negligible)	SL-I (Negligible)	b (Negligible)

a The greatest transportation impact under either Truck Scenario 1 or 2 is presented in this table.
b The predicted frequency of railcar crashes with pallet fires in the presence of rain is negligible; therefore, the associated risks would be negligible and consequences are not presented in the table.
Key: SL=severity level.

2.7.1.11 Socioeconomics

Action alternatives involving construction of a new facility are projected to require the employment of approximately 18 people for approximately 6 months. Action alternatives involving the use of existing buildings would require fewer employees than that to complete modifications or upgrades that might be needed. Operation of the mercury storage facility(ies) is estimated to require approximately 8 individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and then approximately 5 individuals for the remainder of the analysis period. The projected employment for construction and operations and associated indirect employment would have a negligible impact on socioeconomic conditions (i.e., overall employment, population trends, and traffic) under all alternatives.

During construction of a new storage facility, it is estimated that construction-related transportation would average 45 vehicle trips per day. During operations of a mercury storage facility(ies), the greatest impacts would occur in the first 2 years. During this time, it is estimated that approximately 12 vehicle trips per day would occur, including trips associated with facility employment and mercury delivery. The minimal increase in the number of vehicle trips projected during construction or operations of a mercury facility(ies) over baseline vehicular traffic would be negligible for all alternative sites.

2.7.1.12 Environmental Justice

Analysis of census population block groups within a region of influence (ROI), defined as a 16-kilometer (10-mile) radius surrounding a site, identified minority and low-income communities at the KCP, SRS, and WCS candidate sites. None of the other candidate sites were determined to have minority or low-income communities within their respective ROIs. Under all alternatives, no disproportionately high and adverse effects are expected for either minority or low-income populations.

Of the 671 census blocks located within 16 kilometers (10 miles) of KCP, 172 have a disproportionately high minority population only, 2 have a disproportionately high low-income population only, and 74 have a disproportionately high minority and low-income population. Within a smaller 3.2-kilometer (2-mile) radius, there are 41 census blocks, 16 of which contain a disproportionately high minority population and 1 contains a disproportionately high minority and low-income population. Impacts on these communities are not expected to result from construction or operations of a mercury storage facility; however, it is reasonable to conclude that a transportation accident at or near the facility could impact minority and low-income individuals disproportionately.

Of the 14 census blocks located within 16 kilometers (10 miles) of SRS, 4 have a disproportionately high minority population and none have a disproportionately high low-income population. Within a smaller 3.2-kilometer (2-mile) radius, there are no census blocks; however, 3 of the 4 minority blocks identified within the larger ROI are adjacent to South Carolina Highway 19 and adjoining U.S. Route 278. Impacts on these communities are not expected to result from construction or operations of a mercury storage facility; however, it is reasonable to conclude that a transportation accident at or near the facility entrance at South Carolina Highway 19 could impact minority individuals disproportionately.

Of the eight census blocks located within 16 kilometers (10 miles) of WCS, one has a disproportionately high minority population and none have a disproportionately high low-income population. Within a smaller 3.2-kilometer (2-mile) radius, there are two census blocks, neither of which contains a disproportionately high minority or low-income population. Impacts are not expected to result from construction or operations of a mercury storage facility. A transportation accident at or near the facility entrance would not disproportionately impact minority or low-income populations.

2.7.2 Summary of Cumulative Impacts

The Council on Environmental Quality regulations implementing the National Environmental Policy Act define cumulative effects as "impacts on the environment which result from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Actions that may contribute to cumulative impacts include on- and offsite projects conducted by government agencies, businesses, or individuals that are within the ROIs of the actions considered in this *Mercury Storage EIS*. The ROIs used in the cumulative impacts analysis were generally assumed to be within a 16-kilometer (10-mile) radius of each facility location.

Projected impacts on the various resource areas of constructing and operating a mercury storage facility range from none, to negligible, to minor. Those resource areas that were predicted to be impacted in a minor way were evaluated for their potential to contribute to cumulative impacts within the ROI. Where impacts were predicted not to occur or were negligible, cumulative impacts were not analyzed since there would be either no or only a very small incremental increase impacts on the resources within the ROI. Regardless of the projected level of impact, land disturbance associated with new construction and air quality impacts resulting from mercury emissions were evaluated for their potential to contribute to cumulative impacts within the ROI. Based on the criteria noted above, the analysis included an evaluation of air quality for all sites; land use for GJDS, Hanford, INL, SRS, and WCS; visual resources for GJDS and WCS; infrastructure for GJDS; and ecological resources for WCS. It was determined that the potential contribution to cumulative impacts on those resource areas evaluated would be negligible.

Table 2–11 summarizes the potential contributions to cumulative impacts for these resource areas. Chapter 4, Section 4.11, provides a detailed discussion of the cumulative impacts assessment and potential contributing actions that were considered, including a discussion of global commons cumulative impacts.

Table 2–11. Summary of Cumulative Impacts Assessment

Alternative	Resource Area	Cumulative Impacts	Contribution of Proposed Action to Cumulative Impacts
Grand Junction Disposal Site	Land use	Rural area; limited development expected within the ROI. Delta County solid waste landfill planned that will occupy 45 hectares (110 acres). No substantial cumulative impacts on land use or visual resources.	Negligible
	Visual resources		Negligible
	Air quality	No exceedance of air quality standards.	Negligible
	Infrastructure	No substantial cumulative impacts on regional power consumption.	Negligible
Hanford Site, 200-West Area	Land use	Numerous projects could disturb up to 1,100 hectares (2,720 acres) across Hanford. Most development is or would be within areas designated as Industrial and Industrial-Exclusive. Potential for minor cumulative impacts.	Negligible
	Air quality	No exceedance of air quality standards except potential impacts from carbon monoxide and particulate emissions from Hanford tank closure and waste management activities.	Negligible
Hawthorne Army Depot	Air quality	No exceedance of air quality standards.	Negligible

Table 2–11. Summary of Cumulative Impacts Assessment (*continued*)

Alternative	Resource Area	Cumulative Impacts	Contribution of Proposed Action to Cumulative Impacts
Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center	Land use	Limited development expected within the ROI. Development would take place within the Central Core Area of INL. No substantial cumulative impacts within ROI.	Negligible
	Air quality	No exceedance of air quality standards.	Negligible
Idaho National Laboratory, Radioactive Waste Management Complex	Air quality	No exceedance of air quality standards.	Negligible
Kansas City Plant	Air quality	No exceedance of air quality standards.	Negligible
Savannah River Site, E Area	Land use	Several onsite projects within ROI. Development is, or would be, within the Industrial Core Management Area. The major offsite project within the ROI is expansion of the Vogtle Electric Generating Plant. No substantial cumulative impacts.	Negligible
	Air quality	No exceedance of air quality standards, although the existing SRS contribution to 24-hour particulate matter concentrations approach the standard.	Negligible
Waste Control Specialists, LLC	Land use	Rural area; numerous projects within ROI along the Highway 176 corridor. Substantial recent local changes to land use and visual resources.	Negligible
	Visual resources		Negligible
	Air quality	No exceedance of air quality standards.	Negligible
	Ecological resources	Numerous projects within ROI along the Highway 176 corridor. Substantial recent local loss of low desert grassland and rangeland habitat.	Negligible

Key: Hanford=Hanford Site; INL=Idaho National Laboratory; ROI=region of influence; SRS=Savannah River Site.

2.8 REFERENCES

Belencan, H., 2009, "SRS Recovery Act Footprint Reduction Project," Presentation to Governor's Nuclear Advisory Council, Savannah River Operations Office, Savannah River, South Carolina, June 11.

Chlorine Institute, 2008, *Eleventh Annual Report to EPA*, Arlington, Virginia, September.

Clinkenbeard, J., 2009, California Department of Conservation, California Geological Survey, personal communication to K. Prindiville, Science Applications International Corporation, Richland, Washington, "California Gold Mining," November 18.

DLA (Defense Logistics Agency), 2004, *Final Mercury Management Environmental Impact Statement*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DOE (U.S. Department of Energy), 2002, *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-0319, National Nuclear Security Administration, Washington, D.C., August.

DOE (U.S. Department of Energy), 2005, *Savannah River Site End State Vision*, Office of Environmental Management, Aiken, South Carolina, July 26.

DOE (U.S. Department of Energy), 2009, *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury*, November 13.

DOE and Mesa County (U.S. Department of Energy and Mesa County Board of Commissioners), 1996, Memorandum of Understanding Between the United States Department of Energy and the Mesa County Board of Commissioners Regarding Utilization of the Cheney Repository, April 24.

Duncan, J.P., ed., 2007, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNNL-6415, Rev. 18, Pacific Northwest National Laboratory, Richland, Washington, September.

EPA (U.S. Environmental Protection Agency), 2005, *Global Mercury Commodity Market Study*, Washington, D.C., May.

EPA (U.S. Environmental Protection Agency), 2007, *Mercury Storage Cost Estimates*, Office of Pollution Prevention and Toxics and Office of Solid Waste and Emergency Response, Washington, D.C., November.

GSA and NNSA (U.S. General Services Administration and National Nuclear Security Administration), 2008, *Environmental Assessment for the Modernization of Facilities and Infrastructure for the Non-nuclear Production Activities Conducted at the Kansas City Plant*, DOE/EA-1592, Kansas City, Missouri, April 21.

Holecek, M., 2009, *Identifying a Storage Facility for Elemental Mercury*, Response to Request for Expressions of Interest, U.S. Department of Energy, National Nuclear Security Administration, Kansas City Site Office, Kansas City, Missouri, April 24.

INL (Idaho National Laboratory), 2008, *Idaho National Laboratory Site Environmental Report Calendar Year 2007*, DOE/ID-12082(07), Idaho Operations Office, Idaho Falls, Idaho, September.

IPCC (Intergovernmental Panel on Climate Change), 2007, *A Report of Working Group I of the Intergovernmental Panel on Climate Change, Summary for Policymakers*, Cambridge, United Kingdom, and New York, New York.

Krahulec, K., 2009, Utah Geologic Survey, Energy and Minerals Group, personal communication to K. Prindiville, Science Applications International Corporation, Richland, Washington, “Utah Gold Mining,” November 16.

Mannon, J., 2009, Cripple Creek and Victor Gold Mining Company, Victor, Colorado, personal communication to K. Prindiville, Science Applications International Corporation, Richland, Washington, “Byproduct Mercury from Cresson Gold Mine,” November 17.

Miller, G., and G. Jones, 2005, *Mercury and Modern Gold Mining in Nevada*, Final Report to U.S. Environmental Protection Agency Region IX, University of Nevada, Reno, Nevada, October 25.

NMA (National Mining Association), 2009, *Gold Production By State*, accessed through http://www.nma.org/pdf/g_production.pdf, August 11.

Szumigala, D., 2009, Alaska Division of Geological and Geophysical Surveys, personal communication to K. Prindiville, Science Applications International Corporation, Richland, Washington, “Alaska Gold Mining,” September 4.

Townsend, B., 2009, South Dakota Department of Environment and Natural Resources, Minerals and Mining Program, personal communication to K. Prindiville, Science Applications International Corporation, Richland, Washington, "South Dakota Gold Mining," November 13.

USGS (U.S. Geological Survey), 2009, Mineral Commodities Summary, accessed through http://minerals.usgs.gov/minerals/pubs/commodity/mercury/mcs-2009-mercu.pdf, August 15.

Code of Federal Regulations

40 CFR 1502.14(a), Council on Environmental Quality, "Environmental Impact Statement: Alternatives Including the Proposed Action."

40 CFR 1508.7, Council on Environmental Quality, "Cumulative Impact."

40 CFR 268, U.S. Environmental Protection Agency, "Land Disposal Restrictions."

49 CFR 172.101, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans: Purpose and Use of Hazardous Materials Table."

Federal Register

64 FR 28949, U.S. Environmental Protection Agency, 1999, "Potential Revisions to the Land Disposal Restrictions Mercury Treatment Standards," May 28.

68 FR 4481, U.S. Environmental Protection Agency, 2003, "Land Disposal Restrictions: Treatment Standards for Mercury-Bearing Hazardous Waste; Notice of Data Availability," January 29.

69 FR 23733, Defense Logistics Agency, Defense National Stockpile Center, 2004, "Record of Decision for the *Final Mercury Management Environmental Impact Statement*," April 30.

74 FR 31723, U.S. Department of Energy, 2009, "Notice of Intent to Prepare an *Environmental Impact Statement for the Long-Term Management and Storage of Elemental Mercury*," July 2.

United States Code

42 U.S.C. 6901 et seq., Resource Conservation and Recovery Act of 1976, as amended.

U.S. Public Laws

P.L. 110-414, Mercury Export Ban Act of 2008.

P.L. 111-5, American Recovery and Reinvestment Act of 2009.

CHAPTER 3
AFFECTED ENVIRONMENT

> In Chapter 3, the affected environment descriptions of the seven sites considered in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement* provide the context for understanding the environmental consequences of the action alternatives described in Chapter 4. In addition, a description of the environment of the Y–12 National Security Complex is included for purposes of comparison since it is being evaluated under the No Action Alternative. The affected environment serves as a baseline from which any environmental changes that may be brought about by implementing the proposed alternatives can be identified and evaluated; the baseline conditions are the currently existing conditions. The affected environment is described for the following impact areas: land use and visual resources; geology, soils, and geologic hazards; water resources; meteorology, air quality, and noise; ecological resources; cultural and paleontological resources; infrastructure; waste management; occupational and public health and safety; socioeconomics; and environmental justice.

3.1 APPROACH TO DEFINING THE AFFECTED ENVIRONMENT

This chapter describes the environment at the seven sites that could be affected through implementing the alternatives evaluated in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement (Mercury Storage EIS)*. The seven sites comprise the following: Grand Junction Disposal Site (GJDS), Hanford Site (Hanford), Hawthorne Army Depot, Idaho National Laboratory (INL), Kansas City Plant (KCP), Savannah River Site (SRS), and Waste Control Specialists, LLC (WCS), site. In addition, the environment at the Y–12 National Security Complex (Y–12), which is part of the No Action Alternative, is described for purposes of comparison with the action alternatives. For each site, the affected environment is described for the following resource areas: land use and visual resources; geology, soils, and geologic hazards; water resources; meteorology, air quality, and noise; ecological resources; cultural and paleontological resources; infrastructure; waste management; occupational and public health and safety; socioeconomics; and environmental justice. This environmental impact statement (EIS) provides a description of the existing environment of each site as a whole, as well as that of the area(s) of each site within which the proposed action would take place.

The U.S. Department of Energy (DOE) evaluated the environmental impacts of managing and storing mercury[1] within defined regions of influence (ROIs). These ROIs are specific to the resource area evaluated; encompass geographic areas within which any meaningful impact is expected to occur; and can include the areas within which the proposed action would take place, the sites as a whole, or nearby or distant offsite areas. For example, impacts on historic resources were evaluated at specific facility locations within each site, whereas human health risks to the general public were assessed for an area within a 16-kilometer (10-mile) radius of the facility location. Brief descriptions of the ROIs for each resource area are given in Table 3–1; more-specific information is presented in Appendix B. Appendix E, Table E–1, lists the scientific names of plants and animals used in this chapter, grouped by common name in alphabetical order.

Table 3–1. General Regions of Influence for the Affected Environment

Environmental Resource Area	Region of Influence
Land use and visual resources	The project location, the site, and nearby offsite areas
Geology, soils, and geologic hazards	The project location, the site, and nearby offsite areas
Water resources	The project location, the site, and adjacent surface-water bodies and groundwater
Meteorology, air quality, and noise	For air quality, the site and nearby offsite areas potentially affected by air pollutant emissions; for noise, the project location, the site, and surrounding areas, including transportation corridors where proposed activities might increase noise levels

[1] Unless indicated otherwise, elemental mercury is referred to hereafter simply as "mercury" in this environmental impact statement.

Table 3–1. General Regions of Influence for the Affected Environment (*continued*)

Environmental Resource Area	Region of Influence
Ecological resources	The project location, the site, and nearby offsite areas
Cultural and paleontological resources	The project location and adjacent areas
Infrastructure	The project location, the site, and local areas supporting the site
Waste management	The waste management facilities located on the site
Occupational and public health and safety	The site, offsite areas within 16 kilometers of the site, and the transportation corridors
Socioeconomics	The counties where at least 90 percent of site employees reside
Environmental justice	The area within 16 kilometers of the site and the area within 3.2 kilometers of the site as a subset of the 16-kilometer area

Note: To convert kilometers to miles, multiply by 0.6214.

The existing environmental conditions for each resource area were determined from information provided in previous EISs and environmental studies, other government reports and databases, and relevant laws and regulations.

3.2 GRAND JUNCTION DISPOSAL SITE

3.2.1 Land Use and Visual Resources

Land use at GJDS and all sites is defined in terms of the kinds of anthropogenic activities (e.g., agricultural, residential, industrial) for which land is developed (EPA 2006). Natural resource and other environmental characteristics make a site more suitable for some land uses than for others. Changes in land use may have beneficial or adverse effects on other resources—ecological, cultural, geological, and atmospheric. Visual resources are natural and manmade features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape.

3.2.1.1 Land Use

Land use at GJDS is zoned "Agricultural, Forestry, Transitional." The 146-hectare (360-acre) site is located on DOE land in a rural area of Mesa County, Colorado, approximately 29 kilometers (18 miles) southeast of the city of Grand Junction. The property was withdrawn from the public domain for the emplacement of uranium mill tailings in a 38-hectare (94-acre) disposal cell located in the west-central portion of the site. Small structures are currently on the site to facilitate disposal and maintenance operations; these include a personnel office building and two storage buildings. The site is enclosed by a security fence with locked gates. Entrance to the site is provided by a 2.4-kilometer (1.5-mile) restricted-access road extending east from U.S. Route 50 (Geiser 2009:3, 4, 6).

As discussed in Chapter 1, Sections 1.6 and 1.7.1, DOE and the Mesa County Board of Commissioners (Mesa County) entered into a Memorandum of Understanding (1996 MOU) (DOE and Mesa County 1996) to provide meaningful consultation with and participation of Mesa County in DOE's use of GJDS. Mesa County's position is that the use of GJDS is restricted per the 1996 MOU and that DOE is obligated to honor this agreement. DOE currently is evaluating the applicability of the 1996 MOU to determine whether it would affect the viability of this site as a reasonable alternative.

Land use surrounding GJDS is predominantly open rangeland used seasonally for grazing (DOE 2009a). The site is surrounded by land owned by the U.S. Bureau of Land Management (BLM) on all but the west side, which is bordered by a private parcel. Although private parcels are interspersed throughout the BLM lands, it is very unlikely that this area will see more than rural, low-density development (Geiser 2009:4). The nearest residence is located approximately 3.2 kilometers (2 miles) north of the site; however, recently approved residential site plans could result in residences being closer to the site. The nearest portion of the 26,823-hectare (66,280-acre) Dominquez Canyon Wilderness Area, established in 2009, is located approximately 7.4 kilometers (4.6 miles) southwest of the site (DOI 2009).

A seasonal pond (Cheney Reservoir) is located 1.6 kilometers (1 mile) south of the site and is used for livestock and wildlife watering; the Gunnison River is located 6.4 kilometers (4 miles) to the west (DOE 1986:62; Geiser 2009:4).

3.2.1.2 Visual Resources

The developed areas of GJDS are consistent with the BLM's Visual Resource Management (VRM) Class IV. Class IV includes areas in which major modifications to the character of the landscape have occurred. These changes may be dominant features of the view and the major focus of viewer attention (DOI 1986:App.2). The uranium mill tailings disposal unit (or disposal cell) is not visible from U.S. Route 50 (Geiser 2009:4). The viewshed, which is the extent of the area that may be viewed from GJDS, consists mainly of open range with scrub vegetation, dominated by views of Grand Mesa, which is located approximately 10 kilometers (6 miles) to the northeast. This viewshed is generally consistent with VRM Class II (where visible changes to the character of the landscape are low and do not attract the attention of the casual observer). The site can be seen from Grand Mesa and Grand Mesa National Forest (the latter located approximately 8 kilometers [5 miles] to the northeast), but is not readily discernable at that distance (DOE 1986:115).

3.2.2 Geology, Soils, and Geologic Hazards

The geologic resources at GJDS and all sites are described with respect to geology, soils, and geologic hazards. Geologic resources are consolidated or unconsolidated earth material, including ore and aggregate material, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts. Geologic hazards can include seismic activity, landslides, volcanic eruptions, and erosional processes.

3.2.2.1 Geology

GJDS is located in the Canyon Lands section of the Colorado Plateau physiographic province. This province is characterized by deeply incised river channels flowing through sedimentary rocks, exposing large cliffs and flat mesas (DOE 1986:74, 75). Elevations across the immediate area of the disposal site range from 1,580 meters (5,190 feet) to approximately 1,610 meters (5,270 feet) above mean sea level. The site is specifically located on the west flank of Grand Mesa (Jacobs 1998:2-2, 2-8).

The disposal site is on the northeast flank of the Uncompahgre Uplift. The crest or axis of this northwest striking feature is approximately 24 kilometers (15 miles) to the west and southwest of the site. This feature is an asymmetrical block that has uplifted and faulted the sedimentary rock strata to form the Uncompahgre Plateau. The uplift is bounded on its flanks by locally faulted monoclines. Major geologic faults within the vicinity of the site are the Redlands Fault, the Jacobs Ladder Fault complex, and the Cactus Park-Bridge Port Fault where evidence suggests fault displacement during the Quaternary Period and into the Holocene Epoch (i.e., within the last 10,000 years). The nearest mapped trace of the Cactus Park-Bridgeport Fault is located approximately 8 kilometers (5 miles) west of the site (Livaccari and Hodge 2005). Evidence suggests that the Uncompahgre Uplift was rising as recently as 3 million years ago, and it is likely that uplift has continued to the present (DOE 1986:74, 76, 79).

Bedrock beneath the site consists of a thick sequence of sedimentary rocks primarily consisting of alternating layers of shales, sandstones, siltstones, mudstones, and some limestones and ranging in age from Late Cretaceous to Triassic. The uppermost bedrock unit at the site is the Mancos Shale, which is primarily a marine shale within beds of limestone. The total thickness of the Mancos Shale ranges from about 90 meters (300 feet) to more than 210 meters (700 feet) beneath the site; Dakota Sandstone underlies the Mancos Shale. As much as 9 meters (30 feet) of Mancos Shale was penetrated in the borings at the site. At the point of contact between the overlying soils and the bedrock, the Mancos Shale is weathered to the point of having an almost soil-like texture. Within a few feet, however, it becomes fairly fresh and becomes noticeably fractured, with many of the fractures filled with gypsum. With increasing depth, the fracturing diminishes and the shale becomes relatively impermeable (DOE 1986:74–76, 80). There are no outcrops of the Mancos Shale at the site; the shale is overlain by colluvium, terrace deposits, and alluvium ranging from 7 to 13 meters (23 to 42 feet) thick (DOE 1986:76; Jacobs 1998:2-8).

Geologic resources in the vicinity of GJDS include natural gas, coal, oil, and sand and gravel aggregate. Uranium ore processed at the Grand Junction Processing Site was mined from a large number of surface and underground mines across western Colorado and eastern Utah. Coal occurs in the upper Dakota Sandstone, primarily as thin beds of lignite. One-third of the natural gas fields in Mesa County produce gas from the Mancos, Dakota, Morrison, and Entrada Formations. There are oil and gas leases in the vicinity of the site, as well as active oil and gas fields in the area. While aggregate resources are available from the Colorado River floodplain, the gravel at the disposal site has low commercial value, as it is more or less uniformly distributed in a matrix of sandy silt and clay (DOE 1986:52, 75, 81).

3.2.2.2 Soils

At the surface, natural soil parent materials are described as consisting of an eolian (wind-blown) silt deposit with some clay and sand with sporadic gravel- to boulder-size basalt fragments as much as 1 meter (3.3 feet) thick. This silty deposit is underlain by a mixture of alluvium and colluvium, which comprise interlayered clay, si1t, sand, and gravel with sporadic layers of basalt cobbles and boulders. Gully erosion of the ephemeral washes on and near the site that drain from higher elevations in the site vicinity is the major hazard for these materials (DOE 1986:73). Soil unit mapping by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), identifies natural soils across the site as belonging to the Utaline, sodic-Uffens complex (3 to 12 percent slopes, very stony) mapping unit. The soils are uniformly well drained and are generally characterized as cobbly clay loams and very stony clay loams at depths of 1.5 meters (5 feet). Soils in this complex are rated as being very limited for commercial building site development due to large stones. None of the soils on or in the vicinity of GJDS are prime farmland or other important farmland soils (NRCS 2009a).

3.2.2.3 Geologic Hazards

The GJDS area is located within the stable interior portion of the Colorado Plateau, but within a few kilometers of potentially active faults associated with the Uncompahgre Uplift (DOE 1986:76). In general, Colorado is considered a region of minor earthquake activity, although there are many uncertainties because of the very short time period for which historical data are available. The northwestern and southwestern corners and the Sangre de Cristo Mountains in the south-central section of the state have had no activity in historic times (USGS 2009a). The largest recorded earthquake in Colorado occurred in November 1882. It was estimated to have had a magnitude of 6.6 and produced shaking of up to a Modified Mercalli Intensity (MMI) of VII at its epicenter. Although the epicenter is uncertain, it is thought to have been located in the Front Range west of Fort Collins. It was felt throughout most of Colorado and Wyoming and well into Utah, Idaho, and Nebraska. In the vicinity of GJDS, probable ground shaking was in the MMI V range (USGS 2009b). Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects.

Since 1973, a total of 103 small earthquakes (most ranging in magnitude from 2.4 to 4.6) have been recorded within a radius of 100 kilometers (62 miles) of GJDS. However, 61 of these earthquakes were attributed to nontectonic sources primarily from coal bumps from collapsing pillars of coal or rockbursts in coal mines at distances ranging from about 64 to 97 kilometers (40 to 60 miles) east of the site. In

April 1995, a small, felt earthquake of probable tectonic origin had its epicenter within 2 kilometers (1.2 miles) of the site (magnitude of 2.7) (USGS 2009c). Estimates for the maximum credible earthquake for the Colorado Plateau range in magnitude from 5.5 to 6.5 (DOE 1986:76). Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity), as further described in Appendix B, Section B.3. For the purposes of comparing the relative seismic hazard based on predicated earthquake-produced ground motions among the various mercury storage candidate sites in this EIS, the latest probabilistic peak (horizontal) ground acceleration (PGA) data from the U.S. Geological Survey (USGS) are used. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For GJDS, the calculated PGA is approximately 0.14 *g* (USGS 2009d). The potential for soil liquefaction was assessed for the site and is considered to be low (DOE 1986:B-109, B-121).

3.2.3 Water Resources

Water resources at GDJS and all sites include all forms of surface water and groundwater. Surface water is defined as all water bodies that occur above the ground surface, including rivers, streams, lakes, ponds, and other features. Groundwater is water within the saturated zone—i.e., water that typically originates naturally as recharge from rain and snowmelt or artificially as recharge from activities such as irrigation, industrial processing, and wastewater disposal, and water destined to return to the surface through discharge to springs and seepage into rivers and streams, evaporation from shallow water table areas, or human activity involving wells or excavations.

3.2.3.1 Surface Water

No major streams or rivers are located within 3.9 kilometers (2.4 miles) of GJDS. An area of approximately 97 hectares (240 acres) drains toward GJDS. The Gunnison River is located about 6.4 kilometers (4 miles) from the site at its closest point. GJDS is situated on a pediment surface that forms a divide between two small ephemeral washes, one approximately 240 meters (800 feet) north of the site and one approximately 520 meters (1,700 feet) south of the existing disposal cell and just beyond the eastern and southeastern property boundary (see Figure 2–7). These washes merge with Indian Creek, 0.2 to 0.8 kilometers (0.1 to 0.5 miles) southwest of the site. Indian Creek flows into Kannah Creek, which is perennial, some 6.4 to 8 kilometers (4 to 5 miles) northwest of the ephemeral wash confluences. Kannah Creek empties into the Gunnison River at a point approximately 3.2 kilometers (2 miles) west of the Indian Creek conf1uence. The Gunnison River flows toward the city of Grand Junction, where it joins the Colorado River (DOE 1986:85; Jacobs 1998:2-2). In addition, Cheney Reservoir is located approximately 1.6 kilometers (1 mile) southeast of GJDS at its closest point. The reservoir is used for livestock and wildlife watering and measures approximately 16 hectares (40 acres) in size. It is not in the surface-water flow path from GJDS and is topographically separated from the site by several drainage divides, including Indian Creek (DOE 1986:62, 64, 65).

Slopes in the watershed range from 2 to 5 percent. Sheet wash and rill erosion are the primary erosive forces currently active in the area of the site; washes in the area are in places incised to a depth of 1.5 meters (5 feet). Minor gullying is occurring on the small ephemeral washes that flank the site. Moderate to intense gullying is evident along Indian Creek, but most of GJDS is classified as having only a moderate potential for future erosion (DOE 1986:85). DOE's Office of Legacy Management continues to operate and maintain surface-water diversion and drainage structures at the site to ensure proper functioning. The engineered features include the south diversion channel, which is a riprap armored structure that conveys runoff water away from the disposal cell southeast into the east ephemeral wash. Other drainage features at the site include north and south stormwater collection ditches, the north stormwater retention pond, and a stormwater and sediment collection pond on the east side of the south diversion channel. These small drainage features control stormwater runoff primarily from the various disposal cell cover materials stockpiled on the northern and eastern portions of the property. The north stormwater collection ditch also captures run-on stormwater from a large catchment area north and east of the disposal site (DOE 2009b:6-1, 6-3, 6-6).

No surface-water-quality data exist for the ephemeral streams in the vicinity of the site, and DOE does not monitor surface-water runoff quality as part of annual site monitoring. Limited data exist for Kannah Creek and the Gunnison River downgradient of the site; however, these data indicate that the quality of these bodies is influenced more by groundwater recharge than the flow that enters from the small creeks and ephemeral streams in the area of GJDS (DOE 1986:F-28). The State of Colorado classifies surface waters and assigns water quality standards for the purposes of maintaining and improving the quality of the state's surface waters. Tributaries to the Gunnison River in the vicinity of GJDS are classified as protected for Class 2 uses, including warm-water aquatic life, recreation Class N (unsuitable for primary contact use), water supply, and agriculture (5 CCR 1002-31; 5 CCR 1002-35). Further, the Colorado River serves as an irrigation and drinking water supply for much of the southwestern United States. Water use at GJDS is discussed in Section 3.2.7.4.

No data exist on historical floods for the site. The site is approximately 6.4 kilometers (4 miles) from the floodplain of the Gunnison River, and Kannah Creek and Indian Creek flow at an elevation of approximately 61 meters (200 feet) below the site. Therefore, the site is not subject to river flooding. Nevertheless, a very conservative analysis was conducted of the effects of a probable maximum flood based on a one-hour rainfall of 21.6 centimeters (8.5 inches). Under such a scenario, the watershed of GJDS would experience flows in excess of 57 cubic meters (2,000 cubic feet) per second leading to flash flooding from sheet flow. The probable maximum flood was the design basis for the tailings disposal cell at the site and its associated diversion ditch system (DOE 1986:B-53–B-55, F-24, F-27).

3.2.3.2 Groundwater

Groundwater in the vicinity of the disposal site area occurs transiently in subtle, alluvium-filled paleochannels eroded on the Mancos Shale surface, in fracture systems in the underlying Mancos Shale, and permanently in the deeper Dakota Sandstone. Detailed field investigations performed during site characterization identified a large area suitable for the existing disposal cell that was devoid of paleochannels containing saturation zones. The Dakota Sandstone is defined as the uppermost aquifer beneath GJDS (Jacobs 1998:2-8).

Alluvium-filled paleochannels exposed by continuous trenches contain saturation zones ranging from less than 0.3 to more than 1.8 meters (1 to 6 feet) thick. Paleochannels are separated in some cases by relatively large distances of approximately 150 meters (500 feet). Three separate paleochannel flow systems have been identified on GJDS. One system passes within approximately 30 meters (100 feet) of the northwest corner of the existing disposal cell footprint and possibly in the vicinity of the proposed mercury storage facility location. The other two are within approximately 180 meters (600 feet) of the southern portion of the disposal cell footprint (Jacobs 1998:2-8).

Local groundwater flow generally parallels the slope of the land surface to the west. The portion of the unconsolidated deposits below the water table has a relatively low permeability. Because of the low permeability and thinness of the saturated layer, a well completed in the saturated layers would probably yield less than 11 liters (3 gallons) per day. The local groundwater system is likely recharged by seepage from the ephemeral wash or ditch just to the east of the site. The ditch diverts water from Indian Creek, an intermittent drainage fed by snowmelt on the Grand Mesa. Discharge of the local groundwater system is not readily apparent, but may occur as evapotranspiration or as underflow to an ephemeral reach of Indian Creek southwest of the site (DOE 1986:91).

Groundwater in the Mancos Shale is found in discontinuous zones separated both laterally and vertically by large regions of unsaturated rock. Aquifer pumping tests and computer simulations demonstrate that the Mancos Shale yields less than 570 liters (150 gallons) per day and is considered "limited-use" groundwater (i.e., groundwater that is not a current or potential source of drinking water) (5 CCR 1002-41; 40 CFR 192.11(e)). Pockets of groundwater were found in isolated intervals in the unweathered Mancos Shale at several depths, but principally between 15 and 37 meters (50 and 120 feet) and between 84 and 150 meters (275 and 492 feet). The groundwater occurs in saturated, multiple fracture zones. Three monitoring wells completed in the Dakota Sandstone encountered confined groundwater with hydraulic pressures greater than 110 meters (360 feet) above the Mancos Shale/Dakota Sandstone contact. Groundwater in the Dakota Sandstone is confined by unsaturated low-permeability shales and sandstone of the overlying units. Total dissolved solids concentrations exceed 10,000 milligrams per liter, and thus groundwater in the Dakota Sandstone (uppermost aquifer) is also considered “limited-use” groundwater (Jacobs 1998:2-8).

Background groundwater quality beneath the disposal site was determined prior to emplacement of tailings material in the facility. In general, groundwater quality is good in the alluvium, poor in the Mancos Shale, and unusable even for stock watering in the Dakota Sandstone. Water quality in these units correlates well with the ages of the groundwater. Carbon-14 analyses of groundwater samples collected from the three units show that alluvial groundwater is relatively young (less than 2,000 years), the shallow Mancos Shale groundwater is old (20,000 to 30,000 years), and the Dakota Sandstone groundwater is very old (probably more than 42,000 years) (Jacobs 1998:2-8). The large differences in the chemical conditions of the groundwater also suggest little, if any, hydraulic interconnection between the groundwater zones. Background groundwater quality in the Mancos Shale is brackish, with elevated total dissolved solids levels ranging from 870 to 7,010 milligrams per liter. Average selenium concentrations slightly exceed the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) (40 CFR 141). Background groundwater quality in the Dakota Sandstone is saline with high total dissolved solids concentrations, as discussed above. Thus, this aquifer is neither a current nor a potential source of drinking water. In addition, groundwater from this unit contains natural gas, and average concentrations of radium-226 and radium-228 exceed the EPA and state MCL of 5 picocuries per liter (Jacobs 1998:2-8, 2-9).

Confined groundwater in the uppermost aquifer lies approximately 230 meters (750 feet) below the existing ground surface and is hydrogeologically isolated from the tailings material by mudstones and shales of the Mancos Shale. In lieu of monitoring groundwater in the uppermost aquifer, DOE voluntarily monitors groundwater as a best management practice from two monitoring wells completed in (or very near) buried alluvial paleochannels adjacent to the disposal cell (MW−0731 and MW−0732) and one monitoring well in the disposal cell (MW−0733). This monitoring is performed to assess the performance of the disposal cell and to ensure that any groundwater in the paleochannels is not being impacted by seepage (transient drainage) from the disposal cell. Selenium concentrations continued to exceed the MCL of 0.05 milligrams per liter in the paleochannel wells. In 2008, the highest concentration of selenium, 0.59 milligrams per liter, occurred in paleochannel well MW−0731. Selenium occurs naturally in the Mancos Shale deposits that underlie the disposal cell and may be the cause of elevated concentrations reported in both paleochannel monitoring wells (Geiser 2009:6-7–6-10).

3.2.4 Meteorology, Air Quality, and Noise

The discussion of meteorology at GJDS and all sites refers to the atmospheric conditions, especially severe weather conditions that could be important to the viability of a storage facility. Air pollution refers to the direct or indirect introduction of any substance into the air that could endanger human health; harm living resources, ecosystems, or material property (e.g., buildings); or impair or interfere with the comfortable enjoyment of life or other legitimate uses of the environment. Air pollutants are transported, dispersed, and concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography. Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.2.4.1 Meteorology and Air Quality

The climate of the GJDS area is continental, that is, it is characterized by hot summers and colder winters. The average annual rainfall at the National Weather Service Station in the city of Grand Junction is 23 centimeters (8.9 inches). Maximum rainfall occurs in late spring and during the fall. Minimum rainfall months are January, February, and June (WRCC 2009a). Damaging hailstorms rarely occur in Mesa County (NCDC 2009a). The average annual snowfall is 54.6 centimeters (21.5 inches) (NOAA 2009a). Precipitation is expected to be slightly higher at GJDS than at the National Weather Service Station (DOE 1986:69).

One tornado resulting in property damage occurred in Mesa County between January 1950 and March 2009. Several occurrences of high winds typically occur every year (NCDC 2009a). The average annual windspeed is 3.5 meters per second (7.8 miles per hour) (WRCC 2009a). Prevailing winds are from the east-southeast to southeast (NOAA 2009a). The maximum windspeed, based on the highest 1-minute average value, is 25 meters per second (57 miles per hour) (NOAA 2009b:64).

The average annual temperature at the Grand Junction National Weather Service Station is 11.8 degrees Celsius (°C) (53.3 degrees Fahrenheit [°F]) (WRCC 2009a). Temperatures range from a monthly average minimum temperature of –8.9 °C (15.9 °F) in January to a monthly average maximum of 33.8 °C (92.8 °F) in July (NOAA 2009a). The maximum recorded temperature is 41 °C (106 °F) and the minimum recorded temperature –31°C (–23°F) (NCDC 2009a). GJDS is about 48 kilometers (30 miles) from the Grand Junction National Weather Service Station and is approximately 150 meters (500 feet) higher in elevation. Therefore, it is expected that the average maximum annual temperature would be 0.6 to 1.1 °C (1 to 2 °F) lower (DOE 1986; Geiser 2009).

GJDS is in an area of Mesa County that is designated as better than national standards for sulfur dioxide and nitrogen dioxide. The area is unclassifiable/attainment regarding attainment of the standards for carbon monoxide, ozone, and annual particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$). EPA has not assigned an attainment status designation for lead. The area is unclassifiable for annual particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}) (40 CFR 81.306).

The nearest Prevention of Significant Deterioration (PSD) Class I area is the wilderness area within Black Canyon of the Gunnison National Park, about 64 kilometers (40 miles) to the southeast. A Class I area is one in which very little increase in pollution is allowed due to the pristine nature of the area. GJDS and its vicinity are classified as a Class II area, in which more-moderate increases in pollution are allowed. No PSD permits are required for any emission source at the site.

The primary sources of criteria air pollutants at GJDS are propane heaters and material-handling equipment. The site has no air pollutant sources that require an air permit (Geiser 2009).

There are no nearby monitors for criteria air pollutants. The closest offsite monitors are in the city of Grand Junction for carbon monoxide, $PM_{2.5}$, PM_{10}, and mercury. For 2008, the mean mercury concentration at the Grand Junction monitor was 0.0031 micrograms per cubic meter and the maximum 24-hour concentration was 0.005 micrograms per cubic meter (EPA 2009a). The nearest ozone monitor is at Colorado National Monument about 32 kilometers (20 miles) northwest of the site (EPA 2009b). Monitored concentrations in the region are well below ambient standards.

3.2.4.2 Noise

Major noise emission sources at GJDS include various pieces of equipment, such as material-handling equipment, machines, and vehicles. The nearest residence is approximately 3.2 kilometers (2 miles) north of the site (DOE 2009a:3).

The State of Colorado has established community noise standards. The daytime (7:00 A.M. to 7:00 P.M.) noise limit at the property line of an industrial facility is 80 decibels A-weighted (dBA) (a unit of measurement that accounts for the frequency response of the human ear), and the nighttime limit is 75 dBA (CRS 25-12-103). Sound level measurements have not been recorded near GJDS; however, it is expected that the acoustic environment near the site boundary ranges from that typical of rural to industrial locations. Traffic is the primary source of noise near GJDS except when there is activity on the site. There is little traffic generated by activities at the site. Noise-producing activities at the site currently occur only during several weeks every year or two when the cell is opened for disposal of uranium mill tailings. U.S. Route 50 provides access to the site (DOE 2009a).

3.2.5 Ecological Resources

Ecological resources at GJDS and all sites include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Terrestrial resources are the plant and animal communities most closely associated with the land; aquatic resources are those associated with a water environment. Wetlands are "those areas that are inundated or saturated by groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3). Endangered species are those plants and animals in danger of extinction throughout all or a large portion of their range; threatened species are plants and animals likely to become endangered within the foreseeable future throughout all or a significant portion of their range. Candidate species are plants and animals for which the U.S. Fish and Wildlife Service (USFWS) has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act (16 U.S.C. 1531 et seq.), but for which development of a proposed listing regulation is precluded by other higher-priority listing activities. Critical habitat is defined as specific geographic areas, whether occupied by a listed species or not, that are essential for its conservation and that have been formally designated by rule published in the *Federal Register*. Not all species have had critical habitat designated for them. The state also identifies threatened and endangered species.

3.2.5.1 Terrestrial Resources

Historically, GJDS was part of the western shrub and grassland habitat of the Colorado Plateau. Common plant communities once included saltbush-greasewood, surrounded by pinyon-juniper woodland. Currently the site consists of approximately 46 hectares (114 acres) of disturbed land with sparse, mainly early successional vegetation. Galleta grass, Indian ricegrass, squirrelgrass, and prickly pear are now considered the most abundant and widespread plant species (DOE 1986:94).

Mammals occurring at GJDS include the desert cottontail, white-tailed antelope squirrel, deer mouse, and pronghorn. The diversity of bird species at GJDS is low due to the limited variety of vegetation. Common nesting species include the horned lark and western meadowlark. The golden eagle, prairie falcon, and kestrel have been observed hunting at the site. The only nesting bird of prey recorded on the site was the burrowing owl. Reptiles that occur at the site include the short-horned lizard, sagebrush lizard, and gopher snake. Amphibians are not expected to occur on this site due to the lack of permanent water or temporary ponding (DOE 1986:95).

The proposed mercury storage location, situated in the northwest corner of the site, consists of mostly disturbed and developed land. However, about 40 percent of the proposed location has not been disturbed and supports native flora and fauna (Geiser 2009:7).

3.2.5.2 Wetlands

No wetlands are present within the boundaries of GJDS or its ROI (DOE 1986:95-96).

3.2.5.3 Aquatic Resources

Aquatic resources at GJDS are limited to evaporation ponds, drainage ditches, and other manmade structures (Geiser 2009:Figure 3). These areas generally contain water during or immediately after precipitation events. Cheney Reservoir, a seasonal pond used by both livestock and wildlife, and the Gunnison River are located 1.6 kilometers (1 mile) south and 6.4 kilometers (4 miles) west of the site, respectively. Indigenous population of mammals, birds, reptiles, and amphibians are known to occur at Cheney Reservoir. Common species include the raccoon, red-winged blackbird, and bullfrog. The segment of the Gunnison River flowing past GJDS towards the city of Grand Junction contains a relatively healthy assemblage of native fish. Common species include bluehead sucker, flannelmouth sucker, and roundtail chub (DOI 2008:56–58).

3.2.5.4 Threatened and Endangered Species

The burrowing owl, which has nested on the site, is listed as threatened by the Colorado Division of Wildlife. While other threatened or endangered species have the potential to occur at GJDS, none have been observed. It is unlikely that any federally or state-protected species would be found within the proposed mercury storage location (CDNR 2009; DOE 1986:97-99; USFWS 2009a, 2009b). The Gunnison River has been federally designated as critical habitat for the Colorado pikeminnow and the razorback sucker. These species are also listed as threatened and endangered, respectively, by the state of Colorado (CDNR 2009; DOI 2008; USFWS 2009b).

3.2.6 Cultural and Paleontological Resources

Cultural resources at GJDS and all sites are of three categories: (1) prehistoric resources, physical properties reflecting human activities that predate written records; (2) historic resources, physical properties that postdate the advent of written records (in the United States, generally considered to be those documented no earlier than 1492); and (3) American Indian resources, all areas, sites, and materials deemed important for religious or heritage-related reasons, as well as certain natural resources such as plants, which have many uses within various American Indian groups. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geologic age that may be sources of information on paleoenvironments and the evolutionary development of plants and animals.

3.2.6.1 Prehistoric Resources

Evidence of human habitation in the GJDS area goes back to the Paleo-Indian Period (10,000 to 5500 B.C.). Archaeological remains of this period consist mainly of fragmentary or isolated finds of the characteristic spear tips. More-extensive remains of this period have been found elsewhere in North America (DOE 1986:4.11-117).

Evidence of prehistoric resources in the GJDS area dating to the Archaic Period (5500 B.C. to A.D. 500) is quite plentiful. Small and large sites consisting of chipped-stone debris, tools, and open hearths are known (DOE 1986:4.11-117).

Prehistoric resources in the GJDS area dating back to the Formative Period (A.D. 500 to 1200) include remains of pottery, masonry architecture, and drawings on rock faces. The sites of this period that yield masonry structures, ceramics, or cultigens (i.e., plants modified by humans and no longer considered wild) are rare. Recent archaeological investigations have indicated that the transition between the Archaic and Formative Periods was not as definitive as other periods. Recent evidence indicates that the nomadic groups never really disappeared, but rather continued into the next period (DOE 1986:4.11-117).

During the latter part the Protohistoric Period (A.D. 1200 to 1820), Spanish explorers from Santa Fe, New Mexico, entered the GJDS area; however, they left little evidence of their visits. Aboriginal remains from this period are common in the region and include campsites and scatters of artifacts (DOE 1986:4.11-116).

GJDS and the surrounding area contain a high density of potentially significant cultural resources. There are two concentrations of cultural resources in the GJDS area. One occupies a low ridge that cuts diagonally (southwest to northeast) through the area and the other is located to the southeast of the site. The southern concentration has the greater artifact density of the two. The State Historic Preservation Office (SHPO) has determined that four lithic scatters, two sites in each concentration, need more data to determine their eligibility for listing in the National Register of Historic Places (NRHP) (DOE 1986:4.11-117).

3.2.6.2 Historic Resources

European incursions to the GJDS area became more frequent and organized at the beginning of the Historic Period (A.D. 1820 to 1932). Communities like the city of Grand Junction were established during the latter part of the nineteenth century. Railroads and roads were built along the Colorado River in the early years of the twentieth century. The region is known for cycles of mining activity. The mining of coal goes back to the 1880s, while the mining and milling of uranium and vanadium began in the 1920s and 1930s (DOE 1986:4.11-117).

The majority of vicinity properties is younger than 50 years and, therefore, is ineligible for inclusion in the NRHP. To date, no historic properties on the site or in the vicinity have been identified for inclusion in the NRHP (DOE 1986:4.11-117).

3.2.6.3 American Indian Resources

For nearly two decades, beginning in 1863, the GJDS region was a reservation of the Ute Indians. After the Ute Indians left the area, full-scale settlement by European Americans ensued (DOE 1986:4.11-117). There are no American Indian reservations in the Grand Junction area. The nearest Ute Indian reservation is located south of Durango, Colorado, on the Colorado/Arizona border.

3.2.6.4 Paleontological Resources

No paleontological resources have been identified on GJDS.

3.2.7 Site Infrastructure

As used throughout this *Mercury Storage EIS*, “infrastructure” at GJDS and all sites encompasses the condition, capacity, and usage of ground transportation and utilities (electricity, fuel, and water). This section discusses the existing infrastructure at GJDS and in the site vicinity. Additional information on transportation infrastructure is presented in Section 3.2.10.3, and waste management infrastructure is addressed in Section 3.2.8.

In addition to the description provided below, a summary of GJDS’s sitewide infrastructure is presented in Table 3–2.

Table 3–2. Grand Junction Disposal Site Infrastructure Characteristics

Resource	Current Site Usage	Site Capacity
Transportation (kilometers)		
Roads	2.4[a]	2.4[a]
Railroads	none	none
Electricity		
Energy consumption (megawatt-hours per year)	15	109[b]
Fuel		
Natural gas (cubic meters per year)	(c)	(c)
Fuel oil (liters per year)	(c)	(c)
Diesel fuel (liters per year)	(c)	(c)
Gasoline (liters per year)	(c)	(c)
Propane (liters per year)	3,410	(d)
Water (liters per year)	197,000[e]	(d)

a Length of restricted-access road extending east from U.S. Route 50.

b Assumes 1 kilovolt-ampere equals 1 kilowatt (power factor of 1.0).

c Fuel resource not used on site.

d Limited only by the ability to transport resource to the site.

e Includes process and sanitary water usages.

Note: All values based on reported use in 2008. To convert kilometers to miles, multiply by 0.6214; cubic meters to cubic feet, by 35.315; and liters to gallons, by 0.26417.

Source: Baur 2009; Geiser 2009; GJDS 2009:7-8.

3.2.7.1 Ground Transportation

GJDS is located 29 kilometers (18 miles) southeast of the city of Grand Junction, Colorado, and 24 kilometers (15 miles) northwest of Delta, Colorado. Site access is from U.S. Route 50, approximately 2.4 kilometers (1.5 miles) to the west of the site. There is no rail access to the site; however, loading facilities are located 24 kilometers (15 miles) to the southeast in Delta and 29 kilometers (18 miles) to the northwest in the city of Grand Junction (Geiser 2009:1, 4).

3.2.7.2 Electricity

Electricity is supplied to the GJDS area by XCEL Energy and Grand Valley Rural Power. DOE owns the transmissions lines on the site (GJDS 2009:8).

In 2008, annual electricity consumption at the site was 15 megawatt-hours per year with a sitewide capacity of 109 megawatt-hours per year (Baur 2009; GJDS 2009:8).

3.2.7.3 Fuel

Liquid propane is used for heating the operations building at GJDS. Liquid propane gas is delivered to the site via delivery truck and stored on site in a 1,890-liter (500-gallon) tank. No other fuel use was reported for the site (Baur 2009).

Fuel consumption (liquid propane) in 2008 was approximately 3,410 liters (900 gallons) per year (Baur 2009; GJDS 2009:8).

3.2.7.4 Water

Potable water is not provided by public utility; bottled water is used for drinking. Sanitary supply water is delivered to GJDS and stored in a water supply tank with a capacity of 1,890 liters (500 gallons). Sanitary wastewater is stored in a sanitary waste vault with a capacity of 3,790 liters (1,000 gallons). A private service contractor periodically empties the waste vault.

Process water is trucked to the site as needed. The process water supply tank has a capacity of 38,000 liters (10,000 gallons). Process wastewater is contained in an onsite pond for evaporation (Geiser 2009; GJDS 2009).

Sanitary wastewater generation is 7,570 liters (2,000 gallons) per year. Process wastewater generation is up to 189,000 liters (50,000 gallons) per year, depending on operational activities (GJDS 2009:7-8).

Annual sitewide water consumption (including sanitary and process water consumption) was 197,000 liters (52,000 gallons) in 2008 (see Table 3–2).

3.2.8 Waste Management

Waste management at GJDS and all sites includes activities related to the generation, treatment, storage, and/or disposal of site wastes. Managed waste streams may include various forms of waste, as defined under the Resource Conservation and Recovery Act (RCRA) and Toxic Substances Control Act (TSCA), and nonhazardous waste. Waste management activities may be a component of, but are not limited to, routine site operations, facility management, capital improvements, and/or ongoing remediation efforts. Waste minimization activities include various site-specific programs that support efforts to reduce the quantity and toxicity of site wastes, conserve resources and energy, reduce hazardous substance use, and prevent or minimize pollutant releases into the environment.

3.2.8.1 Waste Generation and Management

In compliance with the Uranium Mill Tailings Radiation Control Act (42 U.S.C. 7901 et seq.), GJDS received approximately 3.4 million cubic meters (4.4 million cubic yards) of residual radioactive materials from the Title 1 Grand Junction Processing Site and surrounding properties from 1990 to 1998 (Geiser 2009). These materials are placed within a 732- by 549-meter (2,400- by 1,800-foot) multicomponent permanent isolation disposal cell. A majority of the materials disposed of within the cell are uranium mill tailings and other waste related to uranium ore processing. However, as part of the decommissioning of the Grand Junction Processing Site and surrounding vicinity properties, other materials, including asbestos, were also disposed of within the cell (DOE 2009a:5).

The disposal cell occupies 38 hectares (94 acres) of the 146-hectare (360-acre) GJDS. Operations at GJDS include frequent (weekly) monitoring of the cell, annual inspections, and, every 1 or 2 years, opening the cell for several weeks to receive additional residual radioactive material waste. Onsite security and monitoring activity is performed by DOE’s Office of Legacy Management (DOE 2009a:4).

The 1996 MOU requires DOE to provide meaningful consultation and participation with Mesa County on DOE’s use of the disposal cell. Once the disposal cell is permanently closed, the site will operate under general license (10 CFR 40.27; Geiser 2009). The site currently operates in compliance with applicable Federal and state statutes. No known environmental contamination issues have been identified outside of the disposal cell (DOE 2009b:6-12). Currently, no RCRA-permitted facilities exist on site.

Waste generation at GJDS is minimal. There is a relatively small volume of previously treated hazardous waste within the disposal cell. There is no RCRA-regulated hazardous waste generated or stored at the site (Geiser 2009).

Site-generated nonhazardous solid waste (relatively small volumes) is shipped off site and disposed of at the Mesa County Landfill (DOE 2009b:17). Sanitary wastewater is collected in an underground tank and is periodically emptied using a licensed commercial wastewater disposal company. Potential radiologically contaminated wastewater from the disposal cell is directed to one of two small onsite evaporation ponds. In total, these ponds have a surface area of 0.4 hectares (1.1 acres) and a depth of 1.1 meters (3.5 feet) and are regulated under the Uranium Mill Tailings Act and an interim NRC general license (Desormeau 2009).

3.2.8.2 Waste Minimization

DOE's Office of Legacy Management supports a comprehensive Pollution Prevention Program and Environmental Management System as part of an overall proactive environmental management effort at its Grand Junction, Colorado, facilities (including the Processing Facility and Disposal Site). Waste source reduction and recycling efforts are implemented wherever technically and economically feasible (DOE 2005a:3-8, 3-9).

3.2.9 Occupational and Public Health and Safety

Environmental health risks include the effects of exposures to hazardous chemicals and ionizing radiation. This section discusses current sources of health risk to the public and workers and programs to evaluate potential health impacts. A summary of accident experiences at facilities managing hazardous or radioactive material is also provided.

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media, through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, food). Hazardous chemicals can cause cancer and non-cancer-related health effects (DOE 2009c:3-90).

Noncarcinogenic health effects are expressed in terms of the Hazard Quotient and Hazard Index. The Hazard Quotient is the ratio between the estimated exposure to a toxic chemical and the level of exposure at which adverse health effects can be expected. Hazard Quotients for noncarcinogens are summed to obtain the Hazard Index. If the Hazard Index is less than 1, no adverse health effects are to be expected (DOE 2009c:3-91).

3.2.9.1 Normal Operations

GJDS contains a disposal cell for uranium mill tailings that is designed to isolate the tailings from the human environment. There is no reported contamination outside the cell at the site (Geiser 2009). Risks related to normal radioactive materials transportation to the site are negligible and are associated with shipping uranium mill tailings to the site during several weeks every year or two through year 2023 (DOE 1986:144; GJDS 2009:2.9.2). No current health effect studies have been identified for the area near the site.

3.2.9.2 Facility Accidents

GJDS has not had any spills, fires, explosions, leaks, or other such incidents in the last 5 years (GJDS 2009:2.8.3).

The DOE Office of Legacy Management has established an emergency management system for all the sites for which it is responsible, including GJDS. This plan provides for spill response and responses to natural events and other emergencies. The site relies on offsite fire and emergency services and emergency response teams (Stoller 2009:I-1).

3.2.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to GJDS and employee traffic. These include death or injury from accidental release of nonradioactive and radioactive materials, effects of air pollutants and low levels of radiation emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of nonradioactive or radioactive materials. Risks related to nonradioactive material transportation to GJDS have not been quantified.

3.2.10 Socioeconomics

Socioeconomic variables at GJDS and all sites are associated with community growth and development within the GJDS ROI that could potentially be affected, directly or indirectly, by project-related changes. Included are economic characteristics, the region's demography, housing, and local transportation.

GJDS is located approximately 29 kilometers (18 miles) southeast of the city of Grand Junction, Colorado. The majority of people employed in this area are assumed to reside in Mesa County due to the local employment dynamics compiled by the U.S. Census Bureau (DOC 2009a). Therefore, Mesa County has been identified as the ROI in this socioeconomics analysis. When receiving uranium mill tailings, the disposal site employs seven people (GJDS 2009).

3.2.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of Mesa County increased by approximately 39 percent to 82,111. By July 2009, the unemployment rate for the county was 9.1 percent, which was higher than the unemployment rate for Colorado (7.7 percent) (BLS 2009).

3.2.10.2 Demographic and Housing Characteristics

In 2008, the estimated population of Mesa County was 143,171. From 2000 to 2008, the population of the county grew by 23 percent, compared with 15 percent growth in Colorado (DOC 2009b). The percentage of the population within the county under the age of 18 was 23 percent; women ages 18 to 39 composed 15 percent (DOC 2009c). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. There were 58,666 housing units in the county in 2007 (DOC 2008), 67 percent of which were owner occupied, 27 percent were renter occupied, and 6.5 percent were vacant (DOC 2009c).

3.2.10.3 Local Transportation

The main transportation corridor to GJDS is U.S. Route 50. The average traffic volume for the segment of this highway accessible to the disposal site was 10,600 vehicles per day in 2008 (CDOT 2009). The Union Pacific Railroad company operates what was once the Montrose Branch of the Denver and Rio Grande Western Railroad along the Colorado River. This branch runs through Whitewater, Colorado, up to the main line in the city of Grand Junction. The nearest railroad loading facility would be in either Delta, 24 kilometers (15 miles) southeast of the site, or the city of Grand Junction, 29 kilometers (18 miles) northwest of the site (Geiser 2009:1, 4). The closest airport to GJDS is the Grand Junction Regional Airport, located on the northern fringe of the city of Grand Junction.

3.2.11 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing any disproportionately high and adverse impacts on minority and low-income populations. Minority persons are those who identify themselves as American Indian or Alaska Native, Asian, Black or African American, Hispanic or Latino (of any race), Native Hawaiian or other Pacific Islander, or multiracial (CEQ 1997). Persons who report that their income is less than the Federal poverty threshold are designated as low-income.

A 16-kilometer (10-mile) radius was chosen as the ROI for this analysis to provide a reasonable estimate of the potentially affected population surrounding the facility. This ROI is conservative because any adverse human health consequences to offsite populations resulting from normal operations and facility accidents would be limited to a distance of well under 1.6 kilometers (1 mile), as discussed in Chapter 4, Sections 4.3.9.1 and 4.3.9.2.

The 16-kilometer (10-mile) radius surrounding the storage location at GJDS encompasses parts of two counties in Colorado: Mesa and Delta. Figure 3–1 shows populations residing in the two-county area, as reported in the 1990 and 2000 censuses (DOC 2009d; 2009e). In this figure, lightly shaded bars show populations in 1990, while the darker bars show those in 2000. In the decade between 1990 and 2000, the total population of Mesa and Delta Counties increased by approximately 26 percent to 144,089; the minority population increased by approximately 69 percent to 19,034; and the low-income population decreased 14 percent to 14,923. Demographic data from the 2000 census show that the population self-identified as "some other race" (meaning those who provided write-in entries such as Mexican, Puerto Rican, or Cuban) residing in the two-county area accounted for approximately 29 percent of the county's total minority population. Persons who declared that they are of Hispanic or Latino origin are included in the "total Hispanic" population shown in Figure 3–1, regardless of race. They made up approximately 78 percent of the total minority population residing in Mesa and Delta Counties in 2000.

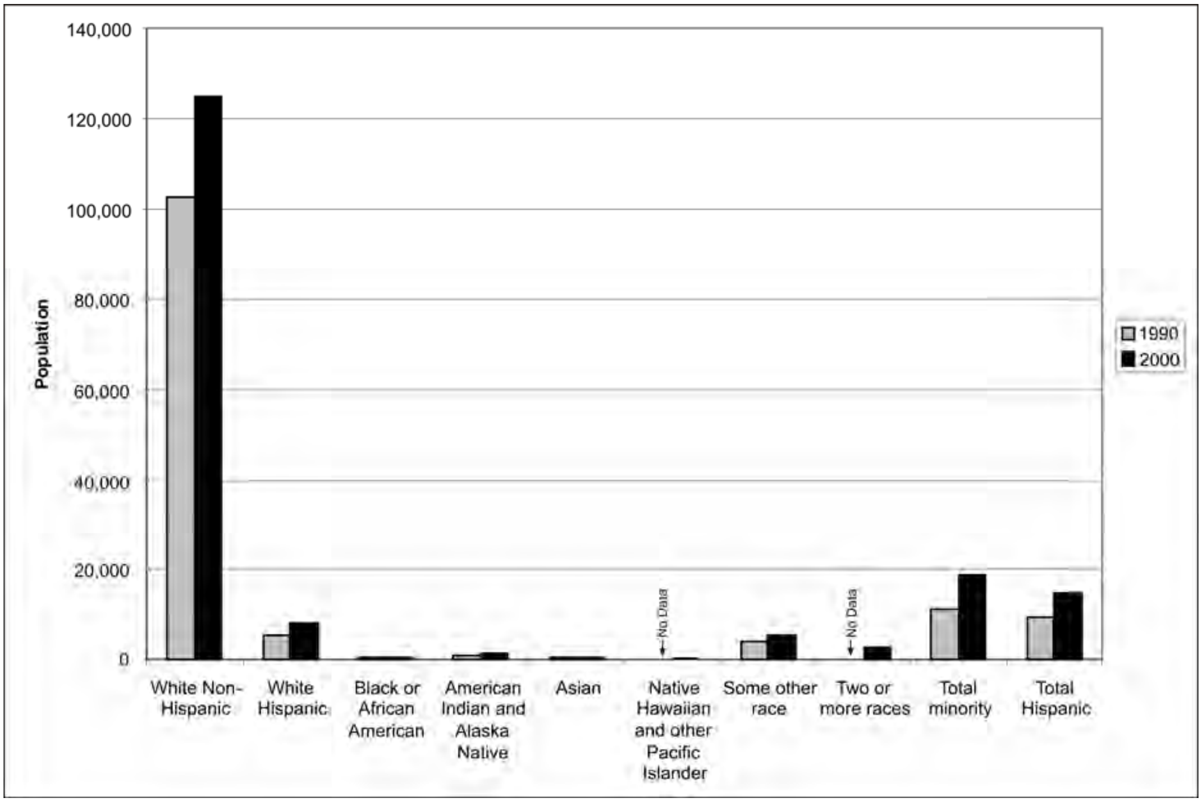


Figure 3–1. Populations Residing in the Two-County Area Surrounding the Grand Junction Disposal Site in 1990 and 2000

The 2000 census was the first decennial census in which multiracial selections were counted; thus there are no data for this category available from the 1990 census. Also, during the 1990 census, Asian and Pacific Islander designations were placed together in a single category, whereas during the 2000 census, Native Hawaiians and other Pacific Islanders were counted separately from Asian respondents. Therefore, direct comparison of 1990 and 2000 census data for these two categories is not possible.

Data for Delta County from the *2007 American Community Survey (ACS) 1-Year Estimates* are unavailable due to a population threshold of 65,000 people. According to the *2005–2007 ACS 3-Year Estimates*, the total population of the two-county ROI increased by approximately 14 percent since 2000 to 164,182. During this same period, the low-income population increased by 44 percent to 21,515 (DOC 2009c). Detailed demographic data of race and Hispanic origin for Delta County from the *2005–2007 ACS 3-Year Estimates* are unavailable due to an insufficient number of sample cases. However, the Census Bureau does report detailed demographic statistics for Mesa County in the *2007*

ACS 1-Year Estimates. From 2000 to 2007, the population of Mesa County increased by approximately 20 percent to 139,082. During this time, the total minority population increased by 38 percent, and the low-income population increased by 44 percent (DOC 2009d, 2009f). In 2007, minority individuals accounted for approximately 13 percent of the population. The largest minority group in 2007 comprised those self-identified as White Hispanic, accounting for 32 percent of the minority population (DOC 2009f).

Approximately 2,119 people lived within 16 kilometers (10 miles) of GJDS in 2000 (DOC 2009d). This area included an estimated 15 percent minority and 11 percent low-income population, and Colorado included a 26 percent minority and 9 percent low-income population. By comparison, Mesa and Delta Counties included a 13 percent minority and 11 percent low-income population. There are five census block groups located within the 16-kilometer (10-mile) radius surrounding GJDS, none of which contained a disproportionately high percentage of minority or low-income individuals. Figure 3–2, shows the cumulative populations living at a given distance from the site. The population living within 16 kilometers (10 miles) of GJDS is mostly concentrated in the town of Whitewater. Approximately 138 people lived within approximately 3.2 kilometers (2 miles) of GJDS in 2000 (DOC 2009d). This area included an estimated 13 percent minority and 12 percent low-income population. There is only one census block group located within this ROI, and it does not contain a disproportionately high percentage of minority or low-income individuals.

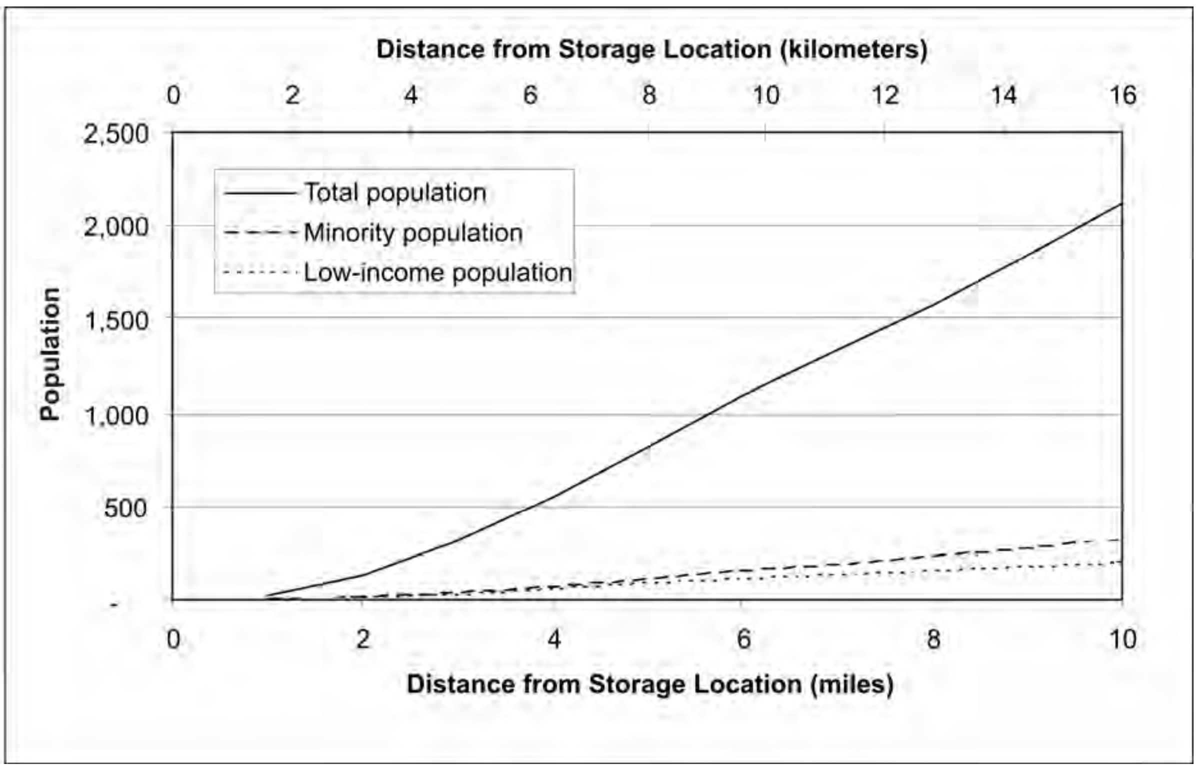


Figure 3–2. Cumulative Populations Residing Within 16 Kilometers (10 Miles) of the Grand Junction Disposal Site

3.3 HANFORD SITE

3.3.1 Land Use and Visual Resources

3.3.1.1 Land Use

Hanford occupies approximately 151,775 hectares (375,040 acres) in Washington State, just north of Richland (Duncan 2007:4.1). The site extends over parts of Adams, Benton, Franklin, and Grant Counties (see Figure 3–3). Hanford is owned and used primarily by DOE, but portions of it are owned, leased, or administered by other Government agencies and private entities. Public access to the site is limited to travel on the Route 4 and Route 10 access roads as far as the Wye Barricade, State Routes 24 and 240, and the Columbia River. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly vacant land with widely scattered facilities (Neitzel 2005:4.144). Figure 3–3 shows the generalized land use at Hanford as developed in the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement (Hanford Comprehensive Land-Use Plan EIS)* (DOE 1999a) and modified by the designation of the Hanford Reach National Monument (65 FR 37253).

In 1977 DOE designated Hanford as a National Environmental Research Park, an outdoor laboratory for ecological research to study the environmental effects of energy development and aquatic environments (DOE 2000:3-91; Vaughan and Rickard 1977:1, 2).

Land use designations based on the *Hanford Comprehensive Land-Use Plan EIS* include Preservation, Conservation (Mining), Recreation, Industrial, Industrial-Exclusive, and Research and Development (see Figure 3–3). Preservation and Conservation (Mining) are the predominant land uses at Hanford. The 200 Areas, which are located in the center of Hanford and include the 200-East and 200-West Areas, are classified as Industrial-Exclusive. Industrial areas include an area to the east of the 200 Areas and most of the southeast corner of the site, including the 400 Area.

Important areas within the Preservation land use designation include the Hanford Reach National Monument, which incorporates a portion of the Columbia River corridor as well as the Fitzner-Eberhardt Arid Lands Ecology Reserve to the south and west and portions of Hanford north of the Columbia River, including the Saddle Mountain National Wildlife Refuge (65 FR 37253). Other special status lands in the vicinity of Hanford include the McNary National Wildlife Refuge, which is administered by the USFWS, as well as the Columbia River Islands Area of Critical Environmental Concern and McCoy Canyon, both of which are administered by the BLM (DOE 2000:3-91).

The Tri-Cities area southeast of Hanford includes residential, commercial, and industrial land uses. This area, which encompasses the cities of Richland, Kennewick, and Pasco, is the population center closest to Hanford. West Richland and Benton City, two somewhat smaller population centers, are located south of the site. Agriculture is a major land use in the remaining areas surrounding Hanford.

200 AREAS

The 200 Areas are located within a 5,064-hectare (12,513-acre) area of the Central Plateau of Hanford designated as Industrial-Exclusive (see Figure 3–3). The Industrial-Exclusive designation preserves DOE control of continuing remediation activities and use of the existing compatible infrastructure required to support activities such as dangerous, radioactive, and mixed waste treatment, storage, and disposal. The Industrial-Exclusive designation also allows for the expansion of existing facilities and the development of new compatible facilities in support of ongoing missions.

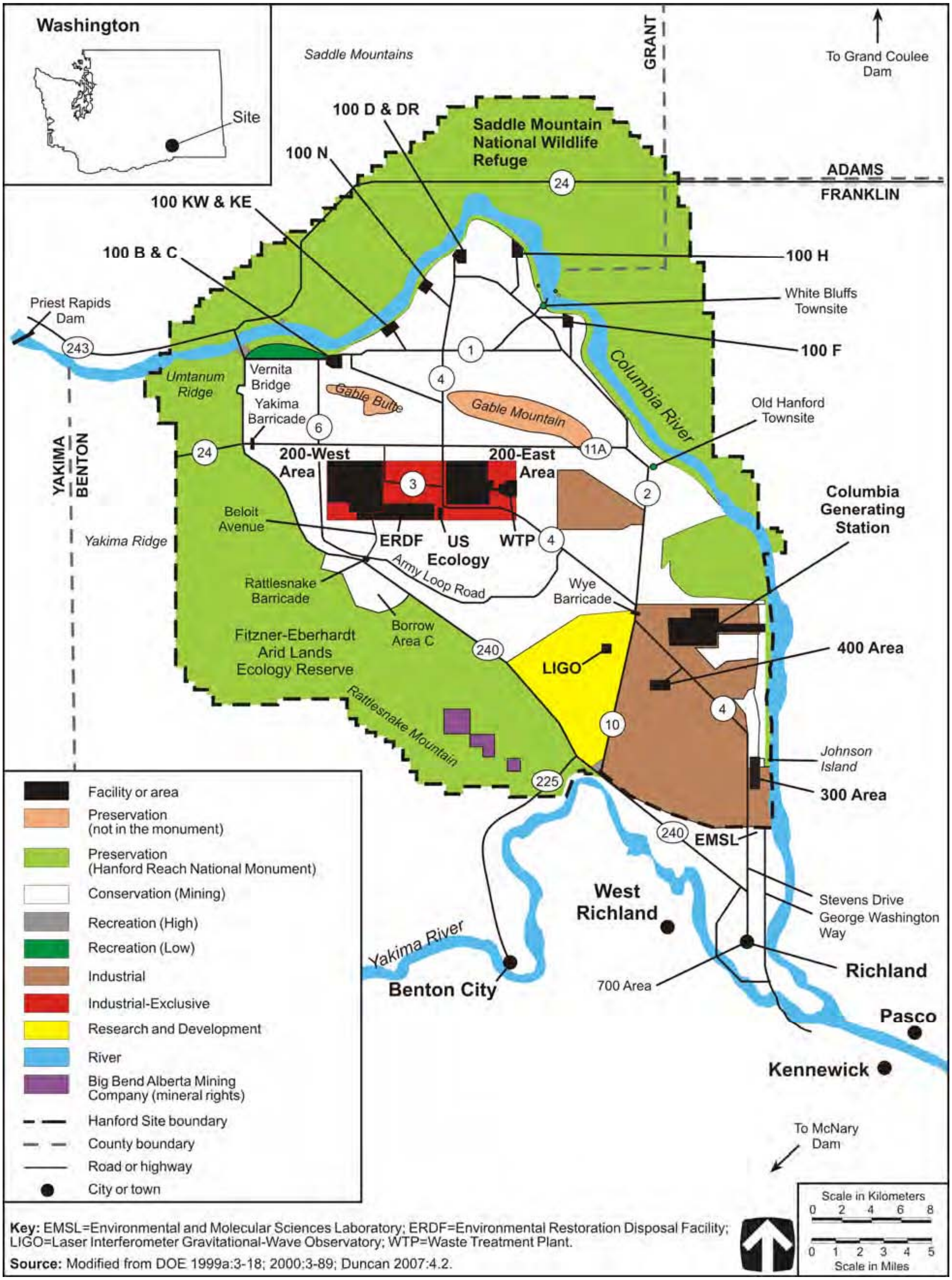


Figure 3–3. Generalized Land Use at the Hanford Site and Vicinity

3.3.1.2 Visual Resources

The land in the vicinity of Hanford ranges from generally flat to gently rolling. Rattlesnake Mountain, rising to 1,060 meters (3,480 feet) above mean sea level, forms the southwestern boundary of the site. Gable Mountain and Gable Butte are the highest landforms within the site, rising to heights of 329 meters (1,081 feet) and 238 meters (782 feet), respectively. The Columbia River flows through the northern part of the site, and turning south, it forms part of the eastern site boundary. White Bluffs, steep whitish-brown bluffs adjacent to the river, are a striking feature of the landscape (DOE 2000:3-93).

Typical of the regional shrub-steppe desert, the site is dominated by widely spaced, low-brush grasslands. A large area of nonvegetated, stabilized sand dunes extends along the east boundary, and nonvegetated blowouts are scattered throughout the site. Hanford is characterized by mostly undeveloped land, with widely spaced clusters of industrial buildings along the southern and western banks of the Columbia River and at several interior locations (DOE 2000:3-93).

The landscape adjacent to Hanford consists primarily of rural rangeland and farms. Hanford facilities can be seen from elevated locations such as Gable Mountain, Gable Butte, Rattlesnake Mountain, and other parts of the Rattlesnake Hills along the western perimeter. Site facilities also are visible from State Routes 240 and 24 and the Columbia River. Because of terrain features, distances involved, the size of Hanford, and the size of individual structures, not all facilities are visible from the highways or the Columbia River (DOE and Ecology 1996:4-60).

Developed areas are consistent with a BLM VRM Class IV rating, and, for the remainder of Hanford, VRM ratings range from Class II to Class III (DOI 1986:6, 7). Management activities within Class II and III areas may be seen but should not dominate the view; those in Class IV areas dominate the view and typically are the focus of viewer attention.

200 AREAS

The tallest structure within the 200 Areas is the meteorological tower, with a height of 124 meters (408 feet) (Duncan 2007:4.8). Additionally, a number of stacks are around 61 meters (200 feet) in height. Aboveground structures throughout the 200 Areas are visible from segments of State Route 240 and elevated locations such as Gable Mountain, Gable Butte, and Rattlesnake Mountain. They are not visible from the Columbia River. Because the 200-East and 200-West Areas are highly developed industrial areas, they have a VRM Class IV rating. Natural features of visual interest within the vicinity of the 200 Areas include Gable Butte, 6.9 kilometers (4.3 miles) to the northwest; Gable Mountain, 8 kilometers (5 miles) to the northeast; Rattlesnake Mountain, 14 kilometers (8.7 miles) to the south; and the Columbia River, as close as 10 kilometers (6.2 miles) to the northwest.

3.3.2 Geology, Soils, and Geologic Hazards

3.3.2.1 Geology

Hanford lies within the Columbia Basin, which comprises the northern part of the Columbia Plateau physiographic province and the Columbia River flood-basalt geologic province (Duncan 2007:4.25; Reidel et al. 1993:1, 2). Within this region, Hanford lies within the Pasco Basin, a structural and topographic depression of generally lower-relief plains and anticlinal ridges (Duncan 2007:4.25, 4.26). Elevations across the basin floor at Hanford range from about 119 meters (390 feet) above mean sea level at the Columbia River to 229 meters (750 feet) above mean sea level across the 200 Areas. Rattlesnake Mountain (see Figure 3–3), the highest of the Rattlesnake Hills, reaches an elevation of 1,050 meters (3,447 feet) above mean sea level, the highest elevation in the area (DOE 1999a:4.12, 4.13; Duncan 2007:4.25, 4.26, 4.29, 4.159).

Mapped faults in the Hanford area include reverse or thrust faults on the north side of the Saddle Mountains on the northern Hanford boundary and in association with Rattlesnake Mountain and the Rattlesnake Hills in the southwestern portion of the site (Duncan 2007:4.35, 4.37). Other faults include the Cold Creek Fault, on the west end of the Cold Creek syncline, and the May Junction Fault, located nearly 4.8 kilometers (3 miles) east of the 200-East Area. Moreover, a potential for Quaternary-age (Holocene) faulting has been identified on the Gable Butte–Gable Mountain Segment of the Umtanum Ridge–Gable Mountain anticline—specifically, on Gable Mountain where the Central Gable Mountain Fault has offset sediments 13,000 years old (Reidel et al. 1993:12–14).

The major geologic units immediately underlying Hanford are, in descending order, (1) the Hanford formation, Cold Creek Unit, and the Ringold Formation, collectively known as the suprabasalt sediments; and (2) the Columbia River Basalt Group and interbedded Ellensburg Formation. The unit informally called the Hanford formation is composed of unconsolidated sediments with sizes ranging from boulder-size gravel to sand and silt deposits of up to 100 meters (330 feet) thick, which are products of Ice-Age floods that inundated the Pasco Basin and Hanford during the Pleistocene epoch (DOE 2002a:3-9; Duncan 2007:4.33, 4.39). Locally, surficial Quaternary-age (Holocene) deposits (gravel, sand, and silt) with a total thickness of generally less than 5 meters (16 feet) immediately overlie the Hanford formation and span much of Hanford. Eolian (wind-deposited) deposits of fine-grained sand and silt also occur, particularly in the southern part of the 200-East Area and in the 200-West Area (Hartman 2000:3.4).

The Cold Creek Unit includes alluvial and eolian sediments, as well as a series of extensively weathered, carbonate-rich, buried soil profiles (paleosols) (DOE 2002a:3-1, 3-2). Materials comprising the Ringold Formation consist of a mix of variably cemented gravel, sand, silt, and clay deposited by the ancestral Columbia River system (Duncan 2007:4.31; Hartman 2000:32). The Ringold Formation at Hanford is as much as 185 meters (600 feet) thick (Reidel et al. 1993:3).

The Columbia River Basalt Group consists of sequences of Miocene-age continental flood basalts that cover an extensive area across Washington, Oregon, and Idaho. These basalts erupted over a period ranging from approximately 6 million to 17 million years ago. Beneath Hanford is a minimum of 50 basalt flows with a combined thickness greater than 3,000 meters (9,800 feet). Basalt outcrops are exposed on ridges at Gable Mountain, Gable Butte, and the Saddle Mountains in the northern part of Hanford, and on Rattlesnake Hills and Yakima Ridge on the western and southwestern edges of the site. The basalts are interbedded with, and in some places overlain by, volcaniclastic (volcanic-sedimentary) and fluvial (stream-deposited) materials of the Ellensburg Formation (Duncan 2007:4.29; Reidel et al. 1993:2).

Geologic resources, including relatively large volumes of gravel, sand, and silt, are available from the suprabasalt sediments and associated soils at Hanford. Basalt is also plentiful. A number of active gravel and sand pits and two rock quarries at Hanford (such as Borrow Area C) have been identified for use, or are currently used, as a continuing source of borrow materials for new facility construction and the maintenance of existing facilities and transportation corridors, as well as fill and capping material for remediation and other sites (DOE 1999a:D–7, 2001a:2-2, 3-1–3-4). As for other geologic resources on the site, placer gold was historically extracted along the Columbia River on and near Hanford, and small volumes of natural gas were produced from wells developed on Rattlesnake Mountain from about 1929 to 1941 (DOE 1999a:4-18).

3.3.2.2 Soils

Fifteen different soil types occur at Hanford. These soils vary from sand to silty and sandy loam. The dominant soil types are Quincy (Rupert) sand, Burbank loamy sand, Ephrata sandy loam, and Warden Silt loam (Duncan 2007:4.39, 4.40). No soils at Hanford are currently classified as prime farmland soils because there are no current soil surveys, and the only prime farmland soils in the region are irrigated

(DOE 1999a:4-23, 4-24). The parent material for the predominant soil types at Hanford includes Hanford formation and Holocene-age surficial deposits, as discussed in Section 3.3.2.1. Quincy (Rupert) sand is the most widespread soil type at Hanford and makes up much of the southeast and east-central portions of the site. However, it is also found across portions of the 200-East Area and the majority of the western portion of the 200-West Area. It developed from sandy alluvial deposits mantled by windblown sand. The soils are deep to moderately deep—51 to 76 centimeters (20 to 30 inches) (DOE 1999a:4-23–4-27; Duncan 2007:4.40–4.42).

3.3.2.3 Geologic Hazards

The seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the magnitude of these events, is lower than that of other regions in the Pacific Northwest. Nevertheless, Hanford has been affected by earthquakes within and beyond the Columbia Plateau. The largest known earthquake in the Columbia Plateau occurred in 1936 near Milton-Freewater, Oregon. This moderate earthquake had a magnitude of 5.75 and a maximum MMI of VII, and it featured a number of aftershocks (Duncan 2007:4.43). Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects. Other moderate-to-major earthquakes with magnitudes greater than 5 or MMIs of VI have occurred along the boundaries of the Columbia Plateau northwest of Hanford and extending into the northern Cascade Range. A strong-to-major earthquake occurred in north-central Washington in 1872. This event had an estimated magnitude of 7.4 and an estimated maximum MMI ranging from VIII to IX (Duncan 2007:4.43; USGS 2009e). Evidence of landslides near Lake Chelan, Washington, suggests an epicenter near there. A more-recent review of this event indicates a magnitude of 6.8, a maximum MMI of VIII, and a location at the south end of Lake Chelan (Duncan 2007:4.43). Near Lake Chelan, huge landslides, massive fissures in the ground, and a 9-meter-high (29-foot-high) geyser were reported. Shaking-intensity maps produced for the event indicate that MMI VI shaking extended southeast across the Columbia Plateau and beyond Hanford (USGS 2009e). The two largest earthquakes near Hanford occurred in 1918 and 1973; each had an approximate magnitude of 4.4 and an MMI of V. They occurred in the central portion of the Columbia Plateau north of Hanford near Othello, Washington (Duncan 2007:4.43).

The Saddle Mountains region in which the December 20, 1973, Othello earthquake occurred is one of the most active earthquake areas in eastern Washington; earthquakes there tend to occur in clusters or "swarms" (i.e., the earthquakes are concentrated in an area and occur in a series over a short period of time) (Noson, Qamar, and Thorsen 1988). Earthquake swarms have also occurred in several locations within Hanford. Deeper earthquakes in the central Columbia Plateau occur up to depths of about 30 kilometers (18.6 miles). These deeper earthquakes are less clustered and generally occur as isolated events. Survey data indicate that the shallow earthquake swarms are occurring in the Columbia River basalts and the deeper earthquakes in deeper, crustal layers (Duncan 2007:4.43, 4.45). A total 118 small earthquakes (ranging in magnitude from 2.5 to 4.3) have been recorded within a radius of 100 kilometers (62 miles) of the Central Plateau of Hanford (200 Areas) since the December 1973 earthquake. The closest of these was a magnitude-3.3 event on November 13, 1994; it had an epicenter about 8 kilometers (5 miles) north of the 200 Areas (USGS 2009f).

As part of the operating license review for Energy Northwest, NRC has estimated a maximum earthquake magnitude of 6.5 for the Rattlesnake-Wallula alignment and a 5.0 event for Gable Mountain (Duncan 2007:4.45, 4.46). Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity). As previously described in Section 3.2.2.3, the latest probabilistic PGA data from the USGS are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For a Hanford central location (i.e., centered on the 200 Areas), the calculated PGA is approximately 0.18 *g* (USGS 2009d). Probabilistic seismic hazard analyses are used to determine ground motions expected from multiple earthquake sources, which are then used to design or evaluate facilities at

Hanford and other sites. On the basis of the most recent site-specific seismic analyses, it is estimated that an earthquake producing a horizontal (ground) acceleration of 0.10 *g* at Hanford would be experienced on average every 500 years (annual probability of occurrence of 1 in 500). An earthquake producing a peak horizontal (ground) acceleration of up to 0.2 *g* is calculated to have an annual probability of occurrence of 1 in 2,500, which is in approximate agreement with the latest USGS seismic hazard estimates (Duncan 2007:4.46).

Several major volcanoes are in the Cascade Range west of Hanford, including Mount Adams and Mount St. Helens, 164 kilometers (102 miles) and 220 kilometers (137 miles), respectively, from the site. Ashfalls from at least three Cascade volcanoes have blanketed the central Columbia Plateau since the late Pleistocene epoch. Generally, ashfall layers have not exceeded more than a few centimeters (less than 1.5 inches) in thickness, with the exception of the Mount Mazama (Crater Lake, Oregon) eruption, when as much as 10 centimeters (3.9 inches) of ash fell over eastern Washington (DOE 2000:3-116).

200 AREAS

The Central Gable Mountain Fault is the nearest potentially active fault to the 200 Areas; it is 4 kilometers (2.5 miles) northeast of the 200-East Area and more than 8 kilometers (5 miles) from the 200-West Area. The 200-West Area has one of the most complete suprabasalt stratigraphic sections at Hanford, including the Cold Creek Unit, with a stratigraphic thickness of up to 168 meters (550 feet) (Hartman 2000:3.11). Gravel-dominated sediments make up most of the Hanford formation in the northern part of the 200-East Area and across the 200-West Area. Beneath the 200-West Area, the Cold Creek Unit overlies the tilted and eroded Ringold Formation where both the lower and upper portions of the unit have been identified. The Lower Cold Creek Unit mainly consists of basaltic to quartzitic gravels, sands, silt, and clay that are cemented with one or more layers of calcium carbonate and other assemblages. The Upper Cold Creek Unit primarily consists of a distinctive silt-rich interval representing eolian deposits in the 200-West Area (Duncan 2007:4.38, 4.39).

The Ringold Lower Mud Unit is present under much of Hanford and is a nearly continuous feature beneath the 200-West Area and the southern half of the 200-East Area. The Lower Mud Unit consists primarily of lake bed silt and clay deposits, with at least one well-developed paleosol at the top of the sequence in the 200-West Area. Where present, the Lower Mud Unit forms the base of the unconfined aquifer at Hanford and acts as an aquitard, separating groundwater in the underlying Ringold Unit A from the unconfined aquifer (Duncan 2007:4.31, 4.38). As described in Section 3.3.2.2, the predominant soil types across the 200 Areas developed from surficial sediments are Quincy (Rupert) sand and Burbank loamy sand.

3.3.3 Water Resources

3.3.3.1 Surface Water

Major surface-water features at Hanford include the Columbia River; Columbia riverbank seepage; springs; and ponds, including those constructed for effluent management (see Figure 3–4). In addition, the Yakima River flows along a short section of the southern boundary of the site. The Columbia River is the second-largest river in the contiguous United States in terms of total flow and is the dominant surface-water feature on the site. Flow of the Columbia River is regulated by several dams including seven upstream and four downstream from the site. The nearest dam upstream from Hanford is the Priest Rapids Dam, and the nearest one downstream is the McNary Dam (Duncan 2007:4.49).

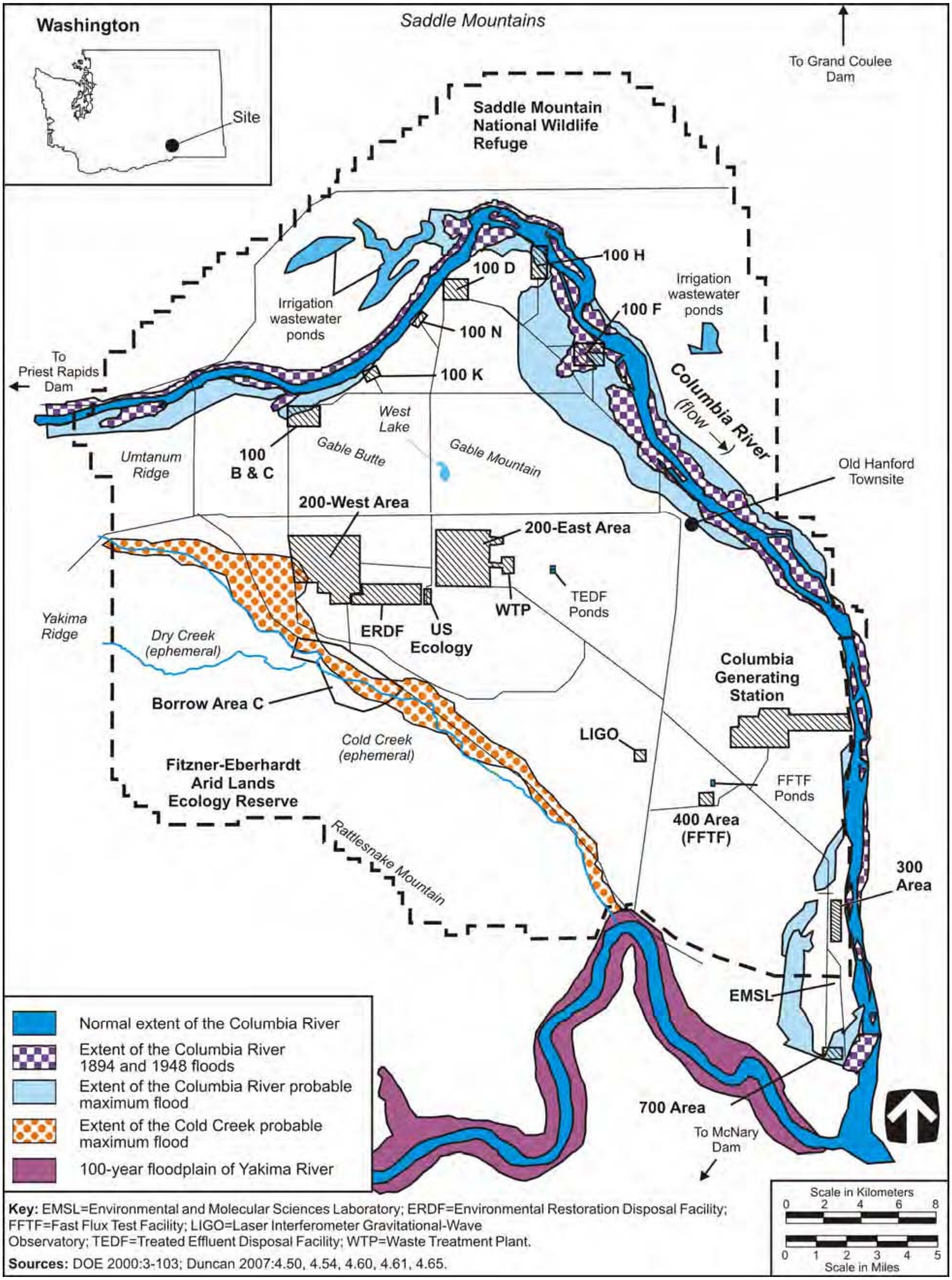


Figure 3–4. Surface-Water Features and Floodplains on the Hanford Site

The 82-kilometer (51-mile) Hanford Reach, which is the last free-flowing, nontidal section of the river in the United States, extends from the Priest Rapids Dam to the upstream edge of Lake Wallula behind the McNary Dam. Because the flows are regulated by the Priest Rapids Dam, flow rates in the Hanford Reach can vary considerably. Mean annual Columbia River flow near the Priest Rapids Dam over the 90-year period of record averaged nearly 3,330 cubic meters (117,600 cubic feet) per second (Duncan 2007:4.49, 4.51). In 2007, the Columbia River had normal flows; the average daily flow rate downstream of Priest Rapids Dam was 3,300 cubic meters (116,500 cubic feet) per second (Poston, Duncan, and Dirkes 2008:10.29). As a result of daily fluctuations in discharges from the Priest Rapids Dam, the depth of the river varies widely over a short time period, with stage changes of up to 3 meters (10 feet) during a 24-hour period along the Hanford Reach. The width of the river varies from approximately 300 to 1,000 meters (1,000 to 3,300 feet) along the Hanford Reach (Duncan 2007:4.51; Poston, Duncan, and Dirkes 2008:10.29, 10.31).

Primary uses of the Columbia River include hydroelectric power generation, irrigation of crops in the Columbia Basin, and materials transport by barge. The Hanford Reach is the upstream navigable limit of barge traffic. Barges are used to transport reactor vessels from decommissioned nuclear vessels to Hanford for disposal. The Columbia River is also used extensively for recreation, including fishing, hunting, boating, sailboarding, water skiing, diving, and swimming. In addition to its use as a water supply source for Hanford, the river is a source of drinking water for several communities (Duncan 2007:4.52). Further, the Washington State Department of Ecology has designated that segment of the Columbia River, extending from the Grand Coulee Dam to the Washington–Oregon border and encompassing the Hanford Reach, for the following uses: salmon and trout spawning and rearing; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting, commerce and navigation; boating; and aesthetic values (WAC 173-201A). DOE continues to assert a federally reserved water withdrawal right for the Columbia River (DOE 1999a:4-49, 4-50). Water use is further discussed in Section 3.3.7.4.

No federally designated wild and scenic rivers exist in the Hanford vicinity. In 1996, the National Park Service proposed designation of the Hanford Reach as a "recreational river" under the National Wild and Scenic Rivers System as part of broader resource conservation initiatives (DOE 1999a:4-5). The Hanford Reach was proclaimed a National Monument in 2000. Creation of the National Monument did not convey with it full protection of the river's eligibility as a wild and scenic river. Section 404 of the Omnibus Parks and Public Lands Management Act of 1996 (P.L. 104-333) amended the original study legislation (P.L. 100-605) to mandate that no Federal agency may construct any dam, channel, or navigation project. Under the Wild and Scenic Rivers Act (16 U.S.C. 1271 et seq.) and U.S. Department of the Interior practices, USFWS manages the river as if it were a wild and scenic river and will take no actions that would change its status. This protection only partially extends to other Federal agencies. Those agencies are obliged to take all reasonable care to protect the river's free flow and "outstandingly remarkable resources," as defined by the Wild and Scenic Rivers Act, but they are not obliged to forego projects if no reasonable alternative exists (USFWS 2008:3-2012).

Flooding of the site has occurred along the Columbia River, but the likelihood of a recurrence of large-scale flooding has been greatly reduced by the upstream construction of several flood control/water storage dams. Major floods are typically due to melting of the winter snowpack combined with above-normal precipitation. No maps of flood-prone areas have been produced by the Federal Emergency Management Agency because maps are produced only for areas that could be developed and are not under Federal control. However, analyses have been completed to determine the potential for the probable maximum flood. The probable maximum flood for the Columbia River below the Priest Rapids Dam has been calculated at 40,000 cubic meters (1.4 million cubic feet) per second, which is greater than the 500-year flood (DOE 1999a:4-34; Duncan 2007:4.58). The extents of the 1894 and 1948 floods and of the probable maximum flood are shown in Figure 3–4.

Springs occur in the western portion of the site and flow into intermittent streams that infiltrate rapidly into the surface sediments. Water discharged from Rattlesnake Springs flows down Dry Creek, a tributary to Cold Creek, for about 3 kilometers (1.9 miles) before infiltrating into the ground. The seepage of groundwater into the Columbia River along the Hanford Reach has been documented long before Hanford operations began. Seepage flows are rather small and intermittent, influenced primarily by changes in the river level. Contaminants originating at Hanford have been documented in some of these discharges along the Hanford Reach (DOE 1999a:4-29–4-32; Duncan 2007:4.55, 4:56).

Other naturally occurring surface-water features at Hanford include West Lake and, in three clusters, approximately 20 vernal ponds or pools. The clusters are located on the eastern end of Umtanum Ridge, in the central part of Gable Butte, and at the eastern end of Gable Mountain. The ponds appear to form during the wetter winter periods in shallow depressions underlain by a layer of basalt (DOE 1999a:4-31, 4-32; Duncan 2007:4.64). In addition, there are irrigation ponds and wetlands in the northwest portion of the site and north of the Columbia River (Duncan 2007:4.50, 4.73).

Hanford has one EPA-issued National Pollutant Discharge Elimination System (NPDES) Permit—No. WA-002591-7. This permit covered three active outfalls: outfall 001 for the 300 Area Treated Effluent Disposal Facility and outfalls 003 and 004 in the 100-K Area. The site continues to be covered by the EPA NPDES Storm Water Multi-Sector General Permit No. WAR05A57F, which establishes the terms and conditions under which stormwater discharges associated with industrial activity are authorized. Facilities such as the 200 Area Treated Effluent Disposal Facility Ponds, Effluent Treatment Facility and Liquid Effluent Retention Facility in the 200-East Area, the Fast Flux Test Facility Ponds, the 100-N Area sewage lagoon, and consolidated industrial activities are covered by state waste discharge permits issued by the Washington State Department of Ecology rather than NPDES permits. State-issued NPDES general permits for mining activities are also in place. Numerous sanitary waste discharges to the ground from sanitary systems serving the 100 and 200 Areas are permitted by the Washington State Department of Health. Sanitary wastewater from the 400 Area is discharged to a treatment facility at Energy Northwest's Columbia Generating Station (Poston, Duncan, and Dirkes 2008:5.13, D.2).

Hanford's Surface Environmental Surveillance Project is responsible for measuring the concentrations of radiological and nonradiological contaminants in environmental media on site and off site at perimeter, community, and distant locations and for determining the potential effects of these materials on the environment and the public. This includes routine sampling and analysis of surface water and sediment, as well as water and sediment from Columbia River shoreline springs, for radionuclides and chemicals, including metals, organics, and anions. As in past years, small amounts of radioactive materials were detected downriver from Hanford. However, all individual radiological contaminant concentrations measured in Columbia River water during 2007 were less than 4 percent of the applicable DOE-derived concentration guideline levels (DOE Order 5400.5) for ingested water and well below Washington State ambient surface-water-quality criteria. The concentrations of metals and anions observed in river water during 2007 were similar to those observed in the past and remain below regulatory limits. During 2007, there was no indication of any deterioration of Columbia River water or sediment quality resulting from operations at Hanford (Poston, Duncan, and Dirkes 2008:xv–xvii, 10.4, 10.34, 10.38).

200 AREAS

The 200 Areas are located in the Central Plateau of Hanford approximately 10 kilometers (6.2 miles) southeast of the Columbia River. Neither the 200-East nor 200-West Area lies within the probable maximum flood area of the Columbia or Yakima River (see Figure 3–4). However, the southwest corner of the 200-West Area is within the probable maximum flood area of Cold Creek. This portion of the 200-West Area has limited development at present. West Lake, located north of the 200-East Area, is a natural feature recharged from groundwater. The lake has not received direct effluent discharges from Hanford facilities; rather, its existence is attributable to the intersection of the elevated water table with the land surface in the topographically low area. The water level and size of the lake have been decreasing over the past several years because of reduced wastewater discharge (Duncan 2007:4.64). Water for the 200 Areas is provided by the 283-W Water Treatment Plant. The water source for this filtration and chlorination plant is the Columbia River (see Section 3.3.7.4).

3.3.3.2 Groundwater

Beneath the vadose zone, groundwater under Hanford occurs in confined and unconfined aquifer systems. The unconfined aquifer system, also referred to as the "suprabasalt aquifer system" or "Hanford/Ringold aquifer system," lies within the sands and gravels of the Hanford formation and, to a greater degree, the sediments of the Ringold Formation, as previously described in Section 3.3.2.1. Portions of the suprabasalt aquifer system are locally confined because major sand and gravel units of the Ringold Formation are separated by fine-grained (e.g., silt- and clay-dominated) units. In some places, the fine-grained units act as aquitards that locally confine groundwater in deeper permeable sediments. Nevertheless, groundwater generally flows eastward across the site from recharge areas in the higher elevations on the western site boundary and discharges primarily to the Columbia River. The Yakima River is also considered a source of recharge. Since the beginning of Hanford operations in 1943, the water table has risen about 9.1 meters (30 feet) under disposal ponds near the 200-East Area and as much as 27 meters (89 feet) in the 200-West Area. This has caused groundwater mounding with radial and northward flow components in the 200 Areas, although groundwater elevations have declined since 1984 with decreased wastewater disposal. However, a groundwater mound beneath the 200-West Area still exists, as do small groundwater mounds near active 200 Area wastewater disposal facilities (Duncan 2007:4.68–4.71; Hartman 2000:3.4, 3.5).

Perched water table conditions have been encountered in sediment above the unconfined aquifer system in the 200-West Area. While the depth to the regional water table across the site ranges from less than 1 meter (3.3 feet) along the Columbia River to more than 100 meters (330 feet) near the center of the site, daily river-level fluctuations may result in changes in the water table of up to 3 meters (10 feet) near the Columbia River during periods of high-river stage. Typically, this inland flow of river water is restricted to within several hundred meters of the shoreline (Duncan 2007:4.69).

The confined aquifer system at Hanford consists of a sequence of basalt-confined aquifers within the Columbia River Basalt Group. Individual aquifers consist of the relatively permeable sedimentary interbeds and the more-porous tops and bottoms of basalt flows that compose the group. The upper basalt-confined aquifer is believed to be recharged from upland areas along the margins of the Pasco Basin as a result of the infiltration of precipitation and surface water where the basalt and interbeds are exposed at or near the ground surface. Hydraulic head information indicates that groundwater in the basalt-confined aquifers generally flows toward the Columbia River and, in some places, toward areas of enhanced vertical interflow with the unconfined aquifer system (Duncan 2007:4.69; Hartman 2000:3.4, 3.5).

Tritium and carbon-14 measurements indicate that groundwater residence or recharge time (the length of time that groundwater has been in the subsurface) is up to thousands of years for the unconfined aquifer and more than 10,000 years for groundwater in the shallow confined aquifer. These rather long residence times are consistent with semiarid-site recharge conditions. However, groundwater travel time from the 200-East Area to the Columbia River has been shown to be much faster—in the range of 10 to 30 years. This is because of the large volumes of recharge from wastewater disposed of in the 200 Areas between 1944 and the mid-1990s and the rather high permeability of Hanford formation sediments, which are below the water table between the 200 Areas and the Columbia River. Residence times in this portion of the aquifer are expected to increase because of the reduction in wastewater recharge in the 200 Areas. Plume monitoring indicates that groundwater from the 200-West Area has moved about 6 kilometers (3.7 miles) during the past 50 years (Duncan 2007:4.72).

Water use in the Pasco Basin, which includes Hanford, is primarily via surface-water diversion; groundwater accounts for less than 10 percent of water use (DOE 1999a:4-49). While most of the water used by Hanford is surface water withdrawn from the Columbia River, some groundwater is used. One of the principal users of groundwater was the Fast Flux Test Facility in the 400 Area, which used about 697,000 liters (184,000 gallons) per day when it operated (DOE 2000:3-109). No aquifers have been designated sole-source aquifers in the Columbia Plateau (EPA 2009c).

Groundwater quality beneath large portions of Hanford has been affected by past liquid waste discharges, primarily to ponds, cribs, and trenches (ditches), and from spills, injection wells, and leaks from waste storage tanks. Additional contaminants from spills, leaking waste tanks, and burial grounds (landfills) have also impacted groundwater in some areas. Contaminant concentrations in the existing groundwater plumes are expected to decline through radioactive decay, chemical degradation, and dispersion. Contaminants also exist within the vadose zone (unsaturated zone) beneath waste sites, as well as in waste storage and disposal facilities. These contaminants could continue to move downward into the unconfined aquifer system. Some contaminants, such as tritium, move with the groundwater, while movement of other contaminants (e.g., strontium, cesium, and plutonium) is slower because they react with or are sorbed on the surface of minerals within the aquifer or the vadose zone (Duncan 2007:4.73, 4.74). Groundwater contamination is monitored and is being actively remediated in several areas through pump-and-treat operations. The unconfined aquifer system contains radiological and nonradiological contaminants at levels that exceed water quality criteria and standards. Overall, tritium, nitrate, and iodine-129 continue to be the most widespread groundwater contaminants associated with past Hanford operations (Hartman, Richie, and Rediker 2009:1.0-3).

200 AREAS

Along the southern edge of the 200-East Area and in the 200-West Area, the water table occurs almost entirely in the upper gravel layers of the Ringold Formation, while in most of the 200-East Area, it occurs primarily in the Hanford formation and in the lower gravel layers of the Ringold Formation. Because the Hanford formation and Cold Creek Unit sand and gravel deposits are much more permeable than the Ringold gravels, the water table is rather flat in the 200-East Area, but groundwater flow velocities are higher (Duncan 2007:4.75).

As previously described, the subsurface hydrology of the 200 Areas has been strongly influenced by the discharge of large quantities of wastewater to the ground for more than 50 years. In recent years, discharges of water to the ground have been greatly reduced, and corresponding decreases in the water table elevation have been measured. The decline in part of the 200-West Area has been more than 8 meters (26 feet) to date (Duncan 2007:4.75, 4.81). The depth to the water table in the 200-West Area varies from about 50 meters (164 feet) to greater than 100 meters (330 feet). Beneath the 200-West Area, the saturated thickness (i.e., the vertical thickness of aquifer material that is saturated with water) of the unconfined aquifer varies from about 65 meters (213 feet) to greater than 150 meters (492 feet) (Hartman 2000:4.9, 4.16).

Groundwater beneath the 200-West Area generally flows from west to east across most of the area, but trends toward the northeast in the northern part of the area; flow is locally altered by pumping, injection, and waste discharge. The decline in liquid effluent discharges to the soil in the 200-West Area and the resulting decline in the water table have changed the flow direction in the northern part of the area about 35 degrees over the past decade from a north-northeast to a more-eastward direction (Hartman, Richie, and Rediker 2009:2.8-1).

3.3.4 Meteorology, Air Quality, and Noise

3.3.4.1 Meteorology and Air Quality

The climate at Hanford and the surrounding region is characterized as that of a semiarid steppe. The humidity is low, and winters are mild. According to data collected from 1946 through 2004, the average monthly temperatures at the Hanford Meteorological Station (located between the 200-East and 200-West Areas) range from a low of –0.7 °C (31 °F) in January to a high of 24.7 °C (76 °F) in July. Annual average relative humidity is 55 percent. While the average annual precipitation is 17 centimeters (6.8 inches), most precipitation occurs during the late autumn and winter, with more than half of the annual amount occurring from November though February. The monthly average windspeeds are lower during the winter, averaging 2.7 to 3.1 meters per second (6 to 7 miles per hour); during the summer they average 3.6 to 4.0 meters per second (8 to 9 miles per hour). Prevailing winds in the 200 Areas are from the northwest, and in the 400 Area predominant winds are from the northwest and south-southwest (Duncan 2007:4.5–4.13). The maximum windspeed at Yakama, Washington (highest 1-minute average), is 21 meters per second (48 miles per hour) (NOAA 2009b:70).

Tornadoes are infrequent and generally of low magnitude in the northwestern portion of the United States. In the 10 counties closest to Hanford (Benton, Franklin, Grant, Adams, Yakima, Klickitat, Kittitas, and Walla Walla in Washington and Umatilla and Morrow in Oregon), 30 tornadoes have been recorded for the period from 1950 through July 2009. The average occurrence of thunderstorms in the vicinity of the Hanford Meteorological Station is 10 per year, with about 1.9 percent considered severe (Duncan 2007:4.13, 4:14; NCDC 2009b).

Most of Hanford is within the South-Central Washington Intrastate Air Quality Control Region No. 230, but a small portion of the site is in the Eastern Washington-Northern Idaho Interstate Air Quality Control Region No. 62. None of the areas within Hanford and its surrounding counties are designated as nonattainment areas with respect to National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (40 CFR 81.348). Particulate matter (PM) concentrations can reach relatively high levels in eastern Washington State because of extreme natural events such as duststorms and large brush fires. Duststorms are treated as uncontrollable natural events under EPA policy (Nichols 1996). Accordingly, the air quality impact of such storms can be disregarded in determining whether an area is in nonattainment for atmospheric particulates. However, states are required to develop and implement a natural events action plan (Duncan 2007:4.19). Applicable NAAQS and Washington State ambient air quality standards are presented in Table 3–3.

The primary sources of criteria and toxic air pollutants at Hanford include emissions from power generation and chemical processing (Duncan 2007:4.19). Other sources include vehicular emissions and construction, environmental remediation, and waste management activities (Wisness 2000). The tank farms in the 200 Areas produced reportable quantities of ammonia emissions in 2007 (Poston, Duncan, and Dirkes 2008:10.10). The ambient air pollutant concentrations at the site boundary attributable to existing sources at Hanford are presented in Table 3–3.

Table 3–3. Modeled Nonradiological Ambient Air Pollutant Concentrations from Hanford Site Sources and Ambient Air Quality Standards

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a] (micrograms per cubic meter)	Maximum Hanford Site Concentration[b] (micrograms per cubic meter)
Criteria Pollutants			
Carbon monoxide	8 hours	10,000[c]	39.5
	1 hour	40,000[c]	162
Nitrogen dioxide	Annual	100[c]	0.263
Ozone	8 hours 1 hour	147[d] 235[f]	(e) (e)
PM_{10}	Annual 24 hours	50[f, g] 150[c]	0.134 0.884
$PM_{2.5}$	Annual 24 hours	15[d] 35[d]	0.134[h] 0.884[h]
Sulfur dioxide	Annual	50[f]	0.00621
	24 hours	260[f]	0.52
	3 hours	1,300[c]	2.01
	1 hour	1,000[f]	4.56
	1 hour	660[f, i]	4.56
Other Regulated Pollutants			
Total suspended particulates	Annual	60[f]	0.134[h]
	24 hours	150[f]	0.884[h]
Ammonia	24 hours	100[j]	1.91

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those standards based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean $PM_{2.5}$ standard is attained when the expected annual arithmetic mean concentration (3-year average) is less than or equal to the standard. The 24-hour $PM_{2.5}$ standard is met when the 98th percentile over 3 years of 24-hour average concentrations is less than or equal to the standard value. The 24-hour PM_{10} standard is met when the 99th percentile over 3 years of 24-hour concentrations is less than or equal to the standard value.

[b] Site contributions based on a 2005 emissions inventory, including emissions from the 200 Areas.

[c] Federal and state standard.

[d] Federal standard.

[e] Not directly emitted or monitored by the site.

[f] State standard.

[g] The U.S. Environmental Protection Agency revoked the annual PM_{10} standard.

[h] Assumed to be the same as the concentration of PM_{10} because there are no specific data for total suspended particulates or $PM_{2.5}$.

[i] Not to be exceeded more than twice in any 7 consecutive days.

[j] State acceptable source impact level.

Note: The National Ambient Air Quality Standards include standards for lead. Lead emissions identified at the site are small (less than 1 kilogram [2.2 pounds] per year) and were not modeled. The State of Washington also has ambient standards for fluorides. No emissions of fluorides have been reported at Hanford. To convert cubic meters to cubic feet, multiply by 35.315.

Key: PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Source: 40 CFR 50; 71 FR 61144, DOE 2006a, 2009c:3-22; WAC 173-460, 173-470, 173-474, 173-475, 173-481, 173-490.

These concentrations are based on dispersion modeling using year 2005 emissions for Hanford, which are presented in Table 3–4. Emissions from carbon tetrachloride vapor extraction work in the 200-West Area are included among the toxic pollutant emissions shown. Emissions from tank vents other than ammonia and criteria pollutants are included among the composite toxic air pollutants. These emissions include 1,3-butadiene, 2-hexanone, 2-pentanone, acetone, acetonitrile, benzene, heptane, hexane, methyl amyl ketone, nonane, octane, phosphoric acid tributyl ester, and toluene (DOE and Ecology 1996:G-36–G-38). The concentrations at the site were calculated from 2000–2004 meteorological data using the AERMOD [American Meteorological Society/EPA Regulatory Model] dispersion model.

Table 3–4. Nonradioactive Constituents Emitted to the Atmosphere at the Hanford Site, 2005

Constituent	Emissions (kilograms)
Carbon monoxide	14,000
Nitrogen oxides	12,000
Particulate matter PM_{10} $PM_{2.5}$	6,500 2,800 1,000
Sulfur oxides	3,000
Lead	0.47
Volatile organic compounds[a]	14,000[b]
Ammonia	12,000[c]
Other toxic air pollutants	6,600[d]

[a] Produced from burning fossil fuels for steam generation and electrical generators and calculated from estimates of emissions from the 200-East and 200-West Area tank farms; evaporation losses from fuel dispensing; and operation of the 242-A Evaporator, 200 Area Effluent Treatment Facility, Central Waste Complex, T Plant complex, and Waste Receiving and Processing Facility.

[b] Estimate does not include emissions from certain laboratory operations and mobile sources.

[c] Calculated estimates of releases from the 200-East and 200-West Area tank farms and operation of the 242-A Evaporator and the 200 Area Effluent Treatment Facility.

[d] A composite of calculated estimates of toxic air pollutants, excluding ammonia.

Note: To convert kilograms to pounds, multiply by 2.2046.

Key: PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Source: DOE 2009c:3-23**.**

Background concentrations of criteria pollutants are well below ambient standards. As shown in Table 3–3, these modeled concentrations from Hanford sources represent a small percentage of the ambient air quality standards. Hanford emissions should not result in air pollutant concentrations that violate the ambient air quality standards for criteria pollutants. Detailed information on emissions of other pollutants at Hanford is discussed in the *Hanford Site Environmental Report for Calendar Year 2007 (Including Some Early 2008 Information)* (Poston, Duncan, and Dirkes 2008:10.10–10.12).

The nearest PSD Class I areas to Hanford are Mount Rainier National Park, 160 kilometers (100 miles) to the west; Goat Rocks Wilderness Area, about 145 kilometers (90 miles) to the west; Mount Adams Wilderness Area, about 153 kilometers (95 miles) to the southwest; and Alpine Lakes Wilderness Area, about 177 kilometers (110 miles) to the northwest (40 CFR 81.434; Duncan 2007:4.19; Ecology 2005). Hanford and its vicinity are classified as a Class II area. The PUREX and Uranium Trioxide Plants were issued a PSD permit for nitrogen oxide emissions in 1980. These facilities were permanently shut down in the late 1980s and deactivated in the 1990s. None of the currently operating Hanford facilities have nonradiological emissions of sufficient magnitude to warrant consideration under PSD regulations (Duncan 2007:4.17). DOE has applied for and received a PSD permit for the Waste Treatment Plant (WTP), which includes the Pretreatment Facility, high-level radioactive waste (HLW) and low-activity waste vitrification facilities, six steam generating boilers, two diesel fire pumps, and three emergency diesel generators (Ecology 2001, 2003, 2005). New emission sources may require a PSD increment consumption analysis if they have significant emissions and air quality impacts. None of the alternatives considered in this EIS are expected to require a PSD permit.

A sitewide air operating permit for Hanford (permit No. 00-05-006) became effective in July 2001 and was renewed in December 2006 (Duncan 2007:6.23) in accordance with Title V of the Clean Air Act and Amendments of 1990 (42 U.S.C. 7401 et seq.), the Federal and state programs under "State Operating Permit Programs" (40 CFR 70), and the *Washington Administrative Code* (WAC 173-401).

As determined by monitoring conducted off site by the Benton County Clean Air Authority, in 2004 the maximum and annual average $PM_{2.5}$ and PM_{10} concentrations were below EPA and Washington State standards (Duncan 2007:4.19). Ambient air quality at Hanford is discussed in more detail in the *Hanford Site Environmental Report for Calendar Year 2007 (Including Some Early 2008 Information)* (Poston, Duncan, and Dirkes 2008:10.13–10.26). The air operating permit indicates that toxic air pollutants from tank farm activities in the 200 Areas have been demonstrated to be below the acceptable source impact levels and are required to remain below these levels (Ecology 2001, 2006).

Routine monitoring of most nonradiological pollutants is not conducted at the site. Continuous monitoring of PM_{10} and $PM_{2.5}$ was initiated at the Hanford Meteorological Station and the 300 Area in 2001. The PM monitors involved in this effort are not used to determine compliance with ambient standards (Poston et al. 2006:10.26). Ambient monitoring of ammonia and other toxic pollutants is not routinely conducted at Hanford.

200 AREAS

Prevailing winds in the 200 Areas are from the west-northwest to northwest (Duncan 2007:4.8, 4.9). The 200 Areas emit various nonradiological air pollutants. The sources of criteria and toxic air pollutant emissions in the 200 Areas include generators; tank farm exhausters; evaporators; boilers; vehicles; and construction, environmental remediation, and waste management activities (DOE 2006a; Hebdon 2003; Wisness 2000). The tank farms in the 200 Areas produced reportable ammonia emissions in 2007 (Poston, Duncan, and Dirkes 2008:10.10). Year 2005 emissions for the 200 Areas are included in the sitewide emissions presented in Table 3–3. Emissions from carbon tetrachloride vapor extraction work in the 200-West Area are included in the toxic pollutant emissions shown in Table 3–4. Emissions from tank vents other than ammonia and criteria pollutants are included in the composite toxic air pollutants. These emissions include 1,3-butadiene, 2-hexanone, 2-pentanone, acetone, acetonitrile, benzene, heptane, hexane, methyl amyl ketone, nonane, octane, phosphoric acid tributyl ester, and toluene (DOE and Ecology 1996:G-36–G-38).

The Hanford Site Air Operating Permit (Ecology 2006) includes emission and reporting requirements for various sources in the 200 Areas, including oil-fired boilers, large internal-combustion engines, tank exhausters, waste retrieval systems, rotary-mode core sampling systems, tank sluicing, emergency fire pump generators, the 200 Area Effluent Treatment Facility, tank waste retrieval, tank farm ventilation systems, storage of vented waste containers at the Central Waste Complex, and Waste Receiving and Processing Facility.

3.3.4.2 Noise

Major noise sources within Hanford include various facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, vehicles). However, most Hanford industrial facilities are far enough from the site boundary that noise from these sources at the boundary is either unmeasurable or barely distinguishable from background levels (DOE 1996a:3-29, 3-31; Duncan 2007).

Background noise levels at Hanford were measured during two surveys in 1996 and 2007. Data from a survey of 15 sites at Hanford found that background noise levels (measured as the 24-hour equivalent sound level) ranged from 30 to 60.5 dBA. A second survey of 5 isolated areas concluded that background sound levels in undeveloped areas could best be described as a mean 24-hour equivalent sound level of 24 to 36 dBA. Wind was identified as the primary contributor to background sound levels at Hanford (Duncan 2007:4.162, 4.164).

The primary source of noise at the site and nearby residences is traffic. The potential impact of traffic noise resulting from activities at Hanford was evaluated for a draft EIS addressing the siting of the proposed New Production Reactor (Duncan 2007:4.164). Estimates were made of baseline traffic noise along two major access routes: State Route 24, from Hanford west to Yakima, and State Route 240, south of the site and west of Richland, where it handles maximum traffic volume. About 9 percent of the employees at Hanford commute by vanpool or bus. Modeled traffic noise levels (equivalent 1-hour sound level) at 15 meters (50 feet) from State Route 24 for both peak and offpeak periods were 62 dBA. Traffic noise levels from State Route 240 for both peak and offpeak periods were 70 dBA. These traffic noise levels were projections based on employment levels about 30 percent higher than actual levels at Hanford in 1997. Existing traffic noise levels may be different due to changes in site employment and ridesharing activities (DOE 1999b:38; Duncan 2007:4.161–4.165).

Washington State has established noise standards for different source and receiving areas. Hanford belongs to source area Class C (industrial). The maximum allowable noise level for residential, commercial, and industrial areas is 50 to 70 dBA (WAC 173-60). For industrial areas impacting a residential area, the limit is 60 dBA during daylight hours and 50 dBA at night. Land use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses (14 CFR 150). These guidelines further indicate that noise levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures. It is expected that, for most residences near Hanford, the day-night average sound level is less than 65 dBA and thus compatible with residential land use, although noise levels may be higher for some residences along major roadways.

200 AREAS

No distinguishing noise characteristics in the 200 Areas have been identified. The 200 Areas are far enough away from the nearest site boundary (10 kilometers [6.2 miles]) that industrial noise emanating from these areas is either unmeasurable or barely distinguishable from background levels at the site boundary. The 200-West Area is about 2.3 kilometers (1.4 miles) from the closest part of the Hanford Reach National Monument.

3.3.5 Ecological Resources

3.3.5.1 Terrestrial Resources

Hanford occupies approximately 151,775 hectares (375,040 acres). Shrub-steppe plant community dominates the majority of the site and provides habitat for a variety of both native and nonnative plant species. A total of 727 species of vascular plants have been recorded, 179 of which are nonnative species. Within the shrub-steppe habitat, sagebrush-dominated communities predominate. Typical vegetation includes big sagebrush, threetip sagebrush, bitterbrush, gray rabbitbrush, winterfat, snow buckwheat, and spiny hopsage (Duncan 2007:4.89).

Approximately 300 species of terrestrial vertebrates have been observed at Hanford, including 46 mammals, 258 birds, 10 reptiles, and 5 amphibians. Mammals include large game animals, such as the Rocky Mountain elk and mule deer, and predators, such as coyotes and bobcats. Forty-one bird species are common to shrub and grassland habitats, including the western meadowlark, horned lark, and long-billed curlew. The side-blotched lizard is the most abundant species of lizard at Hanford, while the Great Basin gopher snake, western yellow bellied racer, and western rattlesnake are the most common snakes. The Great Basin spadefoot toad, Woodhouse's toad, Pacific tree frog, tiger salamander, and bullfrog are the only amphibians found on the site (Duncan 2007:4.83, 4.84, 4.90 4.92).

200 AREAS

Undisturbed portions of the 200 Areas are characterized by the following communities: big sagebrush/bunchgrass-cheatgrass, cheatgrass-bluegrass, crested wheatgrass-bunchgrass-cheatgrass, and gray rabbitbrush/cheatgrass-bluegrass. The former two communities are prominent in the 200-East Area, while the latter two are more common in the 200-West Area. Most of the waste disposal and storage sites are covered by nonnative vegetation or are kept in a vegetation-free condition by the controlled application of approved herbicides because plants could potentially accumulate waste constituents. Due to the disturbed nature of most of the 200 Areas, including the Central Waste Complex, wildlife use is limited; however, surveys have recorded the badger, coyote, Great Basin pocket mouse, mule deer, long-billed curlew, killdeer, horned lark, Say's phoebe, American robin, American kestrel, western meadowlark, and common raven (Sackschewsky 2003a:3, 2003b:9, 10; Sackschewsky and Downs 2007).

3.3.5.2 Wetlands

Riparian habitat occurring in association with the Columbia River includes riffles, gravel bars, backwater sloughs, and cobble shorelines. These habitats occur infrequently along the Hanford Reach and have acquired greater significance because of the loss of wetland habitat elsewhere within the region. Vegetation that occurs along the river shoreline includes willow, mulberry, Siberian elm, water smartweed, reed canary grass, sedges, and rushes (Duncan 2007:4.29, 4.93).

Other large wetland areas at Hanford can be found north of the Columbia River within the Saddle Mountain National Wildlife Refuge and the Wahluke Unit. These two areas encompass all the lands extending from the north bank of the Columbia River northward to the site boundary and east of the Columbia River down to Ringold Springs. Wetland habitat in these areas consists of fairly large ponds resulting from irrigation runoff. These ponds have extensive stands of cattails and other emergent aquatic vegetation surrounding the open-water regions. They are extensively used as nesting sites by waterfowl (Duncan 2007:4.93).

200 AREAS

The only wetland area in the vicinity of the 200 Areas is West Lake. With the cessation of nuclear materials production activities at Hanford, the amount of water discharged to the ground in the 200 Areas substantially decreased. Thus, over the past 10 years, the lake has decreased in size and currently consists of a group of small, isolated pools and mudflats. Predominant plants at West Lake include alkali salt grass, common plantain, and salt rattlepod. Bulrush grows along the shoreline; however, the water is too saline to support aquatic macrophytes (i.e., large aquatic plants) (Duncan 2007:4.98, 4.99).

3.3.5.3 Aquatic Resources

The Hanford Reach of the Columbia River flows through the northern portion of the site and forms the eastern site boundary. It is the last free-flowing, nontidal segment of the Columbia River in the United States. Of specific importance is the spawning habitat the river provides for various salmon species, including the king salmon, coho salmon, and steelhead trout. The Yakima River borders the southern portion of Hanford. Fish found in the river in the site vicinity include smallmouth bass, salmon, steelhead trout, and channel catfish (Duncan 2007:4.99).

There are several springs at Hanford. Rattlesnake Springs, Bobcat Springs, and Snively Springs, located on the Fitzner-Eberhardt Arid Lands Ecology Reserve, form short streams that seep into the ground. None of the springs support any fish populations; however, dense blooms of watercress occur, and aquatic insect populations are higher than they are in mountain streams. Site springs are an important source of water for terrestrial animals such as those listed in Section 3.3.5.1 (DOE 2000:3-120; Duncan 2007:4.103).

Three clusters of approximately 20 vernal pools are distributed on the eastern end of Umtanum Ridge, in the central part of Gable Butte, and at the eastern end of Gable Mountain (DOE 1999b:4.31). Vernal pools are seasonally flooded depressions that retain water much longer than the surrounding uplands; nonetheless, the pools are shallow enough to dry up each season. Only plants and animals that are adapted to this cycle of wetting and drying can survive in vernal pools over time. These pools can host freshwater crustaceans and other invertebrates and are of value to terrestrial species.

200 AREAS

The Liquid Effluent Retention Facility and Treated Effluent Disposal Facility, located in and adjacent to the 200-East Area, contain five ponds. There are three evaporation ponds associated with the Liquid Effluent Retention Facility, each of which is about 0.8 hectares (2 acres) in size. The two disposal ponds associated with the Treated Effluent Disposal Facility are each about 2 hectares (5 acres) in size. While these ponds do not support fish populations, they are accessible to wildlife. West Lake, located north of the 200 Areas, has decreased in size in recent years and is the only other water body near the 200 Areas; however, the lake is too saline to support aquatic macrophytes (Duncan 2007:4.98, 4.99).

3.3.5.4 Threatened and Endangered Species

Threatened, endangered, and other federally and state-listed special status species that occur at Hanford are presented in Table 3–5. Three federally endangered species and 2 federally threatened species may be found on the site. Two species of plants, 1 species of birds, and 1 species of mammals are listed as Federal candidates. Candidate species do not receive legal protection; however, they should be considered during project planning. At the state level, 2 species of plants, 2 species of birds, and 1 species of mammals are listed as endangered and 10 plants and 2 birds are listed as threatened.

Table 3–5. Federally and State-Listed Species Potentially Occurring at the Hanford Site

Common Name	Scientific Name	Federal Status	State Status
Plants			
Awned halfchaff sedge	*Lipocarpha (=Hemicarpha) aristulata*		Threatened
Desert dodder	*Cuscuta denticulate*		Threatened
Geyer’s milkvetch	*Astragalus geyeri*		Threatened
Grand redstem	*Ammannia robusta*		Threatened
Great Basin gilia	*Gilia leptomeria*		Threatened
Loeflingia	*Loeflingia squarrosa var. squarrosa*		Threatened
Lowland toothcup	*Rotala ramosior*		Threatened
Persistent sepal yellowcress	*Rorippa columbiae*	Species of concern	Endangered
Rosy pussypaws	*Calyptridium roseum*		Threatened
Umtanum desert buckwheat	*Eriogonum codium*	Candidate	Endangered
White Bluffs bladderpod	*Lesquerella tuplashensis*	Candidate	Threatened

Table 3–5. Federally and State-Listed Species Potentially Occurring at the Hanford Site (*continued*)

Common Name	Scientific Name	Federal Status	State Status
Plants (*continued*)			
White eatonella	*Eatonella nivea*		Threatened
Fish			
Bull trout[a]	*Salvelinus confluentus*	Threatened	Candidate
Leopard dace[a]	*Rhinichthys flacatus*		Candidate
Mountain sucker[a]	*Catastomus platyrhynchus*		Candidate
River lamprey[a]	*Lampetra ayresi*	Species of concern	Candidate
Spring-run Chinook salmon	*Oncorhynchus tshawytscha*	Endangered[b]	Candidate
Steelhead	*Oncorhynchus mykiss*	Endangered[b] Threatened[c]	Candidate
Reptiles			
Northern sagebrush lizard	*Sceloporous graciosus*	Species of concern	Candidate
Striped whipsnake	*Masticophis taeniatus*		Candidate
Birds			
American white pelican	*Pelecanus erythrorhynchos*		Endangered
Burrowing owl	*Athene cunicularia*	Species of concern	Candidate
Ferruginous hawk	*Buteo regalis*	Species of concern	Threatened
Flammulated owl[a]	*Otus flammeolus*		Candidate
Golden eagle	*Aquila chrysaetos*		Candidate
Lewis's woodpecker[a]	*Melanerpes lewis*		Candidate
Loggerhead shrike	*Lanius ludovicianus*	Species of concern	Candidate
Merlin	*Falco columbarius*		Candidate
Northern goshawk[a]	*Accipter gentilis*	Species of concern	Candidate
Sage sparrow	*Amphispiza belli*		Candidate
Sage thrasher	*Oreoscoptes montanus*		Candidate
Sandhill crane	*Grus canadensis*		Endangered
Western grebe	*Aechmophorus occidentalis*		Candidate
Western sage grouse	*Centrocercus urophasianus phaios*	Candidate	Threatened
Mammals			
Black-tailed jackrabbit	*Lepus californicus*		Candidate
Merriam's shrew	*Sorex merriami*		Candidate
Pygmy rabbit	*Brachylagus idahoensis*	Endangered	Endangered
Townsend's ground squirrel	*Spermophilus townsendii*		Candidate
Washington ground squirrel[a]	*Spermophilus washingtoni*	Candidate	Candidate
White-tailed jackrabbit	*Lepus townsendii*		Candidate

[a] Reported but seldom seen on the Hanford Site.
[b] Protected as an Evolutionarily Significant Unit for the upper Columbia River.
[c] Protected as an Evolutionarily Significant Unit for the middle Columbia River.
Source: DOE 2009c:3-69–3-72; WDFW 2009.

Although no critical habitat for threatened and endangered species, as defined in the Endangered Species Act (16 U.S.C. 1531 et seq.), exists at Hanford, Washington State considers pristine shrub-steppe habitat to be a priority habitat (WDFW 2009). It is so designated because of its relative scarcity in the state and its requirement as nesting/breeding habitat by several federally and state-listed species. Designation and characterization of priority habitat provide a basis for sound and defensible land management planning and assist DOE in integrating stewardship activities into site management to protect regulated species.

200 AREAS

No federally or state-listed endangered or threatened plants or animals have been observed within, or in the immediate vicinity of the 200 Areas, including the Central Waste Complex. However, the sage sparrow, loggerhead shrike, and black-tailed jackrabbit are state candidates and have been observed in the 200 Areas (DOE 2009c:3-73).

3.3.6 Cultural and Paleontological Resources

To date, approximately 32,630 hectares (80,640 acres) of Hanford and adjacent areas have been surveyed for archaeological resources. Approximately 1,550 cultural resource sites and isolated finds and 531 buildings and structures have been documented. Forty-nine cultural resource sites are listed in the NRHP. Most of these sites are associated with the American Indian landscape and are part of six archaeological districts situated on the shores and islands of the Columbia River. To protect resources, the National Historic Preservation Act (16 U.S.C. 470 et seq.), Section 304, and the Archaeological Resources Protection Act (16 U.S.C. 470aa et seq.), Section 9, require agencies to withhold from public disclosure information on the location and character of cultural resources (Duncan 2007:4-115).

3.3.6.1 Prehistoric Resources

More than 8,000 years of prehistoric human activity in the largely arid environment of the middle Columbia River region have left extensive archaeological deposits along the river shores. Well-watered areas inland from the river also show evidence of concentrated human activity, and recent surveys have indicated transient use of arid lowlands for hunting. These cultural sites were occupied continuously or intermittently over substantial timespans (Neitzel 2005:4.103).

Prehistoric period sites common to Hanford include remains of numerous pothouse villages, various types of open campsites, spirit quest monuments (rock cairns), hunting camps, game drive complexes, quarries in mountains and rocky bluffs, hunting and kill sites in lowland stabilized dunes, and small temporary camps near perennial sources of water away from the river (Duncan 2007:4-120).

Although development and amateur artifact collectors have disturbed many prehistoric resources throughout the region, restricted public access imposed at Hanford has resulted in less destruction than in many other areas (Duncan 2007:4.120). Destruction from other causes is also slight. A preliminary assessment of possible effects of the 24 Command Fire in 2000, for example, determined that a minimum of 190 previously recorded prehistoric and historic archaeological sites could have been affected (DOI 2000:80). Postfire surface visibility, in fact, has been greatly enhanced, presenting opportunities for archaeologists and historians to refine the boundaries of known sites and to locate new sites, though it also increases the potential for looting and vandalism.

200 AREAS

A number of cultural resource surveys have been conducted within the 200 Areas (Chatters and Cadoret 1990; Prendergast-Kennedy 2003). The most important archaeological resource discovered in the 200 Areas is White Bluffs Road, an extensive linear feature that passes diagonally northeast to southwest through the 200-West Area. In the prehistoric period, the road was used as an American Indian trail (Chatters and Cadoret 1990:11). White Bluffs Road in its entirety has been determined to be eligible for listing in the NRHP. Two intact segments of the road within the 200-West Area are considered contributing elements. These occur in the southwest and northeast parts of the 200-West Area. A 100-meter (330-foot) easement was created to protect these segments of the road from uncontrolled disturbance. The remaining central portion of the road within the 200-West Area has been determined to be noncontributing (Chatters and Cadoret 1990:11, 21; Duncan 2007:4-130).

Additional finds within and adjacent to the 200 Areas that are associated with the prehistoric period include two cryptocrystalline flakes (i.e., fragments chipped from a rock core during tool making) and a cryptocrystalline silica base of a projectile point (Chatters and Cadoret 1990:15, 16). The former was located within the northwestern portion of the 200-West Area, approximately 300 meters (1,000 feet) northwest of White Bluffs Road. The latter was discovered immediately to the east of the 200-East Area (Prendergast-Kennedy 2003:2). These artifacts have become part of the curated Hanford collection.

3.3.6.2 Historic Resources

It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach, and gold miners began to work the gravel bars. Cattle ranches opened in the 1880s and farmers soon followed. Several small thriving towns, including Hanford, White Bluffs, and Ringold, grew up along the riverbanks in the early twentieth century. These towns, and nearly all other structures, were razed after the U.S. Government acquired the land for the original Hanford Engineer Works (part of the Manhattan Project) in the early 1940s (Neitzel 2005:1.104). Today, the remnants of homesteads, farm fields, ranches, and abandoned military installations can be found throughout Hanford (DOE and Ecology 1996:4-37).

Approximately 650 historic archaeological sites associated with the early settler cultural landscape have been recorded since 1987. Archaeological resources from this period are scattered over Hanford and include numerous areas with gold-mining features along the Columbia riverbanks, as well as the remains of homesteads, building foundations, agricultural equipment and fields, ranches, and irrigation features (Neitzel 2005:4.106).

During the years of the Manhattan Project and the Cold War, numerous nuclear reactors and associated processing facilities were constructed at Hanford. The reactor sites cover over 930 hectares (2,300 acres) of land. Approximately 900 buildings and structures were identified as either contributing properties with no individual documentation requirement (not selected for mitigation) or as noncontributing/exempt properties. There are 528 Manhattan Project and Cold War era buildings/structures and complexes eligible for NRHP listing as contributing properties within the Historic District. Of that number, 190 have been recommended for individual documentation (Duncan 2007:4-119, 4-124). The *Programmatic Agreement Among the U.S. Department of Energy, Richland Operation Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment of the Hanford Site, Washington (PA)* (DOE 1996b) and associated *Hanford Site Manhattan Project and Cold War Historic District Treatment Plan (Treatment Plan)* (Marceau 1998) contain stipulations addressing mitigation requirements for Manhattan Project and Cold War era artifacts. The *Treatment Plan* describes how DOE will implement and carry out the mitigation described in the *PA* stipulations. All adverse effects on Manhattan Project and Cold War era buildings and associated infrastructure located at Hanford have been or are being mitigated in accordance with the *PA* and *Treatment Plan*. The Hanford 105-B Reactor, the world's first full-scale plutonium production reactor, is listed in the NRHP and is designated a National Mechanical Engineering Landmark, a National Historic Civil Engineering Landmark, and a National Nuclear Engineering Landmark (DOE and Ecology 1996:4-37; Neitzel 2005:4.109). Additionally, on August 19, 2008, the B Reactor was designated as a National Historic Landmark (DOE and DOI 2008).

200 AREAS

White Bluffs Road, which passes diagonally northeast to southwest through the 200 Areas, was an important transportation route during mining, cattle ranching, and settlement eras in the Washington Territory (Chatters and Cadoret 1990:17; Neitzel 2005:4.113). The survey conducted during 2000 on White Bluffs Road recorded an additional 54 historic isolated finds and two precontact isolated finds, as well as six dump features (i.e., features containing waste products relating to everyday life) (Duncan 2007:4-130).

The only historic artifacts more than 50 years old that were found in the 200-East Area are a hole-in-top can and a flat-topped crimped can. These artifacts were found in the south-central part of the area (Chatters and Cadoret 1990:11, 13, 15, 16; Prendergast-Kennedy 2003:2).

A historic property inventory has been completed for 72 buildings and structures in the 200 Areas. Of that number, 58 have been deemed eligible for NRHP listing as contributing properties within the historic district and thus have been recommended for mitigation (Duncan 2007:4-130).

An additional feature of historic importance located to the west of the 200-East Area is a small portion of one of the Hanford Atmospheric Dispersion Test Facility arc roads. This portion of the road was determined to be a contributing property within the Hanford Site Manhattan Project and Cold War Era Historic District and was recommended for individual documentation. A Historic Property Inventory Form was completed, and numerous artifacts were identified as having interpretive or educational value in potential exhibits. A selected, representative number of these artifacts were removed and added to the curated Hanford collection (Prendergast-Kennedy 2003:2).

3.3.6.3 American Indian Resources

In prehistoric and early historic times, American Indians of various tribal affiliations heavily populated the Hanford Reach, and some of their descendants still live in the region. Present-day tribal members retain traditional secular and religious ties to the region, and many have knowledge of the ceremonies and lifeways of their culture. The Washani, or Seven Drums religion, which has ancient roots, is still practiced by many American Indians. Native plant and animal foods, some of which can be found at Hanford, are used in ceremonies performed by tribal members (DOE 2000:3-125).

Under separate treaties signed in 1855, a number of regional American Indian tribes ceded lands that included the present area of Hanford to the United States. Under the treaties, the tribes reserved the right to fish at usual and accustomed places in common with the citizens of the territory. They also retained the privilege of hunting, gathering roots and berries, and pasturing horses and cattle upon open and unclaimed land. However, it is the position of DOE that Hanford, like other ceded lands that were settled or used for specific purposes, is not open and unclaimed land. American Indian ties to the environment are complex. To many American Indians, individual and collective well-being is derived from membership in a healthy community that has access to, and utilization of ancestral lands and traditional resources, so that they may fulfill their part of the natural cycles and their responsibility to uphold the natural law. Air quality, physical resources, geological resources, water, biological resources, terrestrial resources, aquatic resources, climate, cultural resources, human health, environmental justice, economics, and transportation are all elements that are linked to the survival and cultural identity of the American Indians. They consider it their responsibility to protect, preserve and enhance the earth and manage modern affairs and environmental practices in a manner consistent with ancient teachings (CTUIR 2009). These tribes have expressed concerns about hunting, fishing, pasture rights, and access to plant and animal communities and important sites. American Indian traditional cultural properties within Hanford include, but are not limited to, various archaeological sites, cemeteries, trails and pathways, campsites and villages, fisheries, hunting grounds, plant-gathering areas, holy lands, landmarks, places important in Indian history, places of persistence and resistance, and "landscapes of the heart" (Duncan 2007:4.120). Culturally important geographic features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Coyote Rapids, and the White Bluffs portion of the Columbia River.

200 AREAS

Much of the 200 Areas have been altered by Hanford operations. The Hanford Cultural Resources Program conducted a comprehensive archaeological resources survey of the fenced portions of the 200 Areas during 1987 and 1988 (Chatters and Cadoret 1990). The results indicate minimal evidence of American Indian cultural landscape resources and early settler/farming landscape resources, with the exception of White Bluffs Road, which traverses the 200-West Area and was originally used as an American Indian trail. Archaeological surveys conducted since that time have revealed the same pattern (Duncan 2007:4.6.4.2).

In addition, several isolated finds, such as cryptocrystalline flakes and projectile points, have been found near the 200 Areas. Traditional cultural properties known to be located in the vicinity of the 200 Areas include the Gable Mountain and Gable Butte Cultural District (to the north of the 200 Areas), which contains many sites used for hunting and religious activities (Duncan 2007:4.130).

3.3.6.4 Paleontological Resources

Remains from the Pliocene and Pleistocene ages have been identified at Hanford. The Upper Ringold Formation dates to the late Pliocene age and contains fish, reptile, amphibian, and mammal fossil remains. Late Pleistocene Touchet Beds have yielded mammoth bones. These beds are composed of fluvial sediments deposited along the ridge slopes that surround Hanford (DOE 2000:3-126).

200 AREAS

No paleontological resources have been identified in the 200 Areas (Schinner 2003).

3.3.7 Site Infrastructure

In addition to the description provided below, a summary of Hanford's sitewide infrastructure characteristics is presented in Table 3–6.

Table 3–6. Hanford Site Infrastructure Characteristics

Resource	Current Site Usage	Site Capacity
Transportation (kilometers)		
Roads	607[a]	607[a]
Railroads	184	184
Electricity		
Energy consumption (megawatt-hours per year)	172,585	1,743,240
Fuel		
Natural gas (cubic meters per year)	977,840	Not Applicable
Fuel oil (liters per year)	2,954,100	(b)
Diesel fuel (liters per year)	1,191,900	(b)
Gasoline (liters per year)	150,330	(b)
Propane (liters per year)	551,410	(b)
Water (liters per year)	816,560,000	18,500,000,000[c]

[a] Includes asphalt-paved roads only.
[b] Limited only by the ability to transport resource to the site.
[c] Capacity of the Hanford Site Export Water System.
Note: All values based on reported use in fiscal year 2006. To convert kilometers to miles, multiply by 0.6214; cubic meters to cubic feet, by 35.315; and liters to gallons, by 0.26417.
Source: DOE 2009c; Duncan 2007:4.150, 4.152; Fluor Hanford 2006:Attachments 1 and 2.

3.3.7.1 Ground Transportation

Hanford is located north of Richland and Benton City, Washington (see Figure 3–3). The DOE-maintained road network within Hanford consists of 607 kilometers (377 miles) of asphalt-paved road and provides access to various work centers. Primary access roads on the site are Routes 1, 2, 3, 4, 6, 10, and 11A and Beloit Avenue. The Hanford rail system originally consisted of about 210 kilometers (130 miles) of track. It connected to the Union Pacific commercial track at the Richland Junction and to the now-abandoned commercial right-of-way (Chicago, Milwaukee, St. Paul, and Pacific Railroad) near Vernita Bridge in the northwest section of the site. In October 1998, 26 kilometers (16 miles) of track were transferred to the Port of Benton and are currently operated and maintained by the Tri-City and Olympia Railroad Company (DOE 2009c; Duncan 2007:4.150, 4.152).

200 AREAS

The 200 Areas are located within the Central Plateau of Hanford. Public access to the 200 Areas and interior locations of Hanford is restricted by guarded gates at the Wye Barricade (at the intersection of Routes 10 and 4), the Yakima Barricade (at the intersection of State Route 240 and Route 11A), and the Rattlesnake Barricade (south of the 200-West Area) (Duncan 2007:4.152). The 200-East Area is accessed primarily by Route 4 South from the east, by Route 4 North off Route 11A from the north, and by Route 4 North off Route 11A for vehicles entering the site at the Yakima Barricade. The 200-West Area is accessed from State Route 240 by Beloit Avenue. A network of both improved and semi-improved roads provide access to individual facilities within the 200-East and 200-West Areas and to the WTP site. Rail spurs traverse portions of the 200-East and 200-West Areas (DOE 2009c).

3.3.7.2 Electricity

Electrical power for Hanford is purchased wholesale from the Bonneville Power Administration, which provided nearly 90 percent of the electricity consumed on the site in 2006 (Duncan 2007:4.157). Hanford is a priority firm customer, and the Bonneville Power Administration is contractually obligated to provide as much power as Hanford requires. Because the transmission line capacity across the site was developed when the nine 100 Area reactors were operating, historically there has been surplus capacity on the Hanford electric transmission system (Ferns 2003a).

Annual electricity consumption at the site during fiscal year 2006 was 172,585 megawatt-hours per year, with a sitewide capacity of 1,743,240 megawatt-hours per year (Fluor Hanford 2006:Attachment 2).

Power to the electrical system that serves the 100 and 200 Areas is provided from two sources, the Bonneville Power Administration Midway Substation at the northwestern site boundary and a transmission line from the Bonneville Power Administration Ashe Substation. The 100 and 200 Area electrical system consists of about 80 kilometers (50 miles) of 230-kilovolt transmission lines, six primary substations, about 217 kilometers (135 miles) of 13.8-kilovolt distribution lines, and 124 secondary substations. (DOE 1999b:3-47). The 251-W Substation (located in the 600 Area) serves to route power to the 200 Areas and is the electrical dispatch center for seven primary substations (including the six in 100 and 200 Areas) and 4 secondary substations (including one in the 200-East Area and one in the 200-West Area (ICF KH Engineers Hanford 1995:4).

Annual electricity consumption at the site during fiscal year 2006 was 53,915 megawatt-hours in the 200-East Area and 43,888 megawatt-hours in the 200-West Area, for a total of 97,803 megawatt-hours in the 200 Areas (Fluor Hanford 2006:Attachment 2). Available capacity of the 200 Areas is 191,844 megawatt-hours per year (based on 21.9 megawatts for 8,760 hours in the 200 Areas) (ICF KH Engineers Hanford 1995:4).

3.3.7.3 Fuel

Both fuel oil and natural gas are used as energy sources at Hanford facilities. A commercial vendor supplies fuel oil to the site, including the 200 Areas (Duncan 2007:4.157; Ferns 2003a). In addition, diesel fuel, gasoline, and liquid propane are consumed to operate vehicles and other equipment at Hanford. Fuel consumption by nonfleet vehicles and equipment was substantially lower in fiscal year 2006 than in previous years due to the slowdown in WTP construction (Fluor Hanford 2006:Attachment 1:4, Attachment 2).

In fiscal year 2006, Hanford sitewide natural gas consumption was about 978,000 cubic meters (35 million cubic feet); fuel oil consumption, reflecting demands in the 200 Areas, was about 3 million liters (780,000 gallons); diesel fuel consumption was about 1.2 million liters (315,000 gallons); gasoline consumption was about 150,000 liters (40,000 gallons); and total propane consumption was about 551,000 liters (146,000 gallons) (Fluor Hanford 2006:Attachment 2).

Individual oil-fired package boilers supply heat and process steam to specific facilities in the 200 Areas (DOE 1999a:4-112). Fuel oil use reported in 2006 in the 200-West Area was 3 million liters (780,000 gallons) (Fluor Hanford 2006:Attachment 2).

3.3.7.4 Water

The Hanford water system includes numerous buildings, pumps, valve houses, reservoirs, and wells, as well as a distribution piping system that delivers water to all areas of the site. The Export Water System, the largest system at Hanford, delivers water from the Columbia River to the 100 and 200 Areas, as well as parts of the 600 Area (DOE 1999a:4-112). The Hanford water system is further divided into nine DOE-owned, contractor-operated, regulated drinking water systems. Only one of the nine systems (the 400 Area system) uses groundwater from the unconfined aquifer instead of water from the Columbia River (Poston et al. 2007:10.55).

The total raw water capacity of the Export Water System is currently rated at approximately 35,000 liters (9,300 gallons) per minute, or about 18.5 billion liters (4.9 billion gallons) per year. However, the potable water capacity of the treatment plant is about 5,680 liters (1,500 gallons) per minute, or about 3 billion liters (788 million gallons) per year, which is limited by the plant's chlorination capacity (Ferns 2003b).

Hanford sitewide water production and usage totaled approximately 817 million liters (216 million gallons) in fiscal year 2006, including groundwater withdrawals in the 400 Area (see Table 3–6).

The original Export Water System was designed to supply raw water to the 100-B, 100-D, 100-F, and 100-H Area reactor operations in addition to the 200 Areas. Since reactor shutdown, it has been reconfigured to mainly furnish water to the 200 Areas and has undergone further modification. Water for the 200 Areas is filtered and chlorinated at the 283-W Water Treatment Plant (Fluor Hanford 2006:Attachment 1:8; Poston et al. 2007:10.55, 10.60).

The total amount of water produced and used in the 200 Areas was 303 million liters (80.1 million gallons) during fiscal year 2006 (Fluor Hanford 2006:Attachment 1:8).

3.3.8 Waste Management

Hanford historic operations have included the use of nine plutonium production reactors, five nuclear reprocessing facilities, and more than 900 support facilities and radiological laboratories. As a result of this activity, the site now supports multiple large environmental cleanup projects (DOE 2009d).

DOE manages the following wastes at Hanford: HLW, transuranic (TRU) waste, mixed TRU waste, low-level radioactive waste (LLW), mixed low-level radioactive waste (MLLW), hazardous waste, and nonhazardous waste. Hanford is listed as an RCRA large-quantity generator and contains permitted treatment, storage, disposal, and recycling facilities for on- and offsite waste treatment. All site wastes are managed using appropriate technologies, in compliance with all applicable Federal and state statutes and DOE orders.

In summary, Hanford has the following types/quantities of waste/material/contamination/facilities (DOE 2009d).

- 2,100 metric tons (2,315 tons) of spent nuclear fuel (80 percent of the irradiated uranium fuel in DOE's inventory).
- About 750,000 cubic meters (980,962 cubic yards) of buried or stored solid waste in 175 waste trenches.
- About 1 trillion liters (264 billion gallons) of groundwater contaminated above EPA drinking water standards, spread out over 20,720 hectares (51,200 acres). The contaminants include metals, chemicals, and radionuclides.
- 1,936 stainless steel capsules of radioactive cesium and strontium, containing roughly 125 million curies of material in water-filled pools.
- More than 1,700 identified waste sites and 500 contaminated facilities.
- More than 200 million liters (53 million gallons) of liquid radioactive waste remain in 170 aging, underground single-shell tanks (7 single-shell tanks retrieved to date).

3.3.8.1 Waste Generation and Management

Information on radioactive solid waste generated from activities at Hanford from 2000 through 2006 is provided in Table 3–7. Liquid waste quantities generated and stored within the tank farm system at Hanford from 2000 through 2006 are provided in Table 3–8. The tables show typical waste generation rates in recent years when no substantial waste generation from tank waste treatment and single-shell tank closure activities occurred.

Table 3–7. Quantities of Radioactive Solid Waste[a] Generated on the Hanford Site, 2000–2006

Waste Category	Year						
	2000	2001	2002	2003	2004	2005	2006
	(kilograms)						
Mixed[b]	441,000	328,500	1,025,000	421,000	144,512	349,416	315,188
Radioactive[c]	700,000	1,675,200	1,588,000	758,000	906,591	1,188,212	465,340

[a] Includes containerized liquid waste but not waste in the tank farm system.
[b] Includes transuranic and low-level radioactive waste and has both radioactive and dangerous nonradioactive constituents.
[c] Categorized as transuranic and low-level radioactive waste.
Note: To convert kilograms to pounds, multiply by 2.2046.
Source: Poston et al. 2007.

Table 3–8. Quantities of Radioactive Liquid Waste[a] Generated and Stored Within the Tank Farm System on the Hanford Site, 2000–2006

Type of Waste	Year						
	2000[b]	2001	2002	2003	2004	2005	2006
	(liters)						
Liquids added to double-shell tanks	8,920,000	2,980,000	9,280,000	9,710,000	3,316,000	3,668,000	3,547,000
Total waste in double-shell tanks (year end)	79,630,000	79,980,000	87,683,000	92,693,000	95,275,000	98,943,000	101,411,000
Liquid waste evaporated at 242-A Evaporator	2,580,000	2,580,000	1,578,000	4,720,000	734,000	706,700	1,052,000
Liquids pumped from single-shell tanks[b]	2,250,000	590,000	5,288,000	6,185,000	2,778,000	888,000	2,953,000[c]

[a] Liquid waste sent to underground double-shell storage tanks during these years, rounded to the nearest 1,000 liters. This does not include containerized (e.g., barreled) solid waste.

[b] Does not include dilution or flush water.

[c] Volume does include dilution or flush water.

Note: To convert liters to gallons, multiply by 0.26417.

Source: Poston et al. 2007.

High-Level Radioactive Waste

HLW was generated from the reprocessing of spent nuclear fuel to recover uranium and plutonium generated in the production reactors. This HLW is considered mixed waste because it also contains hazardous constituents subject to RCRA. The waste, generated as liquids and sludges, is stored and managed within the site tank farm system (various tank farms located in the 200-East and 200-West Areas). In addition, the onsite HLW inventory includes 1,312 cesium capsules, 23 overpacked cesium capsules, and 601 strontium capsules stored and managed within the Waste Encapsulation and Storage Facility (in the 200-East Area) (DOE 2001b:39).

Transuranic and Mixed Transuranic Waste

The waste contained in the underground storage tanks system (149 single-shell tanks and 28 double-shell tanks) is managed as HLW; however, DOE believes it can demonstrate that some of the tanks should be classified as containing TRU waste, based on the origin of the waste. Nontank TRU waste is being placed in above-grade storage buildings within the 27,871-square meter (300,000-square foot) Central Waste Complex located in the 200-East Area (DOE 2002b). The current volume of waste (which includes LLW, TRU waste, and radioactively contaminated polychlorinated biphenyle [PCBs]) stored at the complex totals approximately 7,500 cubic meters (9,809 cubic yards) (Poston, Duncan, and Dirkes 2009). TRU waste is maintained in storage on site until it is shipped to DOE's Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, for disposal (DOE 2002b). TRU waste disposal began in 1999 with the opening of WIPP, and Hanford began the process (TRU waste certification and packaging) to ship waste in July 2000. Hanford processed and shipped 515 cubic meters (674 cubic yards) of waste off site in 2008 (Poston, Duncan, and Dirkes 2009).

Low-Level Radioactive Waste

At Hanford, solid LLW includes protective clothing, plastic sheeting, gloves, paper, wood, analytical waste, contaminated equipment, contaminated soil, nuclear reactor hardware, nuclear fuel hardware, and spent deionizer resin from the purification of water in radioactive material storage basins. Hanford's solid LLW is disposed of on site within the low-level radioactive waste burial grounds (LLBGs). The LLBGs cover a noncontiguous combined area of about 220 hectares (544 acres) (DOE 1997). Only three of the LLBGs are used for the disposal of LLW, MLLW, and defueled U.S. Navy reactor compartments. The LLBGs have been permitted under an RCRA Part A permit since 1985 (Poston, Duncan, and Dirkes 2009).

LLW resulting from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601 et seq.) cleanup activities is disposed of at the Environmental Restoration Disposal Facility (between the 200-East and 200-West Areas), which has been the central Hanford disposal site for contaminated waste generated during such activities since 1996. This facility meets the applicable or relevant and appropriate requirements of RCRA (42 U.S.C. 6901 et seq.) and TSCA (15 U.S.C. 2601 et seq.). The landfill is designed to provide disposal capacity for Hanford waste over the next 20 to 30 years. The landfill is constructed to substantive RCRA Subtitle C Minimum Technology Requirements. In 2006, approximately 475,792 metric tons (524,470 tons) of remediation waste was disposed of at the facility (Poston et al. 2007).

Mixed Low-Level Radioactive Waste

Hanford's MLLW (i.e., LLW with a dangerous waste component is regulated by WAC 173-303) was generated from the operation, maintenance, and cleanup of reactors, chemical separation facilities, tank farms, and laboratories. MLLW contains the same types of contaminated materials as LLW; it typically consists of materials such as sludges, ashes, resins, paint waste, lead shielding, contaminated equipment, protective clothing, plastic sheeting, gloves, paper, wood, analytical waste, and contaminated soil. Hazardous components may include mercury, lead, and other heavy metals, solvents, paints, oils, and other hazardous organic materials. The Central Waste Complex includes 12 small mixed waste storage buildings, 27 modules for low-flash point MLLW, and 12 modules for alkali metals (DOE 2002b). MLLW is treated and/or directly disposed of in LLBG 218-w-s (trenches 31 and 34), LLBG 218-w-12b (trench 94), and the Environmental Restoration Disposal Facility.

Hazardous Waste

There are no treatment facilities for hazardous waste at Hanford; therefore, the waste is accumulated in satellite storage areas (for less than 90 days) or at interim RCRA-permitted facilities. The common practice for newly generated hazardous waste is to ship it off site using U.S. Department of Transportation–approved transporters for treatment, recycling, recovery, and disposal at RCRA-permitted commercial facilities. In 2008, 1,530 metric tons (1,690 tons) of sanitary and hazardous wastes were recycled through sitewide programs (Poston, Duncan, and Dirkes 2009).

Various waste forms containing mercury are managed at Hanford (e.g., those contained in HLW tanks and those derived from site decommissioning and remediation activities). Site waste processing at the T Plant and Waste Receiving and Processing Facility in the 200 Areas includes the amalgamation of mercury or other metals (Poston et al. 2007). Approximately 440 cubic meters (15,538 cubic feet) of hazardous waste was forecasted to be generated at Hanford in fiscal year 2008 (DOE 2009e).

Nonhazardous Waste

Sanitary wastewater is discharged to several different treatment facilities, including the Energy Northwest sanitary station, the City of Richland, and a series of onsite sewage systems. In recent years, extensive efforts have been made to regionalize the onsite sewage system. Many of the smaller systems have been replaced with large systems with design capacities up to 55,000 liters (14,500 gallons) per day (Poston, Duncan, and Dirkes 2009).

Nonhazardous solid waste includes construction debris, office trash, cafeteria waste, furniture and appliances, nonradioactive friable asbestos, powerhouse ash, and nonradioactive and nonhazardous demolition debris. Such waste is disposed of at the Roosevelt Regional Landfill near Goldendale, Washington. Nonradioactive friable asbestos and medical waste are shipped off site for disposal at commercial facilities (DOE 2000:3-139).

3.3.8.2 Waste Minimization

The Hanford Site Pollution Prevention Program is a comprehensive, continual effort to systematically reduce the quantity and toxicity of hazardous, radioactive, mixed, and sanitary wastes; conserve resources and energy; reduce hazardous substance use; and prevent or minimize pollutant releases to all environmental media from all operations and site cleanup activities. In accordance with sound environmental management practices, the program seeks to prevent pollution through establishing goals related to affirmative procurement (the purchase of environmentally preferable products containing recycled material), source reduction, and environmentally safe recycling. In 2008, Hanford recycled 1,530 metric tons (1,690 tons) of sanitary and hazardous wastes (Poston, Duncan, and Dirkes 2009).

3.3.9 Occupational and Public Health and Safety

3.3.9.1 Normal Operations

Activities at Hanford have the potential to release small quantities of hazardous chemicals and radionuclides to the environment. These releases could result in exposures of members of the public to concentrations of chemicals or radionuclides. Types and quantities of chemicals and radionuclides released from Hanford operations in 2006 are listed in the *Hanford Site Environmental Report for Calendar Year 2006 (Including Some Early 2007 Information).* Chemical impacts are not quantified; however, radiation doses to the public are discussed (Poston et al. 2007:10.11, 10.27, 10.144–10.145). These doses fall within the limits established in DOE Order 5400.5 and are much lower than those due to background radiation. There are several non-DOE-related sources of radiation exposure at or near Hanford. The combined annual dose to a member of the public in 2006 from Hanford area DOE and non-DOE sources was well below any regulatory dose limit (Poston et al. 2007:10-149).

Adverse public health impacts may result from the inhalation of hazardous chemicals released to the atmosphere during normal Hanford operations. Risks to public health from other possible pathways, such as the ingestion of contaminated drinking water or direct contact with hazardous chemicals, are lower than those from inhalation. Administrative and design controls have been instituted to reduce hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emission permits, NPDES permits). Moreover, baseline studies have been performed to estimate the highest existing offsite concentrations and the highest concentrations to which members of the public could be exposed; these studies have been used to develop baseline air emission and other applicable standards for hazardous chemicals. Hazardous chemical concentrations remain in compliance with applicable guidelines and regulations. Nevertheless, the effectiveness of all controls and mitigation measures is constantly verified through routine monitoring and inspection (DOE 2009c:3-91).

Contamination from Hanford wastes and past operation of coal-fired power plants at Hanford, as well as releases of trace metals from upriver mining and smelting, may contribute to accumulation of mercury and other contaminants in fish and wildlife tissue. In 2007, samples of tissue from geese collected along the Hanford Reach contained elevated concentrations of mercury compared with samples collected at a reference location. Tissue samples from fish collected in the Columbia River near Hanford did not show elevated mercury concentrations compared with upriver samples. Fish samples were not collected near the 100 Areas in 2007 (Poston, Duncan, and Dirkes 2008:10.44, 10.131-10.135). In 2008, samples of tissue from fish collected near the 100 Areas had maximum concentrations of mercury similar to or less than those collected at the reference location, and samples collected near the 300 Area had elevated concentrations compared with those collected at the reference location (Poston, Duncan, and Dirkes 2009:10.140, 10.141).

Exposure pathways to Hanford workers during normal operations include the inhalation of contaminants in the workplace atmosphere and direct contact with hazardous materials. DOE policy requires that the workplace be as free as possible from recognized hazards—i.e., conditions likely to cause illness or physical harm. Thus, DOE policy states that workers are generally protected from such hazards through adherence to Occupational Safety and Health Administration and EPA limits on atmospheric and drinking water concentrations of potentially hazardous chemicals. Exposure to hazardous chemicals is also minimized by appropriate training, use of personal protective equipment, monitoring of the workplace environment, limits on the duration of exposure, and engineered and administrative controls. Monitoring and controlling hazardous chemical usage in operational processes help ensure that workplace standards are not exceeded and worker risk is minimized (DOE 2009c:3-91).

Epidemiological studies related to radiological exposure at Hanford are discussed in the *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2009c:3-91–3-93).

3.3.9.2 Facility Accidents

A number of incidents that had actual or potential health impacts on workers have occurred in the course of routine facility operations, decommissioning, and environmental remediation activities in and near the 200 Areas. The most notable of these was a May 1997 explosion caused by spontaneous reaction of nonradioactive chemicals left over from discontinued activities in the Plutonium Recovery Facility. Although no one was directly injured by the explosion and no radioactive materials were released to the environment (DOE 2000:3-133), eight workers who may have been exposed to unidentified fumes later complained of symptoms that included headaches, dizziness, and an unidentified metallic taste. All were transferred to a nearby medical center where they were examined and released.

Other incidents with worker health implications over the period from 2000 through 2007, as reflected in Occurrence Reporting and Processing System records, include exposures to chromium, lead, carbon monoxide, plutonium, americium, methylene chloride, curium-244, mercury, nitrobenzene, asbestos fibers, high noise levels, electrical shocks, and unknown vapors/fumes (DOE 2007a, 2008a).

Since about 1987, exposure of tank farm workers to chemical vapors has been of concern at Hanford. The tanks are continuously vented to the atmosphere and inhalation is assumed to be the primary route of chemical exposure to workers during routine operations. Evaluations conducted at different times by the tank farms contractor, Hanford DOE officials, the Defense Nuclear Facilities Safety Board, the DOE Office of Independent Oversight and Performance Assurance, and the Office of the Inspector General have resulted in the implementation of physical (engineered) and administrative controls to reduce or eliminate the potential for worker chemical vapor exposures (DOE 2009c:3-94).

The most recent incident involving chemical and radiation exposures occurred in July 2007 (DOE 2007b). Approximately 320 liters (85 gallons) of highly radioactive mixed waste from tank 241-S-102 in the

200-West Area were spilled on the ground. Overpressurization of a hose in a dilution line was determined to be the cause. In the hours and days following the spill, a number of Hanford workers identified odors, experienced symptoms or health effects, or expressed concerns about their potential exposure to the waste chemicals from the spill. As of September 1, 2007, 24 workers had reported possible exposure to tank vapors resulting from the spill. The worker health impacts could be attributed to other causes, so it is unclear whether the spill directly contributed to these health effects. Because of the low concentrations and short duration of the event, overexposure or chronic health impacts are unlikely. Consequences of the tank 241-S-102 event could have been more severe if workers had been in the immediate vicinity of the spill at the time of the release, and thus had been exposed to higher radiation or chemical vapor concentrations for a longer period. The board reviewing the accident made a number of recommendations to help prevent future spills and to mitigate worker exposures through, among other things, improvement in safety programs and coordination of emergency and medical response (DOE 2009c:3-94).

In nearly all of these cases, the worker health impacts were minimal or temporary. Information concerning these and other safety-related events at Hanford and other sites is maintained in DOE's Occurrence Reporting and Processing System (DOE 2009c:3-94).

In addition to the incidents reported above, a report by the Government Accountability Project cited evidence of 45 chemical vapor exposure events that required medical attention for at least 67 workers over the period from January 2002 to August 2003 (GAP 2003:11).

As required by DOE orders and policies, Hanford has established a comprehensive Emergency Management Program that provides detailed, hazard-specific planning and preparedness measures to minimize the health impacts of accidents involving loss of control over radioactive material or toxic chemicals. This Emergency Management Program embodies the following principles:

- Identification and characterization of the hazardous substances
- Analysis of potential accidents and hazardous releases
- Prediction of consequences of the releases at various locations
- Planned response actions to minimize exposure of workers and the public to the hazard

Emergency response procedures are practiced and exercised regularly to ensure that optimum protective measures can be taken in response to most identified accident conditions and to provide the capability for flexible, effective responses to accidents that were not specifically considered in the emergency planning scenarios.

DOE's Richland Operations Office (DOE-RL) maintains the Hanford emergency plan and implementing procedures by which the department and its contractors will respond in the event of an accident. DOE-RL also provides technical assistance to other Federal agencies and to state and local governments. Hanford contractors are responsible for maintaining emergency plans and response procedures for all facilities, operations, and activities under their jurisdiction and for implementing those plans and procedures during emergencies. The DOE-RL, its contractors, and state and local government plans are fully coordinated and integrated. Emergency control centers have been established by DOE-RL and its contractors for the principal work areas to provide oversight and support to emergency response actions within those areas (DOE 2009c:3-94–3-95).

3.3.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to the site and employee traffic. These include death or injury from accidental release of nonradioactive and radioactive materials, effects of air pollutants and low levels of radiation emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of nonradioactive or radioactive materials. There is no current risk assessment available for ongoing nonradioactive and radioactive material transportation to and from Hanford. Risk from transportation of nonradioactive and radioactive materials resulting from implementing various tank closure, Fast Flux Test Facility decommissioning, and waste management alternatives are presented in the *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2009c:4-444).

3.3.10 Socioeconomics

Hanford is located along the Columbia River in southeastern Washington. Over 90 percent of the people employed at Hanford reside in Franklin and Benton Counties (Duncan 2007). Therefore, Franklin and Benton Counties have been identified as the ROI in this socioeconomics analysis. In fiscal year 2006, Hanford employed 9,759 persons.

3.3.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of the ROI increased by approximately 24 percent to 123,121. By July 2009, the unemployment rate for the ROI was 6.1 percent, which was lower than the unemployment rate for Washington State (8.6 percent) (BLS 2009).

3.3.10.2 Demographic and Housing Characteristics

In 2008, the estimated population of the two-county ROI was 235,841. From 2000 to 2008, the ROI population grew by 23 percent, compared with 11 percent growth throughout the state of Washington (DOC 2009b). The percentage of the ROI population under the age of 18 was 29 percent; women ages 18 to 39 composed 15 percent (DOC 2009c). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. There were 85,591 housing units in the ROI in 2007 (DOC 2008), 64 percent of which were owner occupied, 27 percent were renter occupied, and 8.8 percent were vacant (DOC 2009c).

3.3.10.3 Local Transportation

The primary transportation routes to access Hanford include State Route 24 from points north or west, and State Route 240, Stevens Drive, and George Washington Way from points south. State Route 240 stretches from State Route 395 in Kennewick to State Route 24. Traffic volume along this route is at a maximum between Columbia Park Trail and the junction with Interstate 182. In 2008, the average traffic volume along this segment was 60,000 vehicles per day. Similarly, traffic volume along Interstate 182 is at a maximum at the interchange with State Route 240 and George Washington Way. In 2008, the average traffic volume of this segment was 52,000 vehicles per day (WSDOT 2008). State Route 240 enters the site from the south near West Richland and passes through the southwestern part of the site before converging with State Route 24 south of the Vernita Bridge. State Route 24 intersects State Route 243 north of the Columbia River. Routes 4 and 10 from Stevens Drive to the Wye Barricade also provide access to the site.

Freight rail service to the Tri-Cities area (Richland, Kennewick, and Pasco) is provided by Union Pacific Railroad and BNSF (Burlington Northern Santa Fe) Railroads. Rail passenger service to the area is provided by Amtrak in the city of Pasco. There is also a short-line railroad operated by DOE that extends into Hanford, where it services various facilities; however, portions of this line are no longer in service (BCPD 2007:14). Waste management facilities at Hanford do not currently have rail access.

There are four public airports servicing the Tri-Cities. Vista Field in the city of Kennewick and Prosser Airport are classified as general aviation. The Richland Airport is classified as commuter services, and the Tri-Cities Airport in Pasco is classified as a regional air carrier (BCPD 2007:15).

Hanford also utilizes the Columbia River for transportation by barge. There is a barge landing that operates in the Port of Benton; it is primarily used to transport spent U.S. Naval reactors to the 200 Areas for disposal. Due to developing land use conflicts, options are being explored to relocate the barge landing north of the 300 Area (BCPD 2007:8).

3.3.11 Environmental Justice

The 16-kilometer (10-mile) radius surrounding the storage locations at Hanford encompasses parts of three counties in Washington: Benton, Franklin, and Grant. Figure 3–5 shows populations residing in the three-county area, as reported in the 1990 and the 2000 censuses and the *2007 ACS 1-Year Estimates* (DOC 2009d, 2009e, 2009f). In this figure, lightly shaded bars show populations in 1990, white bars show those in 2000, and darker bars show those in 2007. In the decade between 1990 and 2000, the total population of Benton, Franklin, and Grant Counties increased by approximately 30 percent to 266,520; the minority population increased by approximately 106 percent to 77,710; and the low-income population increased by 16 percent to 36,606. Between 2000 and 2007, the total population increased by 17 percent to 312,039, while the minority population increased by 36 percent to 105,304 and the low-income population increased by 15 percent to 42,124. Demographic data from the 2007 census show that the population self-identified as “some other race” (meaning those who provided write-in entries such as Mexican, Puerto Rican, or Cuban) residing in the three-county area accounted for approximately 48 percent of the county’s total minority population. Persons who declared that they are of Hispanic or Latino origin are included in the “total Hispanic” population shown in Figure 3–5, regardless of race. They composed approximately 84 percent of the total minority population residing in the three-county area around Hanford in 2007.

200 AREAS

There were no people living within 16 kilometers (10 miles) of the 200-West Area at Hanford in 2000 (DOC 2009d). There are two American Indian reservations in proximity to the Hanford region. The Yakama Reservation is located approximately 48 kilometers (30 miles) southwest of the 200-West Area, and the Umatilla Reservation is located 113 kilometers (70 miles) southeast of the 200-West Area.

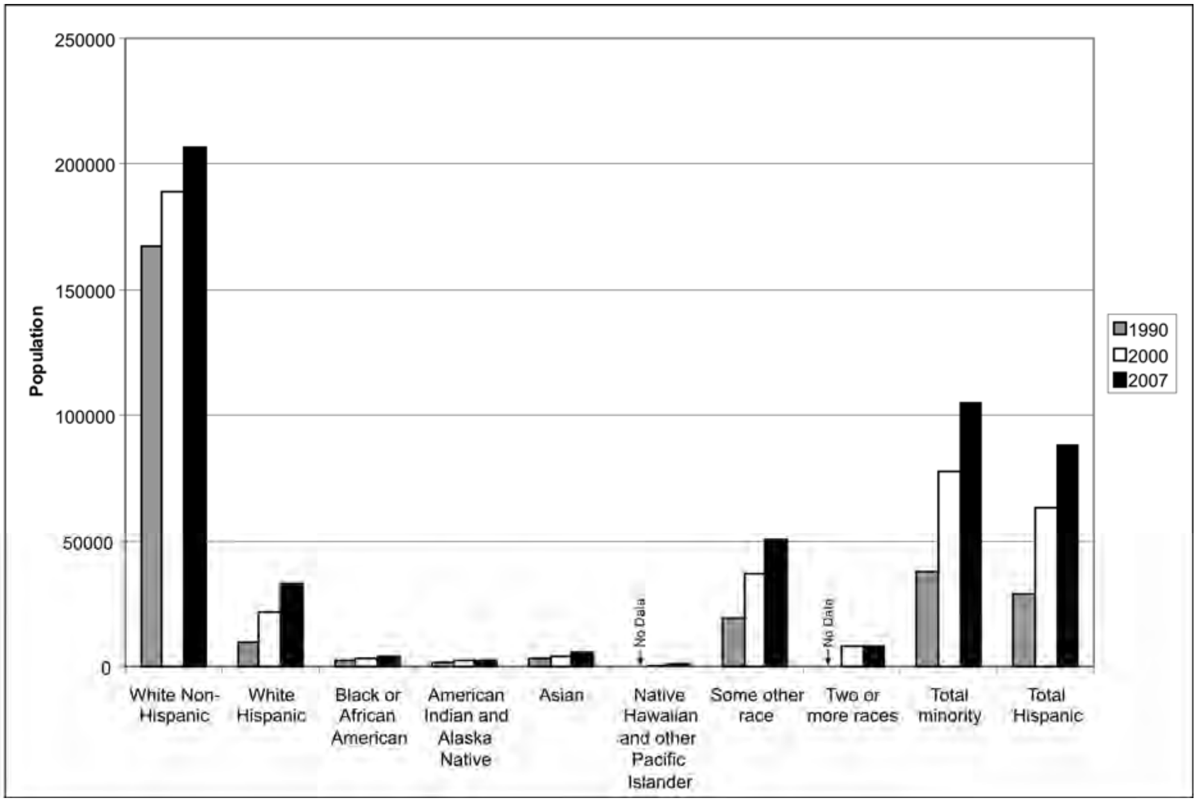


Figure 3–5. Populations Residing in the Three-County Area Surrounding the Hanford Site in 1990, 2000, and 2007

3.4 HAWTHORNE ARMY DEPOT

3.4.1 Land Use and Visual Resources

3.4.1.1 Land Use

Land use at the Hawthorne Army Depot is consistent with that of light to general industry. The vast depot complex encompasses approximately 59,500 hectares (147,000 acres) within Mineral County, Nevada. More than 3,000 structures are present on the installation, including approximately 1,800 explosive storage buildings distributed throughout three large areas (the North, Central, and South Magazine Areas). The remaining portions of the depot are divided into the Industrial Area, which is located along U.S. Route 95 in the west-central portion of the depot and includes headquarters and office buildings, housing areas, a golf course, and maintenance shops; the Western Area Demilitarization Facility, located on the northwestern most portion of the depot; and several production areas, located west and southwest of the Central Magazine Area. The depot is bounded by the Wassuk Range to the west, the Gillis Range to the east, the Excelsior Mountains to the south, and Walker Lake to the north (DLA 2004:3-1, 3-85).

Land use surrounding the Hawthorne Army Depot is predominantly vacant, open space containing a small number of active mining operations. The town of Hawthorne is bordered to the north, east, and south by the depot, with the Hawthorne Municipal Airport extending northwest toward the North Magazine Area of the depot (DLA 2004:3-85).

3.4.1.2 Visual Resources

Developed areas of the Hawthorne Army Depot are consistent with BLM's VRM Class III or IV. Class III includes areas in which there have been moderate changes in the landscape that could attract attention, but do not dominate the view of the casual observer. Class IV includes areas in which major modifications to the character of the landscape have occurred. These changes may be dominant features of the view and the major focus of viewer attention (DOI 1986:App. 2). The tallest structures located at the depot are two 85-meter (280-foot) water storage tanks located in the Central Magazine Area. The viewshed around the Hawthorne Army Depot consists mainly of open range within the Walker Lake Valley, containing low-profile military storage, residential, and light industrial areas dominated by views of the Wassuk Range to the west and the Gillis Range to the east. This viewshed is generally consistent with VRM Class II (where visible changes to the character of the landscape are low and do not attract the attention of the casual observer) and Class III (DLA 2004:3-85).

3.4.2 Geology, Soils, and Geologic Hazards

3.4.2.1 Geology

Hawthorne Army Depot in southwest Nevada lies within the Great Basin section of the Basin and Range physiographic province. The majority of the Hawthorne Army Depot facilities are specifically located in the eastern half of the depot property within the Whiskey-Flat-Hawthorne subarea of Walker Lake Valley. Walker Lake Valley is a high-desert valley that trends north-northwesterly and is bordered by the Wassuk Range to the west and southwest and by the Gillis Range and Garfield Hills to the east and southeast. Just to the northwest of the main depot complex, Walker Lake occupies the topographic low point in the Walker Lake Valley. Walker Lake is a remnant of a glacial lake that once covered much of the northwestern Great Basin. Relief and topography across the 59,500-hectare (147,000-acre) depot differ greatly. Elevations range from 3,426 meters (11,240 feet) above mean sea level at Mount Grant in the Wassuk Range in the far western portion of the depot property to about 1,207 meters (3,960 feet) above mean sea level just to the northwest of the depot facility complex along the shoreline of Walker Lake. Along the valley floor, where the main depot complex is located, the topography is gently sloping (DLA 2004:3-76).

The east face of the Wassuk Range is an active fault scarp that has down-dropped the west side of the Walker Lake Valley relative to the east side. This fault roughly bisects the Hawthorne Army Depot. The fault is part of the regional Walker Lake fault zone. Faulting has occurred in the foothills bordering the depot (DLA 2004:3-76).

Geologic strata comprising the Walker Lake basin and the Walker Lake Valley as a whole consist of unconsolidated alluvium (basin fill) that includes alluvial fan, floodplain, windblown channel and lake deposits, as well as terrace gravels and evaporites. While the maximum depth of the basin fill to bedrock is unknown, it is at least 307 meters (1,008 feet) based on well completion records for Hawthorne Utilities Well No. 5. Rocks of the Wassuk Range are principally granitic rocks dominated by quartz monzonite. Rocks of the Excelsior Formation, which unconformably overlie the rocks of the Wassuk Range, are composed of metamorphosed volcanic rocks (e.g., flows, tuffs, breccias, basalt, and rhyolite) as well as sedimentary interbeds. The Excelsior Formation is also exposed in the Garfield Hills to the southeast of the depot facility complex. Limestones of the Luning Formation also occur southeast of the depot. Additionally, unaltered volcanic rocks are exposed in the vicinity of the depot (e.g., in the Garfield Hills) (DLA 2004:3-76).

Mineral County's principal mineral products include gold and silver. The Lucky Boy Mining District extends into the far southern portion of the depot, along State Route 359. The district is a source for silver and lead. A portion of the Pamlico Mining District encroaches into the South Magazine Area of the depot. Ore in the district contains gold, copper, silver, iron, and uranium. Pamlico Wash drains a portion of the district in the Garfield range (Garfield Hills) and flows onto the depot in the South Magazine Area. In general, some small mineral deposits may occur within the depot property, but the metallic mineral development potential of the depot is considered low. A minor geothermal resource has also been identified in the region. Several hot wells (i.e., with water temperatures exceeding 37 ºC [98 ºF]) are reported from several locations in and around the town of Hawthorne. In fact, groundwater from the depot's main supply well has a temperature of about 49 ºC (120 ºF) (DLA 2004:3-76).

3.4.2.2 Soils

A soil survey of the Hawthorne Army Depot was conducted by the NRCS in 1991. Soils on the valley floor and encompassing the main portion of the depot operational areas were delineated as belonging to the Mazuma-Patna-Soda Lake group. These soils consist of deep, nearly level, well-drained to excessively drained soils on beach or lake plains. Soil textures covering the majority of the depot complex include silty sands, gravelly silt-sand mixtures, inorganic clay, and silt intermixed with sand and gravel (DLA 2004:3-77). Recent soil unit mapping identifies natural soils across the northwestern portion of the Central Magazine Area of the depot as Lakasm-Demill Complex, with 0 to 2 percent slopes; Isolde fine sand, with 2 to 8 percent slopes; and Patna loamy sand, with 0 to 2 percent slopes. These soils have little or no assessed limitations for building site development (NRCS 2009b). No soils are subject to designation as prime farmland or other important farmland soils.

An environmental baseline survey was conducted in 1999 at the Hawthorne Army Depot to review and evaluate the depot for existing or potential environmental contamination that may be a threat to human health or the environment. Hawthorne Army Depot has had an active Installation Restoration Program to address actual or suspected sources of soil and/or groundwater contamination associated with legacy operations. A remedial investigation report, completed in 1999, evaluated 90 sites (i.e., solid waste management units [SWMUs]) across the depot with 41 determined to require corrective action before final closure. Of the 41 sites, removal was the recommended action at 29 sites where high concentrations of explosive compounds exist in site soils. Groundwater monitoring was the recommended corrective action at 7 landfill sites (DLA 2004:3-77, 3-78).

Activities are ongoing at more than 30 sites under either the Installation Restoration Program or Military Munitions Response Program (NDEP 2009a).

3.4.2.3 Geologic Hazards

Nevada is one of the most seismically active states and has experienced the effects of a number of major earthquakes within the past 100 years. Among these, the October 15, 1915, Pleasant Valley earthquake occurred in a relatively uninhabited area of the state about 240 kilometers (150 miles) northeast of Hawthorne. Attributed to a fault on the east side of the Pleasant Valley, it had an estimated magnitude of 7.75 and produced an MMI of X at its epicenter. The earthquake destroyed many adobe homes in Pleasant Valley and was felt from beyond Salt Lake City, Utah, to western Oregon and south to San Diego, California. A magnitude 7.3 earthquake occurred on December 20, 1932, and also produced an MMI of X. This earthquake was located about 55 kilometers (34 miles) northeast of Hawthorne near the Mineral–Nye County line. This earthquake destroyed two cabins near the epicenter and threw down chimneys (reflecting MMI VIII damage) in Hawthorne (DLA 2004:3-77). Since 1973, within a radius of 100 kilometers (62 miles) of the central portion of the depot, a total of at least 1,076 earthquakes (with most in the magnitude 3.0 to 4.0 range) have been recorded. One of the larger and closest events was a magnitude 5.4 earthquake on September 18, 1988, that was located about 24 kilometers (15 miles) southeast of the depot. It had an MMI of V. In September 1974, the largest recorded earthquake in the Hawthorne region was a magnitude 6.1 event centered approximately 97 kilometers (60 miles) to the northwest (USGS 2009g). Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects.

Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity). As previously described in Section 3.2.2.3, the latest probabilistic PGA data from the USGS are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For a Hawthorne Army Depot central location, the calculated PGA is approximately 0.57 *g* (USGS 2009d).

Hawthorne Army Depot lies approximately 97 kilometers (60 miles) north of the Mono-Inyo Craters volcanic chain. This active volcanic complex extends southward for some 48 kilometers (30 miles) from Mono Lake in east-central California. Over the past 5,000 years, an eruption has occurred somewhere along the chain every 250 to 750 years, with the last eruption on its northern end at Paoha Island in Mono Lake about 250 years ago. Southwestern Nevada and Mineral County in particular could experience ashfalls from future eruptions in excess of 5 centimeters (2 inches) in thickness (DLA 2004:3-77).

3.4.3 Water Resources

3.4.3.1 Surface Water

Hawthorne Army Depot is located southeast of Walker Lake (see Figure 2–12). Walker Lake is a freshwater lake covering approximately 15,000 hectares (37,000 acres), with a maximum depth of some 35 meters (115 feet). The lake is the terminal point for surface drainage entering the Walker Lake Valley. The Walker Lake Valley floor adjacent to the lake basin consists of a broad alluvial apron drained by ephemeral streams. No perennial streams cross the valley floor. Relative to Walker Lake, the closest depot facilities (i.e., the Western Area Demilitarization Facility Complex) are located about 8 kilometers (5 miles) southeast of the lakeshore. Little surface water normally reaches Walker Lake directly. Water levels and the surface extent of the lake have generally been declining due to upstream diversion. Between 1950 and 1979, the lake level declined by 13 meters (44 feet) and the south shoreline adjacent to the depot facility complex receded at a rate of about 70 meters (230 feet) per year. However, increased snowfall and runoff in the late 1990s have raised lake levels slightly (DLA 2004:3-78).

The State of Nevada designates beneficial uses and applicable water quality standards and criteria to all natural streams and lakes, reservoirs or impoundments on natural streams, and other specified waterways in the state (unless excepted on the basis of existing irreparable conditions that preclude such use). New water quality standards were adopted for Walker Lake in 2001. Designated uses include contact and noncontact recreation; propagation of wildlife; and propagation of aquatic life (DLA 2004:3-78; NAC 445A.1693). In the vicinity of the depot, Cottonwood, Rose, and Squaw Creeks in the Wassuk Range are designated Class A waters. Class A waters are located in areas of little human habitation, no industrial development, or intensive agriculture, where the watershed is relatively undisturbed by man's activity. The beneficial uses of Class A waters are municipal or domestic supply, or both, with treatment by disinfection only; aquatic life; propagation of wildlife; irrigation; watering of livestock; and contact and noncontact recreation (NAC 445A.124).

A combination of surface-water and groundwater sources is used to provide potable water for the Hawthorne Army Depot. From November to May, water is predominantly derived via a catchment and reservoir system in the Wassuk Range. Water is collected and conveyed from Cottonwood, Squaw, Rose, and House Creeks to Black Beauty Reservoir. There, it is chlorinated and distributed via the depot water distribution system. The Black Beauty Reservoir is located about 6.1 kilometers (3.8 miles) west of the town of Hawthorne. During the remainder of the year, this surface-water source is supplemented by groundwater (via Well Number 1) (see Section 3.4.3.2), although groundwater has never provided more than 40 percent of the depot's total use. Water use is further discussed in Section 3.4.7.4. The depot is above the 100- and 500-year floodplains. However, some portions of the depot are subject to periodic flash flooding. Therefore, dikes (levees) have been constructed along principal drainages and diversion ditches throughout the depot to protect facilities from flash flooding (DLA 2004:3-78). A principal drainage feature (Pamlico Ditch) bisects the southern half of the Central Magazine Area and terminates at a diversion dike approximately 0.6 kilometers (0.4 miles) south of the proposed DOE mercury storage area.

Sanitary and industrial wastewater is generated at the depot. Three NPDES permits regulate depot wastewater and stormwater discharges (SOC 2009:3). A sewage treatment facility serves the industrial and the housing areas of the depot, which are located northwest of the town of Hawthorne and just west of U.S. Route 95. Treated effluent is discharged to a bank of 20 evaporation/percolation ponds in accordance with a current NPDES permit (No. NEV50029). A second NPDES permit (No. NV0021946) covers the discharge of treated wastewater, boiler blowdown, and sanitary wastewater to the evaporation basins as well as stormwater and treated water used for dust suppression. The depot also has a third NPDES permit for general stormwater discharges (No. GNV0022233) (DLA 2004:3-80).

3.4.3.2 Groundwater

The principal source of groundwater in the area of Hawthorne Army Depot is the basin-fill aquifer system beneath the Walker Lake Valley. Groundwater occurs under both confined and unconfined conditions. Gravel, sand, and silt are the predominant sediments to a depth of about 150 meters (492 feet). Fine-grained silt is interbedded with the sand and gravel, which accounts for the confined and semi-confining conditions reported for water-bearing horizons beneath the valley. The coarser-grained materials (e.g., sand and gravel) yield large amounts of water. Several wells near the town of Hawthorne have a saturated thickness exceeding 90 meters (300 feet). However, no specific well yield data are available for Walker Lake Valley wells completed in the basin-fill aquifer system. Because the Walker Valley is a closed hydrogeologic basin with no flow between adjacent basins, groundwater losses are mainly due to evapotranspiration, small springs, and groundwater pumping. Precipitation and runoff, including snowmelt from the Wassuk Range, are the primary sources of recharge to the basin-fill aquifer system. The safe yield of the basin-fill aquifer system has been estimated at 5.7 million cubic meters (4,600 acre-feet) per year. Walker Lake is the terminal point for all groundwater flow within the Walker Lake Valley, and the basin-fill aquifer system contributes an average of approximately 13.6 million cubic meters (11,000 acre-feet) of groundwater inflow to Walker Lake annually (DLA 2004:3-80).

The direction of groundwater flow across the valley, and beneath the depot in particular, averages west-northwest toward Walker Lake and the axis of the valley, but is locally variable based on topographic changes and well pumping influence. Depth to groundwater beneath the depot ranges from about 1.5 meters (5 feet) below land surface on the north side of the depot to about 61 meters (200 feet) in the southern portion of the depot. Groundwater is used to supplement surface water on a seasonal basis. Groundwater for the main depot area has historically been supplied via a single supply well (Well Number 1) located northwest of the town of Hawthorne and just north of the depot's Industrial Area. The well discharges to the Black Beauty Reservoir. A low-flow float in the reservoir turns on the well, and the water then passes through a cooling tower before being pumped to the reservoir for distribution. Water from the town of Hawthorne is supplied to the Central and South Magazine Areas. Well Number 3, located near Magazine Group 6 in the South Magazine Area, is used to supply water for dust control equipment. Several other wells (Wells Number 5, 7, and 8) located within the main depot area are not used for potable supply due to high levels of several chemical constituents, including arsenic, fluoride, and nitrate. Groundwater quality data for the basin indicate relatively high sulfate and total dissolved solids concentrations. Total dissolved solids concentrations in old supply Well Number 5, located just west of the depot's Industrial Area, approach EPA's secondary drinking water standard of 500 milligrams per liter (40 CFR 143). Dissolved solids concentrations increase downgradient toward Walker Lake. Nevertheless, all basin-fill aquifers would be considered Class II aquifers (current or potential sources of drinking water or other beneficial use). There are no designated Class I sole-source aquifers in Nevada (DLA 2004:3-80, 3-81). Water supply and use are further discussed in Section 3.4.7.4.

A depot-wide Groundwater Monitoring Program was first instituted in 1997 with the installation of 55 monitoring wells. These monitoring wells, as well as other existing wells, have been monitored quarterly since 1997 for the purposes of investigation and monitoring groundwater quality and hydrogeologic conditions beneath the depot. The depot's 1999 remedial investigation report identified seven landfill sites at the depot in which groundwater has been impacted by explosions or volatile organic compounds (VOCs), according to groundwater monitoring data. Groundwater monitoring has confirmed groundwater contamination beneath two areas in the North Magazine Area (Group 103-34/41 Complex Area and north of the former Navy Area) and two areas in the Central Magazine Area of the depot (Group 49 and Group 101 Areas). Explosive compound and petroleum product contamination has also been detected in groundwater at several other locations scattered throughout the depot, including the Group 102 and 108 Areas and the Western Area Demilitarization Facility Complex (DLA 2004:3-81).

3.4.4 Meteorology, Air Quality, and Noise

3.4.4.1 Meteorology and Air Quality

The climate of the Hawthorne Army Depot area is semiarid. The average annual rainfall is 16.3 centimeters (6.4 inches). Maximum rainfall occurs in late spring and during the fall. Minimum rainfall months are July and August. Damaging hailstorms rarely occur (DLA 2004:3-71). The average annual snowfall at Hawthorne is 6.4 centimeters (2.5 inches); however, the maximum snow depth, 51 centimeters (20 inches), occurred in 2005 (WRCC 2009b).

No tornadoes were reported in Mineral County between January 1950 and April 2002. Several occurrences of high winds typically occur every year. The average annual windspeed is 2.7 meters per second (6 miles per hour). The maximum windspeed at Reno (the nearest location for which these data are readily available), based on the highest 1-minute average value, is 30 meters per second (67 miles per hour) (NOAA 2009b:67). The mean number of days per year with thunderstorm activity at Reno is 13.5 (DLA 2004:3-72).

The average annual temperature at Hawthorne is 12.3 °C (54.1 °F) (DLA 2004:3-72). At Reno the average annual temperature is 10 °C (50.1 °F); temperatures range from a monthly average minimum temperature of 6.4 °C (20.5 °F) in January to a monthly average maximum of 32.2 °C (89.9 °F) in July. The maximum recorded temperature at Reno is 42 °C (108 °F) (NOAA 2009c).

The Hawthorne Army Depot is in an area of Mineral County that is designated better than national standards for sulfur dioxide and better than national standards or unclassifiable for nitrogen dioxide. The area is unclassifiable/attainment regarding attainment of the standards for carbon monoxide and $PM_{2.5}$ and unclassifiable for PM_{10}. The area is unclassifiable/attainment for ozone. EPA has not assigned an attainment status designation for lead (40 CFR 81.329).

The nearest PSD Class I areas are Yosemite National Park and Hoover National Wilderness Area, about 80 kilometers (50 miles) to the southwest. Hawthorne Army Depot and its vicinity are classified as a Class II area. No PSD permits are required for any emission source at the Hawthorne Army Depot (DLA 2004:3-72).

The primary sources of criteria pollutants at the Hawthorne Army Depot are fuel oil-fired boilers; material-recovery processes; propane furnaces; rock crushing, screening, and stacking operations; portable generators; surface coating operations; and ordinance disposal operations. The Hawthorne Army Depot has an operating permit that covers these sources, as required under the Federal Clean Air Act (42 U.S.C. 7401 et seq.) and companion State of Nevada regulations and a permit for the Plasma Ordinance Disposal Operations. The plasma ordinance disposal system may emit mercury. The system includes emissions controls and monitoring (NDEP 2009b). The storage buildings are not heated; there are no emission sources associated with them that are required to be permitted (DLA 2004:3-72).

There are no monitors for criteria air pollutants in Mineral County. The nearest monitors are in Lyon, Washoe, Clark, Douglas, and Churchhill Counties. The nearest monitor for mercury is in Reno (EPA 2009d).

3.4.4.2 Noise

Major noise emission sources within the Hawthorne Army Depot include various equipment and machines—heating, ventilating, and air conditioning (HVAC) equipment; material-handling equipment (i.e., forklifts and loaders); and vehicles. Some impulsive noise is generated from test firing and demolition of military munitions, weapons, and small arms. An environmental noise study for the depot concluded that incompatible and normally incompatible noise zones from onsite activities do not extend beyond the installation boundary. Noise levels from the depot are expected to be compatible with nearby residential areas and other noise-sensitive land use. The nearest noise-sensitive receptors are in the city of Hawthorne (DLA 2004:3-72, 3-73). The closest residence is approximately 4.8 kilometers (3 miles) from the proposed mercury storage location.

The State of Nevada and Mineral County have not established community noise standards, which specify acceptable noise levels applicable to the depot. Sound level measurements have not been recorded near the depot; however, it is expected that the acoustic environment near the site boundary ranges from that typical of rural to industrial locations. Traffic is the primary source of noise at the site boundary. There is occasional noise from aircraft operations at Hawthorne Municipal Airport. Traffic is the primary source of noise at residences located near roads. The traffic generated by the depot, including employee vehicles and trucks used for shipping, has little effect on traffic on nearby roads and associated traffic noise. Roads that provide access to the Hawthorne Army Depot include U.S. Route 95 and State Route 359 (see Section 3.4.10.3). Railroad activity related to the depot (i.e., delivery or removal of railcars) is occasional, with 474 incoming or outgoing railcars per year, and would result in short-term increases in sound levels near the depot (DLA 2004:3-73).

3.4.5 Ecological Resources

3.4.5.1 Terrestrial Resources

The Hawthorne Army Depot occupies 59,500 hectares (147,000 acres) of basin and range ecosystems typical of those found throughout the Great Basin region. Although the eastern half of the site has been developed into administrative, industrial, and housing areas, the western half of the depot remains largely undeveloped, mountainous land. The depot encompasses representative basin and range ecosystems of the Great Basin, which provide habitat for a diversity of native plants and animals (DLA 2004:3-1, 3-81–3-84).

The biodiversity of the region is extensive due to the variety of plant communities and terrain. A comprehensive survey for flora produced a preliminary checklist of 476 species of vascular plants, including 21 trees, 96 shrubs, 95 grasses and grass-like plants, and 264 other herbaceous perennial and annual plants. A survey of fauna recorded 70 mammals, 185 birds, 45 reptiles, 10 amphibians, and 27 invertebrates. Common mammals include the striped skunk, coyote, and black-tailed jackrabbit. Birds include the great-tailed grackle, western meadowlark, and a variety of raptors. Common reptiles include the ringneck snake, side-blotched lizard, and the common garter snake. Amphibians include the northern leopard frog and western woodhouse toad (DLA 2004:3-81–3-84).

Within the Central Magazine Area, the majority of the land is disturbed. As a result, biodiversity is low and vegetation, in general, is limited to nonnative flora tolerant of human activities and disturbance (DLA 2004:3-81–3-84).

3.4.5.2 Wetlands

A number of wetlands occur on the Hawthorne Army Depot; the largest is located at the southern end of Walker Lake. This area is classified as palustrine emergent by USFWS. Palustrine wetlands generally include nontidal wetlands dominated by persistent emergent vegetation, shrubs, and/or trees. A number of additional small palustrine areas (primarily consisting of scrub-shrub and emergent vegetation) occur along streams draining the Wassuk Range. Only one small wetland area is located near the proposed storage site. This wetland, which is classified as palustrine, unconsolidated shore, is associated with a dike and intermittent stream located just to the northeast of the storage site (DLA 2004:3-81–3-84).

No natural wetlands occur within the proposed location for the mercury storage facility in the Central Magazine Area.

3.4.5.3 Aquatic Resources

Walker Lake, the only naturally occurring water body on site, is located along the northern site boundary. The lake provides habitat for the Lahontan cutthroat trout, Lahontan tui chub, Tahoe sucker, and other native fish. It is also used by thousands of birds, including loons, grebes, pelicans, waterfowl, sea gulls, terns, and ducks. Several species supported by the lake including the Lahontan cutthroat trout, are listed as a federally or state-protected species (DLA 2004:3-81–3-84).

No natural water bodies occur within the proposed location for the mercury storage facility in the Central Magazine Area.

3.4.5.4 Threatened and Endangered Species

The federally threatened and state-endangered Lahontan cutthroat trout occurs in Walker Lake located less than 16 kilometers (10 miles) to the north of the storage site (USFWS 2009c). Though not endangered or threatened, the sand cholla, found throughout the Hawthorne Army Depot, is protected by the State of Nevada as a cactus under the state’s cactus, yucca, or Christmas tree list (NNHP 2009).

Due to the developed nature of the proposed mercury storage facility site, no federally or state-listed threatened or endangered species are expected to occur in this area.

3.4.6 Cultural and Paleontological Resources

3.4.6.1 Prehistoric Resources

In 1976, an archaeological site inventory of the 59,500-hectare (147,000-acre) Hawthorne Army Depot was initiated. By 1996, 22 surveys had been conducted over 4,193 hectares (10,360 acres) by BLM and the Nevada Department of Transportation and other organizations, mostly involving road construction projects. The discovery of campsites, gathering areas, hunting blinds, and hot springs suggests prehistoric habitation of the Hawthorne Army Depot area from the Paleo-Indian through the Protohistoric eras. Fifteen prehistoric sites were designated for listing in the NRHP. Many of the archaeological sites were located on property adjacent to and managed by the depot for water conservation and ordinance protection purposes (DLA 2004:3-83).

3.4.6.2 Historic Resources

An NRHP nomination for architectural resources was drafted for the Hawthorne Army Depot in 1989. Factors for the nomination included its significance as the largest depot in the world; its importance during World War II and to Nevada history; and the integrity of its landscape, infrastructure, and architecture. By 1994, 73 percent of all architectural resources were inventoried, including almost all pre-1946 buildings and structures and less than half of the Cold War resources. This survey concluded that 1,790 of the inventoried architectural resources were eligible for listing in the NRHP, including the 1942-era general-purpose warehouses (DLA 2004:3-83).

Surveys conducted prior to 1996 (see Section 3.4.6.1) revealed homesteads, cabins, railroad beds, and identification of the former Oro City community, providing evidence of the historic period. Three historic sites were designated for listing in the NRHP (DLA 2004:3-83).

3.4.6.3 American Indian Resources

The state of Nevada has 25 federally recognized American Indian tribes and colonies, including the Walker River Indian Reservation, which is located in Mineral County near the Hawthorne Army Depot. The Walker Lake Basin area has been home to American Indians for nearly 11,000 years. Members of the Paiute Tribe, the *Agai Ducutta Numa* (Trout Eater People), lived in this area and were a hunter-gather society at what is now called Walker Lake. The Walker River Indian Reservation currently occupies this area (DLA 2004:3-83).

3.4.6.4 Paleontological Resources

No paleontological resources have been identified on the Hawthorne Army Depot.

3.4.7 Site Infrastructure

In addition to the description provided below, a summary of Hawthorne Army Depot's sitewide infrastructure characteristics is presented in Table 3–9.

Table 3–9. Hawthorne Army Depot Infrastructure Characteristics

Resource	Current Site Usage	Site Capacity
Transportation (kilometers)		
Roads	395	395
Railroads	341	341
Electricity		
Energy consumption (megawatt-hours per year)	7,386	109,500[a]
Fuel		
Natural gas (cubic meters per year)	(b)	(b)
Fuel oil (liters per year)	3,790,000	(c)
Diesel fuel (liters per year)	Not available	Not available
Gasoline (liters per year)	644,300	(c)
Propane (liters per year)	234,980	(c)
Water (liters per year)	310,877,000	2,150,000,000

a Assumes 1 kilovolt-ampere equals 1 kilowatt (power factor of 1.0).
b Fuel resource not used on site.
c Limited only by the ability to transport resources to the site.
Note: All values based on reported use in 2002. To convert kilometers to miles, multiply by 0.6214; cubic meters to cubic feet, by 35.315; and liters to gallons, by 0.26417.
Source: DLA 2004:3-86.

3.4.7.1 Ground Transportation

Hawthorne Army Depot is located in Mineral County in Hawthorne, Nevada, approximately 209 kilometers (130 miles) southeast of Reno. U.S. Route 95 crosses the center of the depot and is the main Federal north/south highway in the region. The depot can also be accessed from the south by State Route 359 and from the north by State Route 839. The area is serviced by a U.S. Army–owned railroad maintained by Special Operations Consulting (DLA 2004:3-85; SOC 2009:Section 2). All rail shipments to the depot go through the Walker River Indian Reservation and the middle of town.

3.4.7.2 Electricity

Sitewide electricity is purchased from the Sierra Pacific Power Company, although the infrastructure is owned by the U.S. Army. The depot is served by three 2,500-kilowatt substations and one 5,000-kilowatt substation (DLA 2004:3-86). Currently there is no transmission line electrical power to the magazines, the proposed storage area. Electrical power in the magazine area is supplied by portable generators as needed (SOC 2009).

Annual electricity consumption at the Hawthorne Army Depot in 2002 was 7,386 megawatt-hours per year with a sitewide capacity of 109,500 megawatt-hours per year (DLA 2004:3-86).

3.4.7.3 Fuel

Currently, fuel oil is the type of fuel used on the Hawthorne Army Depot to fire boilers used for heating. Additionally, propane is used in some buildings for heat, hot water, and miscellaneous uses. Fuel oil and propane are both stored at the depot in above-and belowground storage tanks. Gasoline is used at the depot for small equipment such as mowers and is stored in one aboveground storage tank with a capacity of 3,790 liters (1,000 gallons). Currently, neither natural gas nor coal is used on the Hawthorne Army Depot (DLA 2004).

In 2002, sitewide fuel oil consumption at the Hawthorne Army Depot was about 3.8 million liters (1.0 million gallons); gasoline consumption was about 644,000 liters (170,000 gallons); and propane consumption was about 235,000 liters (62,000 gallons) (DLA 2004:3-86).

3.4.7.4 Water

The primary source of water for the Hawthorne Army Depot comes from the watershed of the Wassuk Mountains on the western site boundary. Surface-water runoff is diverted into three holding reservoirs—Rose Creek, Cat Creek, and Black Beauty. All of the surface water flows through Black Beauty Reservoir and is treated with chlorine before being sent to the depot distribution system. Water in Black Beauty Reservoir is supplemented by a well when surface flow reaches a predetermined minimum level. Water from this distribution system is transported throughout the depot via over 402 kilometers (250 miles) of pipe (DLA 2004:3-86).

Annual sitewide water consumption was approximately 311 million liters (82 million gallons) with a capacity of approximately 2 billion liters (568 million gallons) per year in 2002 (DLA 2004:3-86).

3.4.8 Waste Management

Nonhazardous and hazardous wastes are generated at the Hawthorne Army Depot as a result of routine site operations, environmental restoration activities, and construction activities. All Hawthorne Army Depot wastes are managed on site using appropriate treatment, storage, and disposal technologies, in compliance with applicable Federal and state statutes (DLA 2004:3-73).

In February 2006, the Hawthorne Army Depot was formally identified as the mercury consolidation location for the Defense Logistics Agency, Defense National Stockpile Center. The Defense National Stockpile Center mercury inventory targeted for consolidation at the Hawthorne Army Depot is approximately 4,436 metric tons (4,890 tons) (DNSC 2006; NDEP 2009a).

3.4.8.1 Waste Generation and Management

In general, the primary missions of the Hawthorne Army Depot involve the storage of military ammunition and the recycling of conventional ammunition. The Hawthorne Army Depot has five primary locations for the storage and management of hazardous waste. In total, these areas have capacity to store 3,972 55-gallon (208-liter) drums, 56,700 kilograms (125,000 pounds) of various ammunitions, and 174,182 kilograms (384,000 pounds) of contained hazardous material on pallets. Explosive hazardous waste is treated at the New Bomb Disposal Facility, located on 1,295 hectares (3,200 acres) of land 35 kilometers (22 miles) south of the main depot. The remaining hazardous waste (including large quantities of petroleum, oil, and lubricants in addition to other hazardous materials, such as solvents, pesticides, and compressed gases) is shipped off site for treatment and disposal at commercial facilities. Approximately 47,442 kilograms (104,590 pounds) of hazardous waste is generated each year at the Hawthorne Depot (DLA 2004:3-73).

The Hawthorne Army Depot holds two hazardous waste RCRA Part B permits. One permit is for the treatment and storage of hazardous waste at the main Hawthorne Army Depot. The second permit is for the New Bomb Disposal Facility. The Hawthorne Army Depot is classified as an RCRA large-quantity generator. Ongoing RCRA-based remedial investigations have been initiated at 128 onsite SWMUs as a result of past site operations (DLA 2004:3-73).

Nonhazardous wastes generated at the Hawthorne Army Depot include construction and demolition waste (e.g., wood, concrete, metal objects, soil, and roofing materials), office waste, lunchroom waste, and janitorial waste. Nonhazardous waste generated in the housing area is collected by a commercial waste–hauling contractor and disposed of at the Hawthorne Landfill west of Hawthorne. Construction debris, inert mock-munitions items, office waste, lunchroom waste, and horticultural waste generated on the remainder of the depot are disposed of in the state-permitted, onsite construction and debris landfill. Treated wood and asbestos are disposed of in the state-permitted Asbestos and Treated Wood Landfill. This landfill has a permitted disposal capacity of 467,900 cubic meters (612,000 cubic yards) and consists of six unlined cells; one cell is designated for asbestos-containing material (DLA 2004:3-74).

Sanitary wastewater generated in the industrial and housing areas of the Hawthorne Army Depot is discharged to a sewage treatment facility. The Hawthorne Army Depot is in the process of connecting its sanitary sewer system to the Town of Hawthorne sewage treatment facility. Locations other than the Western Area Demilitarization Facility Area and the Industrial Area are serviced by site septic systems (settling tanks that discharge into subsurface drain fields) (DLA 2004:3-74).

3.4.8.2 Waste Minimization

As one of its primary facility missions, the Hawthorne Army Depot supports various ammunition demilitarization programs. These demilitarization programs include ongoing requirements to recycle metal ammunition components (NDEP 2009a).

3.4.9 Occupational and Public Health and Safety

3.4.9.1 Normal Operations

Environmental studies at the Hawthorne Army Depot have not specifically focused on mercury exposure health effects; however, investigations are ongoing to delineate areas of environmental concern. Depot-wide monitoring has consistently detected the presence of VOCs and explosives in groundwater. Benzene, ethylbenzene, toluene, xylenes, and methyl tertiary-butyl ether have been detected in the subsurface soil as a result of diesel fuel and gasoline releases (DLA 2004:3-75).

Nevada State Health Division, Bureau of Health Protection Services, indicates that human health studies have not been conducted in the vicinity of Hawthorne Army Depot outside of the ongoing Installation Restoration Program studies. Historically, mercury mining has been conducted in the area, thus, mercury occurs naturally and the mercury detected in Walker Lake is not thought to be related to Hawthorne Army Depot activities. Mercury detections in Walker Lake are currently being studied by the USFWS. Mercury has not been detected in the drinking water supply; however, occasionally elevated concentrations of antimony, arsenic, and fluoride are detected. The Nevada Division of Environmental Protection indicates that no evidence of elevated mercury concentrations has been found in the soil at the Hawthorne Army Depot. Extensive explosives contamination (TNT [trinitrotoluene] and RDX [cyclotrimethylenetrinitramine]) in the soil is currently under remediation (DLA 2004:3-75). Soil and groundwater conditions are described in Sections 3.4.2.2 and 3.4.3.2. The infrastructure currently available in the proposed mercury storage warehouses consists of concrete floors and transite roofing. The buildings are vented; however, there is currently no provision for fire protection (DLA 2004:2-11, 3-86; Hawthorne 2009:2.1).

3.4.9.2 Facility Accidents

The structures at Hawthorne Army Depot have not had any spills, fires, explosions, leaks, or other such incidents. Explosives are housed in a magazine within the site Quantity Distance arcs of the candidate buildings (Hawthorne 2009:2.8.3). A fire in a storage magazine containing mercury batteries did not release a reportable quantity of hazardous constituents. Remediation of the site was completed and the fire-damaged building was removed (DLA 2004:3-75).

The Hawthorne Army Depot has an established spill prevention, control, and countermeasures plan and integrated contingency plan to maintain adequate response preparedness for fire and hazardous materials releases. The Hawthorne Army Depot operates and maintains onsite fire and emergency services and emergency response teams. The site contractor provides emergency service to respond to all fires, explosions, and spills where the real or potential threat of fire and explosion exists. Emergency services are initiated through 911 reporting (DLA 2004:3-75–3-76). Mutual response assistance agreements are in place with nearby agencies (Hawthorne 2009:2.8.2).

3.4.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to the site and employee traffic. These include death or injury from accidental release of nonradioactive materials, effects of air pollutant emissions emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of radioactive or nonradioactive materials. There is no current risk assessment available for transportation of materials to and from the Hawthorne Army Depot.

3.4.10 Socioeconomics

Due to the local employment dynamics compiled by the Census Bureau, the majority of people employed in the Hawthorne area are estimated to reside in three counties: Mineral, Lyon, and Churchill (DOC 2009a). Therefore, these three counties have been identified as the ROI in this socioeconomics analysis. In 2001, the Hawthorne Army Depot employed 500 persons (Hawthorne 2001:3).

3.4.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of the ROI increased by approximately 21 percent to 38,883. By July 2009, the unemployment rate of the ROI was 13 percent, which was approximately equal to the unemployment rate for Nevada (12.7 percent) (BLS 2009).

3.4.10.2 Demographic and Housing Characteristics

In 2008, the estimated population of the three-county ROI was 82,602. From 2000 to 2008, the ROI population grew by 30 percent, nearly identical to the growth rate throughout the entire state of Nevada (30.1 percent) (DOC 2009b). In 2000, the percentage of the ROI population under the age of 18 was 28 percent; women ages 18 to 39 composed 13.2 percent (DOC 2009d). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. There were

31,654 housing units in the ROI in 2007, an increase of 18 percent from 2000 (DOC 2008). In 2000, 64 percent of housing units were owner occupied, 25 percent were renter occupied, and 10 percent were vacant (DOC 2009d).

3.4.10.3 Local Transportation

The primary transportation routes in the area of the Hawthorne Army Depot are U.S. Route 95 and State Route 359. The depot is accessible from U.S. Route 95, rail, and a regional airport. The highest volume of traffic on U.S. Route 95 occurs just north of C Street. The average annual daily traffic count on this segment of U.S. Route 95 in 2008 was 5,000 vehicles per day (NVDOT 2009). Rail access is provided by a U.S. Army–owned railroad, which runs through the Walker River Indian Reservation and connects to the Union Pacific main line that spans northern Nevada. The Hawthorne Industrial Airport is a county-owned airport classified as general aviation.

3.4.11 Environmental Justice

The 16-kilometer (10-mile) radius surrounding the storage location at the Hawthorne Army Depot encompasses part of Mineral County, Nevada. Figure 3–6 shows populations residing in Mineral County, as reported in the 1990 and 2000 censuses (DOC 2009d, 2009e). In this figure, lightly shaded bars show populations in 1990, while the darker bars show those in 2000. In the decade between 1990 and 2000, the total population of Mineral County declined by approximately 22 percent to 5,071; the minority population decreased by approximately 5 percent to 1,516; and the low-income population decreased by 5 percent to 761. Demographic data from the 2000 census show that the American Indian and Alaska Native populations residing in Mineral County composed approximately 51 percent of the county's total minority population. Among the minority populations, only the American Indian population increased from 1990 to 2000; all other minority populations declined. Persons who declared that they are of Hispanic or Latino origin are included in the "total Hispanic" population shown in Figure 3–6, regardless of race. They composed approximately 28 percent of the total minority population residing in Mineral County in 2000.

No additional data beyond the 2000 census are available for Mineral County due to the total population falling short of the threshold required for inclusion in the 1-year and 3-year *ACS* estimates (65,000 and 20,000, respectively).

Approximately 3,561 people lived within 16 kilometers (10 miles) of the Hawthorne Army Depot in 2000 (DOC 2009d). This area included an estimated 20 percent minority and 10 percent low-income population. By comparison, Mineral County included a 30 percent minority and 15 percent low-income population, and Nevada included a 35 percent minority and 10 percent low-income population. There are five census block groups located within the 16-kilometer (10-mile) radius surrounding the Hawthorne Army Depot, none of which contained a disproportionately high number of minority or low-income individuals. Figure 3–7 shows the cumulative populations living at a given distance from the Hawthorne Army Depot. The population living within 16 kilometers (10 miles) of the Hawthorne Army Depot is concentrated in the town of Hawthorne. The Walker River Indian Reservation is located approximately 13 kilometers (8 miles) north of the Hawthorne Army Depot site boundary; however, the reservation does not lie within the 16-kilometer (10-mile) radius surrounding the proposed storage location at the depot.

No one resides within approximately 3.2 kilometers (2 miles) of the storage location at the Hawthorne Army Depot (DOC 2009d).

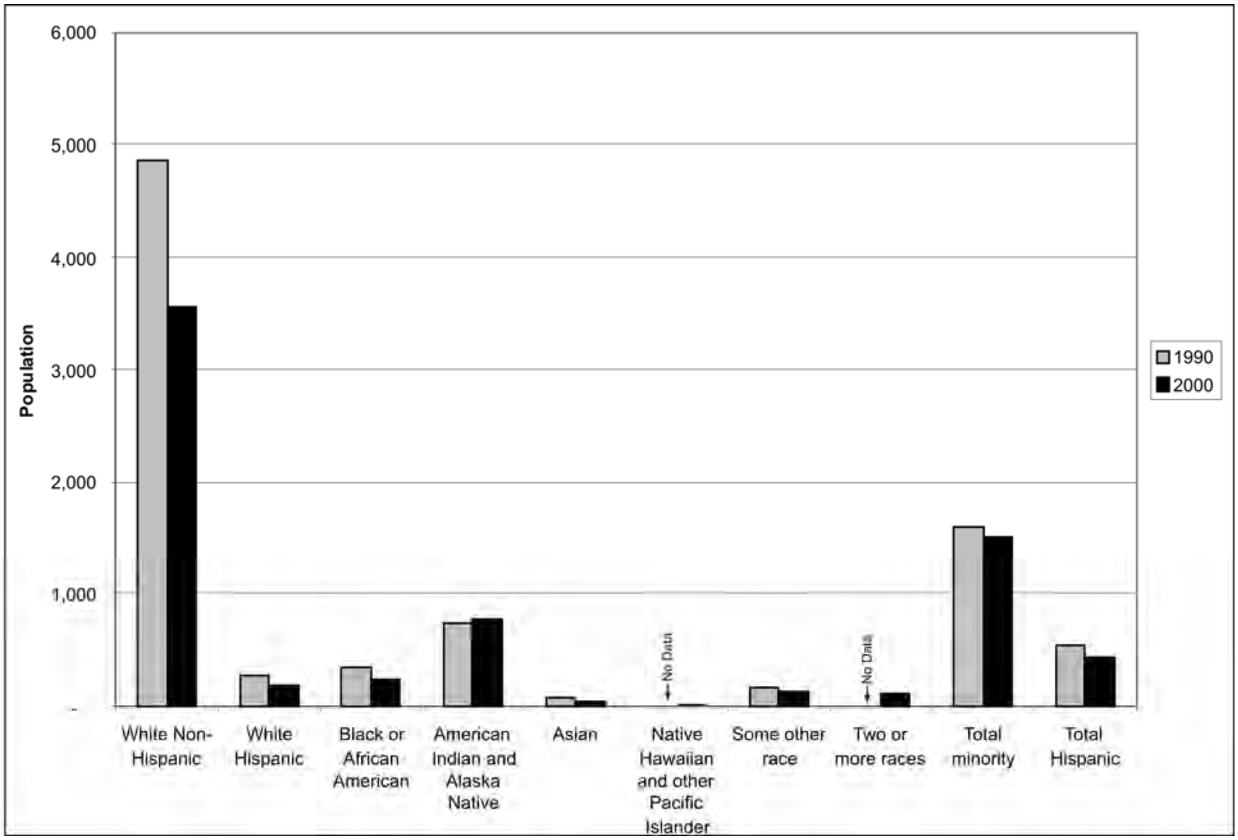


Figure 3–6. Populations Residing in Mineral County, Nevada, Surrounding the Hawthorne Army Depot in 1990 and 2000

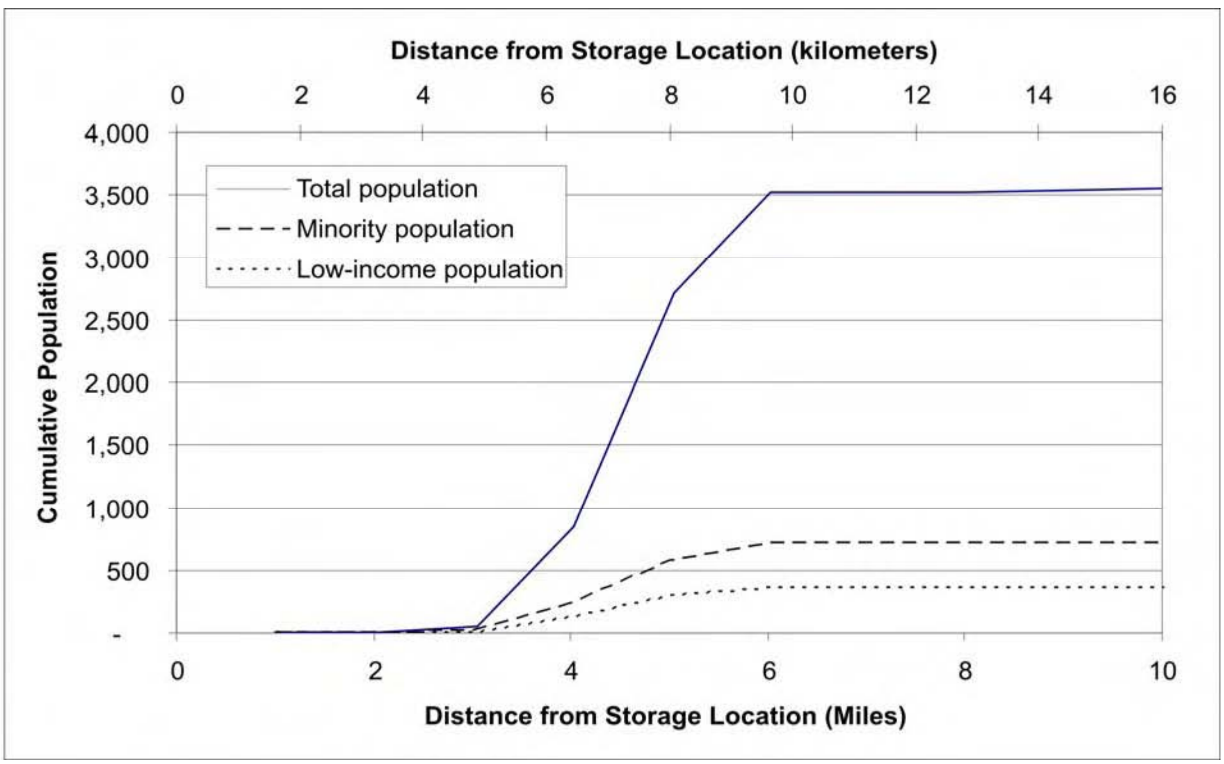


Figure 3–7. Cumulative Populations Residing Within 16 Kilometers (10 Miles) of the Hawthorne Army Depot

3.5 IDAHO NATIONAL LABORATORY

3.5.1 Land Use and Visual Resources

3.5.1.1 Land Use

INL occupies 230,323 hectares (569,135 acres) in southeastern Idaho, approximately 39 kilometers (24 miles) west of Idaho Falls. Most of the site is within Butte County, but portions are also in Bingham, Jefferson, Bonneville, and Clark Counties. Presently INL is administered, managed, and controlled by DOE (O'Rourke 2006:4, 11). Much of INL is open space that has not been designated for specific use, with approximately 2 percent of the total INL site area (4,600 hectares [11,400 acres]) used for facilities and operations (DOE 2002c:4-123). Facility areas, including the Radioactive Waste Management Complex (RWMC) and Idaho Nuclear Technology and Engineering Center (INTEC), are sited within a Central Core Area of about 93,100 hectares (230,000 acres). Public access to most facilities is restricted. Figure 3–8 shows the generalized land use at INL. DOE land use plans and policies applicable to INL are discussed in the *Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report* (O'Rourke 2006).

In 1999, 29,244 hectares (72,263 acres) of open space in the northwest corner of the site was designated as the INL Sagebrush-Steppe Ecosystem Reserve. This area represents one of the last sagebrush-steppe ecosystems in the United States and provides a home for a number of rare and sensitive species of plants and animals (O'Rourke 2006:26, 53).

Land use designations at INL include Facility Operations, Grazing, General Open Space, and Infrastructure (e.g., roads). Approximately 60 percent of the site is used for cattle and sheep grazing. Facility Operations include industrial and support operations associated with energy research and waste management activities. Land is also used for environmental research associated with the designation of INL as a National Environmental Research Park.

The Federal Government, the State of Idaho and various private parties own lands immediately surrounding INL; BLM administers about 75 percent of the adjacent land. Regional land uses include grazing, wildlife management, mineral and energy production, recreation, and crop production (O'Rourke 2006:13). Small communities and towns near the INL boundaries include Mud Lake and Terreton to the east; Arco, Butte City, and Howe to the west; and Atomic City to the south. Two National Natural Landmarks border INL: Big Southern Butte (2.4 kilometers [1.5 miles] south) and Hell's Half Acre (2.6 kilometers [1.6 miles] southeast). A portion of Hell's Half Acre National Natural Landmark is designated as a wilderness study area. The Black Canyon Wilderness Study Area is adjacent to INL, and the Craters of the Moon Wilderness Area is about 19 kilometers (12 miles) southwest of the site's western boundary. On November 9, 2000, President Clinton signed a proclamation that added 267,500 hectares (661,000 acres) to the 21,850-hectare (54,000-acre) Craters of the Moon National Monument, which encompasses this wilderness area. Fort Hall Reservation, the permanent homeland of the Shoshone Bannock Peoples, is located approximately 40 kilometers (25 miles) southeast of INL. Certain areas of the INL site are recognized as having significant cultural and religious significance to members of these tribes.

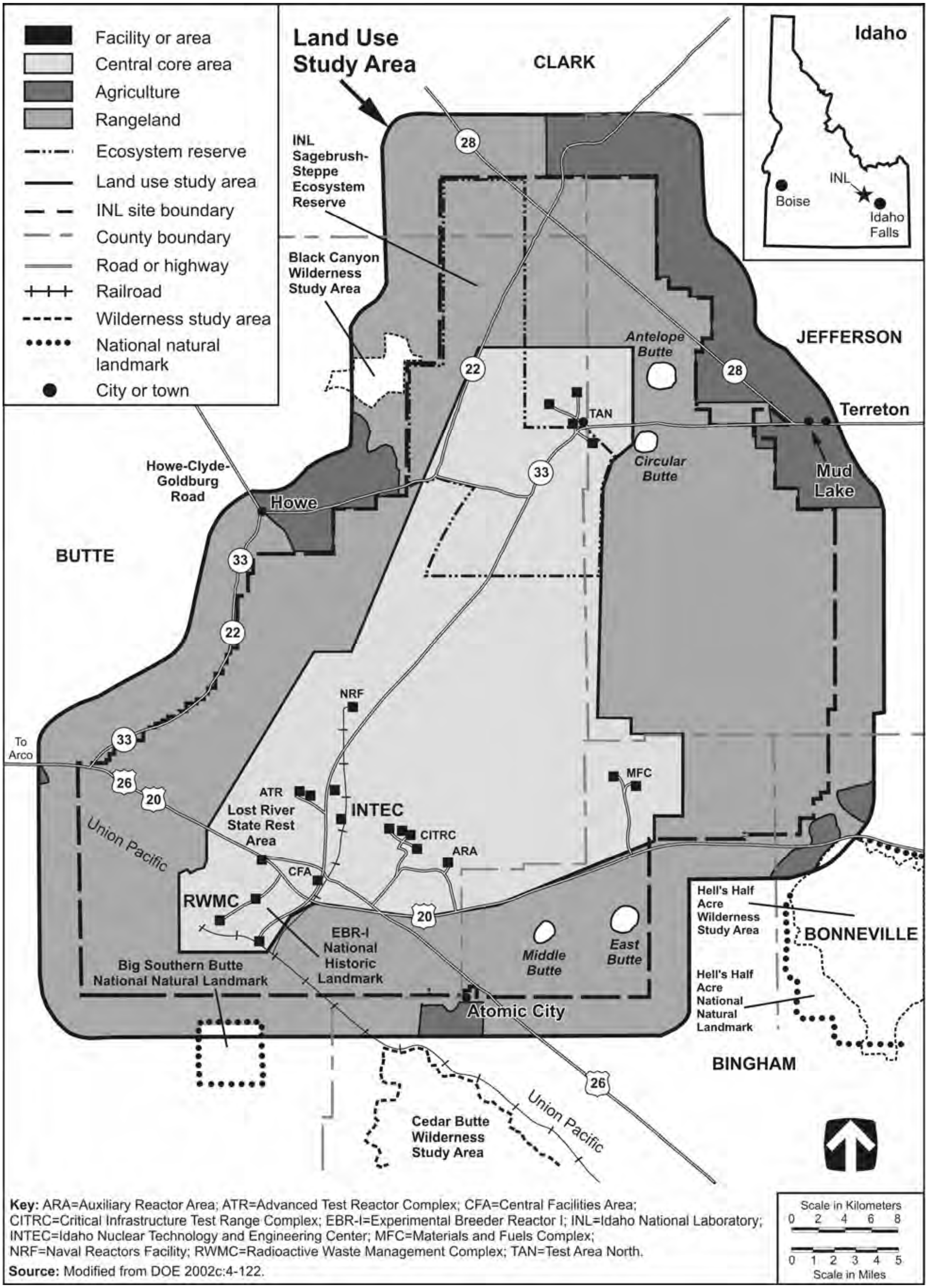


Figure 3–8. Generalized Land Use at Idaho National Laboratory and Vicinity

Radioactive Waste Management Complex

Land in the RWMC is used for industrial activities associated with disposal and transfer of hazardous and radioactive waste. Other land uses include support-related facilities such as offices and maintenance shops. The RWMC occupies approximately 76 hectares (187 acres) in the southwest corner of the Central Core Area, approximately 8 kilometers (5 miles) north of the site boundary and 3.2 kilometers (2 miles) south of the Big Lost River. The RWMC is divided into four zones: the Administrative Area, the Operation Zone, the Subsurface Disposal Area (SDA), and the Transuranic Storage Area (DOE 1999c:4.2-1, 4).

Idaho Nuclear Technology and Engineering Center

Land within INTEC is disturbed; it is used to store spent nuclear fuel and radioactive waste, treat radioactive waste, and develop waste management technologies. The area includes about 85 hectares (210 acres) within the perimeter fence and an additional 22 hectares (54 acres) outside the fence. A number of wastewater and percolation ponds are also present on the site. INTEC is 12 kilometers (7.5 miles) north of the site boundary and 0.8 kilometers (0.5 miles) southeast of the Big Lost River. Facilities at INTEC include spent nuclear fuel storage and processing areas, a waste solidification facility and related HLW storage facilities, remote analytical laboratories, warehouse facilities, and a coal-fired steam-generating plant that is in standby (DOE 1999c:4.2-4; 2000:3-45).

3.5.1.2 Visual Resources

The Bitterroot, Lemhi, and Lost River Mountain ranges border INL on the north and west. Volcanic buttes near the southern boundary of INL can be seen from most locations on the site. INL generally consists of open desert land covered by big sagebrush and grasslands. Uncultivated grazing range borders much of the site. Although INL has prepared a comprehensive land use and environmental stewardship plan, no specific visual resource standards have been established (O'Rourke 2006). INL facilities have the appearance of low-density commercial/industrial complexes that are widely dispersed throughout the site. Structure heights generally range from 3 to 30 meters (10 to 100 feet); a few stacks and towers reach 76 meters (250 feet). Although many INL facilities are visible from highways, most are more than 0.8 kilometers (0.5 miles) from public roads (DOE 2000:3-46).

Public lands adjacent to INL are under BLM jurisdiction and have a VRM Class II rating. Undeveloped lands within INL have a VRM rating consistent with Classes II and III. Management activities within these classes may be seen, but should not dominate the view. The VRM class rating of developed areas of the site is consistent with Class IV, indicating that management activities dominate the view and are the focus of viewer attention (DOI 1986:6, 7). The Black Canyon Wilderness Study Area is located adjacent to the northwestern boundary of INL, and the Hell's Half Acre Wilderness Study Area is located 2.6 kilometers (1.6 miles) southeast of INL's eastern boundary. The Craters of the Moon Wilderness Area is approximately 19 kilometers (12 miles) southwest of INL's western boundary. Other natural features of visual interest within a 40-kilometer (25-mile) radius include Big Lost River, Middle Butte, Big Southern Butte National Natural Landmark, East Butte, and Saddle Mountain (DOE 2000:3-46).

Radioactive Waste Management Complex

The RWMC is a restricted-access area located in a depression circumscribed by basaltic lava ridges. The ground surface is relatively flat at an elevation of about 1,525 meters (5,000 feet) above mean sea level. The RWMC maintains industrial uses consistent with a VRM Class IV rating, which means management activities dominate the view and are the focus of the viewer's attention (DOE 1999c:4.5-1). The RWMC is visible from U.S. Routes 20 and 26, which traverse the southern portion of INL.

Idaho Nuclear Technology and Engineering Center

While the Fuel Processing Facility is the largest building at INTEC, the tallest structure is the main stack, which is 76 meters (250 feet) tall. The VRM rating of INTEC is Class IV. INTEC is visible in the middle ground from U.S. Routes 20 and 26, with Saddle Mountain in the background (DOE 2000:3-46).

3.5.2 Geology, Soils, and Geologic Hazards

3.5.2.1 Geology

INL occupies a rather flat area on the northwestern edge of the Eastern Snake River Plain, which is part of the Columbia Plateau physiographic province. The area consists of a broad plain built up from the eruptions of multiple flows of basaltic lava over the past 4 million years. Four northwest-trending volcanic rift zones that cut across the Eastern Snake River Plain have been identified as the source areas for the most recent basaltic eruptions that occurred between 2,100 and 4 million years ago. Elevations on the site range from 1,450 to 1,953 meters (4,780 to 6,410 feet) above mean sea level. Generally, the terrain slopes toward the Big Lost River. The Eastern Snake River Plain is bounded on the north and south by the north-to-northwest-trending mountains of the northern Basin and Range physiographic province, with peaks up to 3,660 meters (12,000 feet) in height that are separated by intervening basins filled with terrestrial sediments and volcanic rocks. The peaks are sharply separated from the intervening basins by late Tertiary to Quaternary normal faults. To the northeast, the Eastern Snake River Plain is bounded by the Yellowstone Plateau (DOE 2002d:4-20, 4-21, 4-23; INL 2009a:1-9, 1-26–1-28).

The Arco Segment of the Lost River Fault is mapped as ending about 7 kilometers (4.3 miles) from the INL boundary. The Howe Segment of the Lemhi Fault ends near the northwest boundary of the site. Both segments are considered capable or potentially active. A capable fault is one that has had movement at or near the surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years (10 CFR 100; DOE 2005b:3-12).

The Eastern Snake River Plain formed as a result of interaction of the North American tectonic plate with a rising plume and hot mantle rocks, the so-called Yellowstone Hotspot. As the North American plate moved southwestward, its interaction with the hotspot produced the low-elevation, low-relief volcanic province that is the Eastern Snake River Plain. The crust of the INL area was directly above the hotspot about 4.3 to 6.5 million years ago (INL 2009a:1-27).

The upper 1 to 2 kilometers (0.6 to 1.2 miles) of the crust beneath INL is composed of a sequence of Quaternary (recent to 2 million years old) basalt lava flows and poorly consolidated sedimentary interbeds that are collectively called the Snake River Group. The lava flows at the surface range from 2,100 to 2 million years old (DOE 2005b:3-10; INL 2009a:1-27). The sediments are composed of fine-grained silts that were deposited by wind; silts, sands, and gravels deposited by streams; and clays, silts, and sands deposited in lakes such as Mud Lake and its much larger Ice Age predecessor, Lake Terreton. Basaltic volcanism on the Eastern Snake River Plain has been a sporadic process, with sediments accumulating between volcanic episodes. During short periods of volcanic activity, basalt lava flows were erupted from vents concentrated in the four volcanic rift zones and along the central axis of the Eastern Snake River Plain (the Axial Volcanic Rift Zone). The basalts, along with intercalated sediments, are underlain by a great thickness of rhyolitic volcanic rocks that erupted when the area was over the Yellowstone Hotspot more than 4 million years ago (INL 2009a:1-27, 1-30).

Several Quaternary rhyolite domes are located along the Axial Volcanic Rift Zone near the southern and southeastern borders of INL. Their names and ages are Big Southern Butte (300,000 years), a rhyolite dome near Cedar Butte (400,000 years), East Butte (600,000 years), Middle Butte (age unknown), and an unnamed butte near East Butte (1.2 million years). Paleozoic carbonate rocks (limestones), late-Tertiary rhyolitic volcanic rocks, and large alluvial fans occur in limited areas along the northwest margin of INL.

A wide band of Quaternary mainstream alluvium (unconsolidated gravels and sands) extends along the course of Big Lost River from the southwestern corner of INL to the Big Lost River Sinks area in north-central INL. Elsewhere at INL, the basaltic lava flows are variably covered with a thin veneer of eolian silt (loess), which can be up to several meters thick, but mostly ranges in thickness from 0 to 2 meters (6.6 feet) (INL 2009a:1-30).

Mineral resources within INL include sand, gravel, pumice, silt, clay, and aggregate (e.g., sand, gravel, crushed stone). These resources are extracted at several quarries or pits at INL and are used for road and new facility construction and maintenance, waste burial activities, and ornamental landscaping. The geologic history of the Eastern Snake River Plain makes the potential for petroleum production at INL very low. The potential for geothermal energy exists at INL and in parts of the Eastern Snake River Plain; however, a study conducted in 1979 identified no economically productive geothermal resources (DOE 2005b:3-12).

3.5.2.2 Soils

Four basic soilscapes exist at INL: river-transported sediments deposited on alluvial plains, fine-grained sediments deposited into lake or playa basins, colluvial sediments originating from bordering mountains, and windblown sediments (silt and sand) over lava flows. The alluvial deposits follow the courses of the modern Big Lost River and Birch Creek. The playa soils are found in the north-central part of the site; the colluvial sediments, along the western edge of INL; and the windblown sediments, throughout the rest of the site. Surficial sediments range in thickness from less than 0.3 meters (1 foot) at basalt outcrops east of INTEC to 95 meters (312 feet) near the Big Lost River sinks. No soils designated as prime farmland exist within the INL boundaries (DOE 2005b:3-15).

3.5.2.3 Geologic Hazards

The seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are different. The Eastern Snake River Plain has historically experienced infrequent small-magnitude earthquakes (DOE 2005b:3-12). In contrast, the major episode of Basin and Range faulting that began approximately 16 million years ago continues today (Rodgers et al. 2002). Since the installation of INL's seismic network in 1971, only 35 microearthquakes (magnitude of less than 2.0) have been detected within the Eastern Snake River Plain. However, INL's seismic stations record about 2,000 annually elsewhere in southeast Idaho (INL 2009b). Thus, the Eastern Snake River Plain and INL have lower seismicity than adjacent regions. Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects.

The largest historic earthquake near INL took place on October 28, 1983, about 90 kilometers (56 miles) northwest of the western site boundary, near Borah Peak in the Lost River Range (part of the Basin and Range Province). It occurred in the middle portion of the Lost River Fault. The earthquake had a surface-wave magnitude of 7.3 (moment magnitude of 7.0). An MMI of up to IX was assigned for effects at the event's epicenter (DOE 2005b:3-12; INL 2009a:1-37). The Advanced Test Reactor within the INL Advanced Test Reactor Complex (ATRC) experienced an MMI of VI during this event, with no damage to the facility found upon inspection (DOE 2005b:3-12). Since 1973, 25 earthquakes, other than the Borah Peak event and its immediate after shocks, have been recorded within 100 kilometers (62 miles) of south-central INL, ranging in magnitude from 2.6 to 3.9. These represent minor earthquakes, with none centered closer than 76 kilometers (47 miles) from the south-central portion of the site. Most of the earthquakes had epicenters to the north and west of INL in the Basin and Range Province (USGS 2009h).

Earthquakes with moment magnitudes higher than 5.5 and associated strong ground shaking and surface fault rupture are not likely within the Eastern Snake River Plain given the region's seismic history and geology. Moderate-to-strong ground shaking from earthquakes in the Basin and Range Province, however, could affect INL (DOE 2002d:4-23). Consequently, INL authorities have supported efforts to estimate, for all regional earthquake sources, the levels of ground shaking that are expected at INL facilities—specifically, estimate of ground shaking levels that would not be exceeded in specified time periods. A probabilistic ground-motion study for all facility areas was finalized in 2000 (INEEL 2000). The INL ground-motion evaluation incorporated the results of all geologic, seismologic, and geophysical investigations conducted since the 1960s. The fault segments closest to INL facilities, the Lost River, Beaverhead, and Lemhi Faults, were studied in detail. Results of these investigations indicated that these faults are capable of generating earthquakes of magnitude 6.6 to 7.2, and that the most recent earthquakes on the southernmost fault segments occurred more than 15,000 years ago. The data collected also continue to support historic observations that the alternating sequence of basalt and sedimentary interbeds composing the Eastern Snake River Plain tend to dampen seismic energy, resulting in reduced earthquake ground motions as compared to locations with uniform basaltic rock (INL 2009b).

Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity). As previously described in Section 3.2.2.3, the latest probabilistic PGA data from the USGS are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For a south-central INL location, the calculated PGA is approximately 0.12 *g* (USGS 2009d). For comparison, the aforementioned Borah Peak earthquake produced PGA's ranging from 0.022 *g* to 0.078 *g* across INL (INL 2009a:1-37; Jackson and Boatwright 1985:51, 57).

Basaltic volcanic activity occurred over a period from about 2,100 to 4 million years ago in the INL site area. Although no eruptions have occurred on the Eastern Snake River Plain during recorded history, lava flows from the Hell's Half Acre lava field erupted near the southern INL boundary as recently as 5,400 years ago. The most recent eruptions within the area occurred about 2,100 years ago in an area 31 kilometers (19 miles) southwest of the site at the Craters of the Moon Wilderness Area. The estimated recurrence interval (repeat time) for volcanism associated with the five identified volcanic zones ranges from 16,000 to 100,000 years (DOE 2005b:3-15). Because the Yellowstone Hotspot is no longer present beneath the INL area, there is no threat of catastrophic volcanism such as at Yellowstone. The main volcanic threat at INL is from basaltic lava flows. INL seismic stations are located near or within identified volcanic rift zones to provide early warning of any signs of renewed volcanic activity (INL 2009b).

Radioactive Waste Management Complex

The RWMC is situated approximately 29 kilometers (18 miles) to the west of the terminus of the Arco Segment of the Lost River Fault and on the eastern edge of the Arco Volcanic Rift Zone. This rift zone has an estimated recurrence interval of 16,000 years (DOE 2005b:3-11). Topographically, RWMC is situated in a small valley surrounded by basaltic ridges rising to about 18 meters (60 feet) above the landscape. Surface sediments vary in thickness from about 0.6 to 7 meters (2 to 23 feet) and consist of unconsolidated clay, silt, and gravel. The elevation of the RWMC is 1,527 meters (5,010 feet) above mean sea level (DOE 1999c:4.6-1).

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The Arco Segment of the Lost River Fault terminates approximately 32 kilometers (20 miles) to the west of INTEC. INTEC is also situated near the western edge of the Howe-East-Butte Volcanic Rift Zone, which has an estimated recurrence interval for volcanic activity of 100,000 years (DOE 2005b:3-11). However, no volcanic vents in the vicinity of INTEC are younger than 400,000 years, and the probability of volcanic activity from this source is considered low based on the estimated recurrence interval (DOE 2002d:4-23–4-25). The complex is situated adjacent to the Big Lost River in relatively flat terrain. The average elevation of INTEC is approximately 1,499 meters (4,917 feet) above mean sea level. Surface sediments are alluvial deposits from the Big Lost River that are composed of gravel-sand-silt mixtures that are 7.6 to 19.8 meters (25 to 65 feet) thick and that contain locally interbedded silt and clay deposits that are generally less than 2.7 meters (9 feet) thick. All soil near INTEC was originally fine loam over a sand or sand-cobble mix deposited in the floodplain of the Big Lost River. However, all natural soils within INTEC fences have been disturbed. The soils beneath the INTEC area are not subject to liquefaction because of the high content of gravel mixed with the alluvial sands and silts. In addition, the sediments are not saturated (DOE 2000:3-63).

As a result of past practices, radioactive and hazardous materials have been released to surface soils at INTEC. Contaminants found in the soil include metals, organic compounds and radionuclides. Results from CERCLA (42 U.S.C. 9601 et seq.) risk assessments indicated that radionuclides are the most significant soil contaminants (DOE 2002d:4-23).

3.5.3 Water Resources

3.5.3.1 Surface Water

INL is in the Mud Lake–Lost River Basin (also known as the Pioneer Basin). This closed drainage basin includes three main streams—Big and Little Lost Rivers and Birch Creek (see Figure 3–9). These three streams are essentially intermittent and drain the mountain areas to the north and west of INL, although most flow is diverted for irrigation in the summer months before it reaches the site boundaries. Flow that reaches INL infiltrates the ground surface along the length of the streambeds in the spreading areas at the southern end of INL and, if the streamflow is sufficient in the ponding areas (playas or sinks), in the northern portion of INL as well. During dry years, there is little or no surface-water flow on the INL site. Because the Mud Lake–Lost River Basin is a closed drainage basin, water does not flow off INL, but instead infiltrates the ground surface to recharge the aquifer or is consumed by evapotranspiration. Big Lost River flows southeast from Mackay Dam, past the city of Arco, and onto the Snake River Plain. On the INL site near the southwestern boundary, a diversion dam prevents flooding of downstream areas during periods of heavy runoff by diverting water to a series of natural depressions or spreading areas. During periods of high flow or low irrigation demand, Big Lost River continues northeastward past the diversion dam, passes within about 61 meters (200 feet) of INTEC, and ends in a series of playas 24 to 32 kilometers (15 to 20 miles) northeast of INTEC, where the water infiltrates the ground surface (DOE 2002d:4-40, 2005b:3-15–3-17).

Flow from Birch Creek and Little Lost River infrequently reaches INL. The waters in these streams are diverted in summer months for irrigation prior to reaching the site. Yet during periods of unusually high precipitation or rapid snowmelt, those waters can enter INL from the northwest and infiltrate the ground, recharging the underlying aquifer (DOE 2005b:3-17).

The only other surface-water bodies on the site are natural wetland-like ponds and manmade percolation and evaporation ponds (DOE 2005b:3-17). The latter are used for wastewater management at INL. Discharges to the ground surface are made through infiltration ponds, trenches (ditches), and a sprinkler irrigation system. Wastewater at INTEC also is discharged to the INTEC Sewage Treatment Plant and associated infiltration trenches and a sprinkler irrigation system at the Central Facilities Area that is used during the summer months to apply industrial and treated sanitary wastewater (DOE 2008b:5.2, 5.3, 5.18). Discharge of wastewater to the land surface is regulated under Idaho Wastewater Reuse Permit (WRP) rules (IDAPA 58.01.17). An approved WRP normally requires the monitoring of nonradioactive parameters in the influent waste, effluent waste, and groundwater, as applicable. WRPs generally require compliance of specified groundwater monitoring wells with Idaho groundwater quality primary and secondary constituent standards (IDAPA 58.01.11). The facilities covered by WRPs include the Central Facilities Area Sewage Treatment Facility, the INTEC New Percolation Ponds, and the Test Area

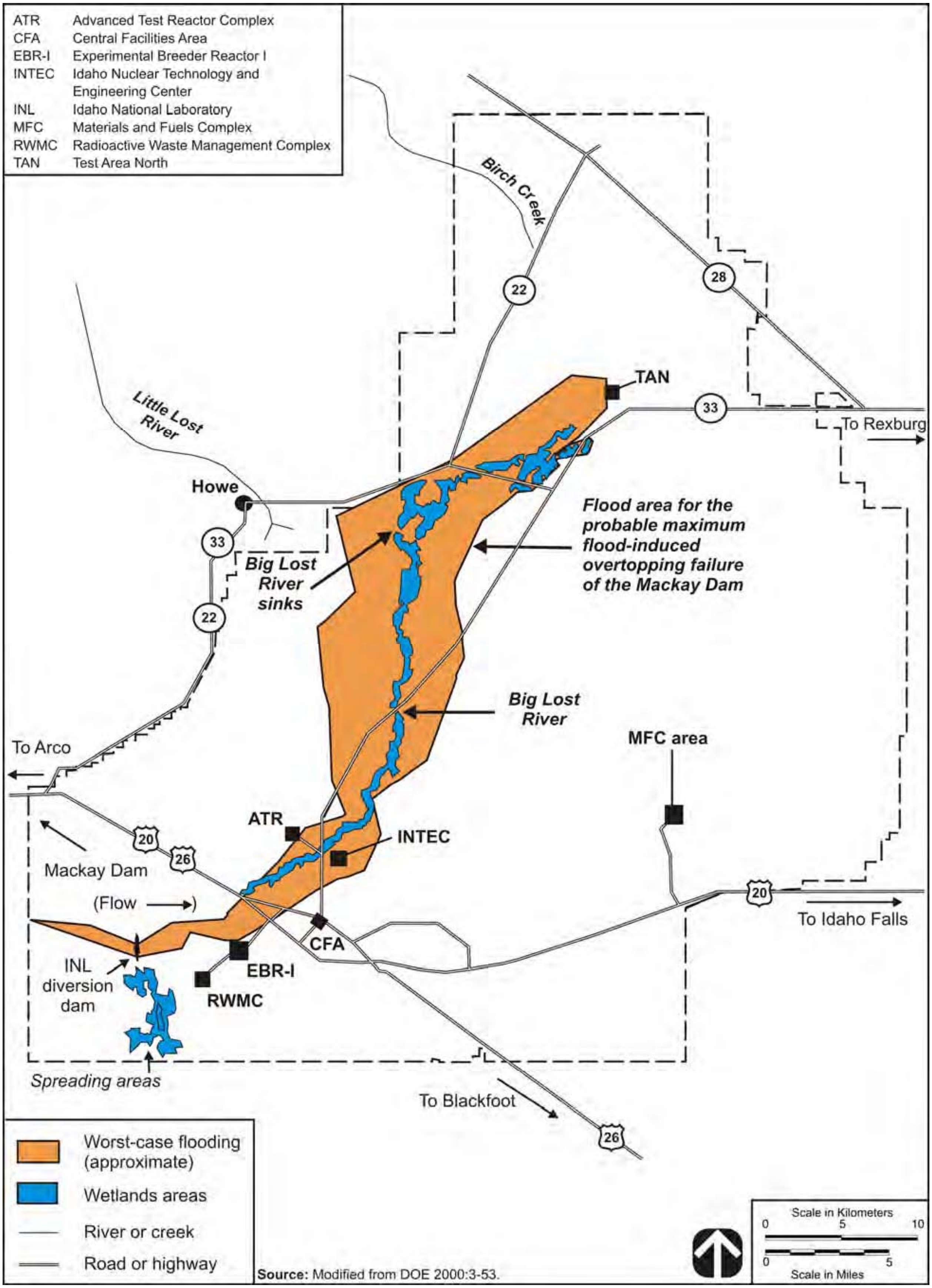

Figure 3–9. Surface-Water Features at Idaho National Laboratory

North/Technical Support Facility Sewage Treatment Facility. In addition, the ATRC Cold Waste Pond has been authorized to operate under the Idaho WRP rules, although no permit has been issued. Also, INL has submitted an application to the State of Idaho to obtain a WRP for the Materials and Fuels Complex Industrial Waste Pond (DOE 2008b:5.1–5.5).

Water bodies in Idaho are designated by the Idaho Department of Environmental Quality for specific and varied uses to ensure protection of the water quality for such uses. Big Lost River, Little Lost River, and Birch Creek in the vicinity of INL have been designated as cold water aquatic communities available for use in salmonid spawning and primary contact recreation, and the Big Lost River sinks and channel and lowermost Birch Creek, as domestic water supplies and special resource waters (IDAPA 58.01.02). In general, the waters of Big Lost River, Little Lost River, and Birch Creek are similar in quality because they reflect the similar carbonate mineral compositions of the mountain ranges drained by them, as well as chemically similar irrigation water return flows. There is no use or discharge of effluents to surface water on the site (DOE 2005b:3-17).

INL's General Permit for Storm Water Discharges from Construction Sites was issued in June 1993 and has been renewed twice since then. INL site contractors obtain coverage under the General Permit for Individual Construction Projects. Stormwater pollution prevention plans are completed for individual construction projects. Inspections of construction sites are performed in accordance with permit requirements. Only construction projects that are determined to have a reasonable potential to discharge pollutants to a regulated surface water are required to have a stormwater pollution prevention plan and permit (DOE 2008b:2.10, 2.11).

Flooding of the Big Lost River was evaluated for its potential impact on INL facilities. Included was an evaluation of the impact of the probable maximum flood due to the failure of Mackay Dam, 72 kilometers (45 miles) upstream of INL (see Figure 3–9). This flood would result in a peak surface-water elevation at INTEC of 1,499 meters (4,917 feet)—the average elevation at that facility—as well as a peak flow of 1,892 cubic meters (66,830 cubic feet) per second in Big Lost River, measured near INTEC. Thus, INTEC would be flooded, especially at the north end. Moreover, because the ground surface at INL and INTEC is rather flat, the floodwaters would spread over a large area and pond in the lower-lying areas. Although predicted flood velocities would be fairly slow and water depths shallow, some facilities could be impacted. There is no record of historical flooding at INTEC from Big Lost River, although evidence of flooding in geologic time exists. The INL diversion dam, constructed in 1958 and enlarged in 1984, was designed to secure INL from the 300-year flood (estimated peak flow of slightly above 142 cubic meters [5,000 cubic feet] per second) of Big Lost River by directing flow through a diversion channel into four spreading areas. Effects of a systematic (noninstantaneous) failure of the diversion dam were included in the probable maximum flood analysis (DOE 2005b:3-19; Koslow and Van Haaften 1986:24, 26, 30).

Studies have also been performed that have indicated the potential for varying degrees of flooding based on assumptions relative to the 100-year and 500-year floods. Most recently, studies aimed at reducing the uncertainty in flood hazard estimates at INL were undertaken by both USGS and the U.S. Bureau of Reclamation because of the large difference in the earlier estimates. USGS, in cooperation with DOE, published a study in 2003 providing its new estimate of the 100-year peak flow for Big Lost River at INL. The estimate was based on analysis of recorded and estimated peak-flow data, long-term gauging station data, and documented conditions in the basin during historical high-flow periods. The analysis resulted in a 100-year peak-flow estimate of 118 cubic meters (4,170 cubic feet) per second near the city of Arco and a flow of about 106 cubic meters (3,750 cubic feet) per second for Big Lost River immediately upstream from the INL diversion dam (Hortness and Rousseau 2003:2, 21, 22). The U.S. Bureau of Reclamation published the INL Big Lost River flood hazard study of record in 2005 (Adams 2006). This study used historic stream gauge measurements and reprocessed topographic data in combination with geologic and geomorphic maps and trenching data to constrain high-resolution two-dimensional hydraulic models of the Big Lost River on INL. These data and analyses were independently peer reviewed with respect to meeting DOE flood hazard study and other requirements. The study yielded a series of inundation maps and stage discharge estimates for DOE Big Lost River flood hazard characterization purposes, including a 100-year peak-flow estimate of 87 cubic meters (3,072 cubic feet) per second at the INL diversion dam (Ostenaa and O'Connell 2005:iii, iv).

Radioactive Waste Management Complex

The RWMC is located approximately 3.2 kilometers (2 miles) southeast of the Big Lost River channel and about 1.6 kilometers (1 mile) east of the diversion spreading areas. The RWMC is separated from the Big Lost River by a lava ridge that serves as a hydraulic barrier; therefore, the Big Lost River is not a surface-water flowpath for contaminant transport. Analysis of the probable maximum flood due to the failure of Mackay Dam showed that the RWMC would not be inundated from flow from the Big Lost River. Nevertheless, three historical flood events (in 1962, 1969, and 1982) have occurred at the RWMC as a consequence of rapid snowmelt combined with heavy rains and warm winds, resulting in runoff water from the surrounding areas entering the facility. Upgrades to the perimeter drainage system have greatly reduced the likelihood of local basin flooding affecting the RWMC. The current peripheral drainage ditch and the main discharge channel are designed for a maximum 10,000-year combined rain-on-snow storm event. Also, soil was added to the surface of the SDA to create sufficient slopes to direct water away from pits and trenches and into surrounding drainage systems. Although several instances of standing water have occurred due to rapid spring thaws in combination with frozen ground since 1982, there has not been flooding at the RWMC from offsite flow due to improvements in the dikes and drainage diversion systems (DOE 1999c:4.8-1–4.8-3). The proposed existing facilities for mercury storage are located in the Transuranic Storage Area portion of the RWMC. The portion of the RWMC has never flooded and is on higher ground than the SDA.

Surface-water monitoring is performed at the RWMC SDA to determine if radionuclide concentrations exceed administrative control levels or if concentrations have increased significantly compared with historical data. Surface water runs off the SDA only during periods of rapid snowmelt or heavy precipitation. At these times, water may be pumped out of the SDA retention basin into a drainage canal, which directs the flow outside the RWMC. The canal also carries runoff from outside the RWMC that has been diverted around the SDA. During 2007, no precipitation occurred to cause a surface-water runoff event at the RWMC SDA. Therefore, no surface-water runoff was available for sampling at the RWMC SDA (DOE 2008b:5.23, 5.25).

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INTEC is situated on an alluvial plain with its northwestern corner located approximately 61 meters (200 feet) from the Big Lost River channel near the channel's intersection with Lincoln Boulevard. INTEC is surrounded by a stormwater drainage ditch system. Stormwater runoff from most INTEC areas flows through the ditches to an abandoned gravel pit on the northeast side of INTEC, where it infiltrates into the subsurface. Stormwater runoff volumes are usually small and spread over a wide area (DOE 2002d:4-40). The only other surface-water features at the site are the INTEC New Percolation Ponds. The two ponds comprise a rapid infiltration system and are excavated into the surficial alluvium and surrounded by bermed alluvial material. Each pond measures 93 meters by 93 meters (305 by 305 feet) and is 3 meters (10 feet) deep. The ponds receive wastewater from the INTEC Sewage Treatment Plant located east of INTEC and outside the INTEC security fence. The plant treats sanitary and other related waste at INTEC and uses four sewage lagoons for physical and biological treatment of sanitary waste before discharge to the percolation ponds. In 2007, the INTEC New Percolation Ponds received an average flow of 6.2 million liters (1.64 million gallons) per day, and flow and effluent concentrations were within specified WRP limits (DOE 2008b:5.3, 5.6–5.8).

INTEC and other facilities have been evaluated for susceptibility to the probable maximum flood, as discussed above. Other than natural topography, the primary choke points for probable maximum flood flows are the diversion dam on the INL site and the culverts near INTEC that allow Big Lost River to flow beneath Lincoln Boulevard between INTEC and the ATRC. The probable maximum flood would quickly overtop the diversion dam. The Lincoln Boulevard culverts are capable of passing about 42 cubic meters (1,500 cubic feet) of floodwater per second (DOE 2002d:4-42).

3.5.3.2 Groundwater

The Snake River Plain Aquifer lies below the INL site. It covers an area of approximately 24,900 square kilometers (9,600 square miles) in southeastern Idaho. Aquifer boundaries are formed by contact with less-permeable rocks at the margins of the Eastern Snake River Plain. These boundaries correspond to the mountains on the west and north and the Snake River on the east. This aquifer is the major source of drinking water for southeastern Idaho and has been designated a sole-source aquifer by EPA. Water storage in the aquifer is estimated at some 2,500 billion cubic meters (660,400 billion gallons), and irrigation wells can yield 26,000 liters (7,000 gallons) per minute. The aquifer is composed of numerous thin basalt flows, with interbedded sediments extending to depths in excess of 1,067 meters (3,500 feet) below the land surface (INL 2009a:1-23, 1-24, 1-26). In some instances, the process of sediment accumulation resulted in discontinuous distributions of fairly impermeable sedimentary interbeds, which led to a localized perching of groundwater. These perched water tables tend to slow the migration of pollutants to the Snake River Plain Aquifer. Other perched water tables detected beneath INTEC and ATRC are attributable mainly to disposal ponds (DOE 2005b:3-20). Estimates of the thickness of the active portion of the Snake River Plain Aquifer at INL range from 102 to 368 meters (334 to 1,207 feet). Depth to the water table ranges from about 61 meters (200 feet) below land surface in the northern part of the site to more than 274 meters (900 feet) in the southern part (INL 2009a:1-23).

Water movement regionally in the aquifer is mainly horizontal through basalt interflow zones, i.e., highly permeable rubble zones between basalt flows. Groundwater flow is primarily toward the southwest. Locally, the flow direction can be affected by recharge from rivers, surface-water spreading areas, and heterogeneities in the aquifer. Flow rates in the aquifer have been reported to range from about 1.5 to 6.1 meters (5 to 20 feet) per day (DOE 2005b:3-20). The Big Lost River, the Little Lost River, and Birch Creek terminate at sinks on or near INL and recharge the aquifer. Recharge occurs through the surface of the Eastern Snake River Plain from flow in the channel of the Big Lost River and its diversion area. Additionally, recharge may occur from melting of local snowpacks during years in which snowfall accumulates on the Eastern Snake River Plain and from local agricultural irrigation activities. Valley underflow from the mountains to the north and northeast of the Eastern Snake River Plain has also been cited as a source of recharge. Aquifer discharge is via large spring flows to the Snake River and pumping for irrigation. The aquifer discharges approximately 8,800 billion cubic meters (2,320 million gallons) of water annually to springs and rivers (DOE 2005b:3-20; INL 2009a:1-24–1-26).

From 1982 to 1985, INL used about 7.9 billion liters (2.1 billion gallons) per year from the Snake River Plain Aquifer, the only source of water at INL. This represents less than 0.3 percent of the groundwater withdrawn from that aquifer. Since 1950, DOE has held a Federal Reserved Water Right for INL that permits a pumping capacity of approximately 2.3 cubic meters (80 cubic feet) per second, with a maximum water consumption of 43 billion liters (11.4 billion gallons) per year (DOE 2005b:3-22). Total groundwater withdrawal at INL has averaged about 10 percent of that permitted amount in recent years. Most of the groundwater withdrawn for use by INL facilities is returned to the subsurface via percolation ponds. Water use is further discussed in Section 3.5.7.4.

INL has an extensive groundwater quality monitoring network maintained by USGS. This network includes 171 observation or production wells in the Snake River Plain Aquifer and auger holes from which samples are collected and analyzed for selected organic, inorganic, and radioactive substances (DOE 2008b:3.8). Historical waste disposal practices have produced localized plumes of radiochemical and chemical constituents in the Snake River Plain Aquifer at INL. Of principal concern over the years have been the movements of the tritium and strontium-90 plumes. Nevertheless, no contaminant exceeded an EPA MCL in a well along the southern boundary of INL or downgradient of the site in the fiscal year 2007 groundwater monitoring. Within the areal extent of the plume, tritium was detected in two wells (USGS-104 and -106), which are guard wells located just south of the Central Facilities Area and east of the RWMC in the southern portion of INL. Over the past 20 years, both wells have exhibited a downward trend in tritium concentration. The tritium concentrations in these wells currently are less than 600 picocuries per liter and considerably less than the EPA MCL of 20,000 picocuries per liter. The INTEC facility used direct injection as a disposal method until 1984. This wastewater contained high concentrations of both tritium and strontium-90. Once direct injection ceased, wastewater from INTEC was directed to a pair of shallow percolation ponds, from which the water infiltrated into the subsurface. Disposal of low- and intermediate-level radioactive waste solutions into the percolation ponds ceased in 1993 with the installation of the Liquid Effluent Treatment and Disposal Facility. New INTEC percolation ponds went into operation in August 2002 (DOE 2008b:6.7, 6.31).

Radioactive Waste Management Complex

Depth to groundwater near the RWMC is approximately 180 meters (590 feet). Water-level monitoring by the USGS may indicate that groundwater may respond to Big Lost River water infiltrating into the spreading areas. In addition, perched aquifer zones are present in the vicinity of the RWMC. Vertically, the perched zones consist of two regions, referred to as “shallow” and “deep.” The shallow perched water refers to ephemeral saturated zones that form at the contact between the shallow surficial sediments and underlying basalt. Deep perched water occurs at greater depths that are above, but in association with, the 33-meter (110-foot) and 73-meter (240-foot) interbeds (DOE 1999c:4.8-3–4.8.6). Groundwater quality beneath the RWMC has been affected by contamination emanating from the SDA, a 39-hectare (97-acre) disposal area containing buried hazardous and radioactive waste. Organic solvents contained in this waste are a source of groundwater contamination and are being removed by ongoing cleanup activities (DOE 2008b:1.5, 3.19).

A single RWMC production well supplies all of the drinking water for more than 500 people. Water samples collected for monitoring purposes are collected from the wellhead and throughout the distribution system. In the past, carbon tetrachloride, trichloroethylene, and nitrate have been detected in the drinking water system at RWMC. All other regulatory parameters were well below drinking water limits in 2007. Concentrations of carbon tetrachloride, trichloroethylene, and nitrate, along with other monitored parameters, remained below their respective MCLs within the distribution system in 2007. However, concentrations of carbon tetrachloride (tetrachloromethane) in the well exceeded its MCL of 0.005 milligrams per liter for all 12 months in 2007, and the RWMC production well contained detectable concentrations of eight purgeable organic compounds in all. In July 2007, installation was completed at RWMC of a packed tower air-stripping treatment system for organics in groundwater (DOE 2008b:5.21–5.23. 6.12, 6.13).

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Groundwater directly beneath INTEC generally flows to the southwest and southeast, with some flow to the south. The local groundwater flow is complex and variable and is influenced by recharge from the Big Lost River (when flow is present), percolation ponds, areas of lower-aquifer transmission, and possibly by pumping from the production wells. Groundwater beyond the influence of INTEC recharge sources flows to the south-southwest. The groundwater velocity beneath INTEC has been estimated at 3 to 8 meters (10 to 25 feet) per day. Depth to the water table in the Snake River Plain Aquifer ranges from approximately 140 to 146 meters (460 to 480 feet) below the ground surface. Also, several zones of perched water lie beneath INTEC, which are primarily located beneath, and extend outward from, the percolation ponds and the sewage treatment plant lagoons when the Big Lost River is dry. Additional perched water bodies and interactions occur in the northern part of INTEC during periods of flow in the Big Lost River and subsequent infiltration (DOE 2002d:4-47).

As previously described, groundwater beneath INTEC has been contaminated by past facility effluent discharges. During fiscal year 2007, strontium-90, technetium-99, and nitrate exceeded their respective drinking water MCLs (40 CFR 141) in one or more of the Snake River Plain Aquifer monitoring wells at or near INTEC, with strontium-90 exceeding the standard by the greatest margin (DOE 2008b:6.18–6.20).

Water is supplied to INTEC by two deep wells (CPP–01 and CPP–02) in the northwest corner of the area. The wells are about 180 meters (590 feet) deep. These wells can each supply up to approximately 11,400 liters of water per minute (3,000 gallons per minute) for use in the INTEC fire water, potable water, treated water, and demineralized water systems. The production wells at INTEC have historically contained measurable quantities of strontium-90 (DOE 2000:3-58). During 2007, routine drinking water compliance sampling found that all INTEC monitored parameters were below their respective drinking water limits (DOE 2008b:5.21).

3.5.4 Meteorology, Air Quality, and Noise

3.5.4.1 Meteorology and Air Quality

The climate at INL and the surrounding region is characterized as that of a semiarid steppe. The average annual temperature at INL (at the Central Facilities Area) is 5.6 °C (42 °F); average monthly temperatures range from a minimum of 8.8 °C (16.1 °F) in January to a maximum of 20 °C (68 °F) in July. The average annual precipitation is 22 centimeters (8.7 inches) (Clawson, Start, and Ricks 1989:55, 77). Prevailing winds at INL are southwest or northeast (DOE 1999c:4.7-1). The annual average windspeed is 3.4 meters per second (7.5 miles per hour) (DOE 1996a:3-112). The maximum windspeed at Pocatello, Idaho (minimum time for 1.6 kilometers [1 mile] of wind to pass) is 32 meters per second (72 miles per hour) (NOAA 2009b:65).

Damaging hailstorms rarely occur in Butte County (NCDC 2009c). The average annual snowfall is 70.1 centimeters (27.6 inches) (Clawson, Start, and Ricks 1989:84). Seven tornados were reported in Butte County between January 1950 and March 2009. Several occurrences of high winds typically occur every year in Butte County (NCDC 2009c).

The primary source of air pollutants at INL is fuel oil combustion for heating. Other emission sources include waste burning, industrial processes, stationary diesel engines, vehicles, and fugitive dust from waste burial and construction activities (DOE 2002d). Modeled air pollutant concentrations from INL sources and applicable NAAQS and Idaho State ambient air quality standards are presented in Table 3–10. Emissions for 2006 are presented in Table 3–11.

Routine offsite monitoring of nonradiological air pollutants is generally performed only for PM and nitrogen oxide. Monitoring for PM_{10} is performed at the site boundary and at communities beyond the boundary. All concentrations at these monitors were below the ambient standard. Monitoring for nitrogen dioxide has not been performed at onsite locations since 2003 (DOE 2006b:3.5,4.24). The mean concentrations were well below the ambient standard (DOE 2004a:4.22).

INL is located in the Eastern Idaho Intrastate Air Quality Control Region. Most of this region is designated attainment (or unclassified) for all criteria pollutants. A small part of Power and Bannock Counties, the Fort Hall nonattainment area, has been designated moderate nonattainment for PM_{10} (40 CFR 81.313).

Table 3–10. Modeled Nonradiological Ambient Air Pollutant Concentrations from Idaho National Laboratory Sources and Ambient Air Quality Standards

Pollutant	Averaging Period	Most Stringent Standard[a]	Maximum INL Concentration[b]
		(micrograms per cubic meter)	
Carbon monoxide	8 hours 1 hour	10,000[c] 40,000[c]	71 350
Lead	Quarterly	1.5[c]	0.0081
Nitrogen dioxide	Annual	100[c]	2.3
Ozone	8 hours 1 hour	147[d] 235[f]	(e) (e)
PM_{10}	Annual 24 hours	50[f, g] 150[c]	1.3 20
$PM_{2.5}$	Annual 24 hours	15[d] 35[d]	1.3 20[h]
Sulfur dioxide	Annual 24 hours 3 hours	80[c] 365[c] 1,300[c]	4.5 32 140

a The more stringent of the Federal and state standards is presented if both exist for the averaging period. National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those standards based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean $PM_{2.5}$ standard is attained when the expected annual arithmetic mean concentration (3-year average) is less than or equal to the standard. The 24-hour $PM_{2.5}$ standard is met when the 98th percentile over 3 years of 24-hour average concentrations is less than or equal to the standard value. The 24-hour PM_{10} standard is met when the 99th percentile over 3 years of 24-hour concentrations is less than or equal to the standard value.

b Includes contributions from existing INL facilities with actual 1997 emissions, plus reasonably foreseeable sources such as the Advanced Mixed Waste Treatment Project and CPP-606 steam production boilers.

c Federal and state standard.

d Federal standard.

e Not directly emitted or monitored by the site.

f State standard.

g The U.S. Environmental Protection Agency revoked the annual PM_{10} standard.

h Assumed to be the same as the concentration of PM_{10} because there are no specific data for $PM_{2.5}$.

Note: The State of Idaho also has ambient standards for fluorides. To convert cubic meters to cubic feet, multiply by 35.315.

Key: INL=Idaho National Laboratory; PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Source: 40 CFR 50; 71 FR 61144; DOE 2002d:C.2-43; IDAPA 58.01.01.577.

Table 3–11. Air Pollutant Emissions at Idaho National Laboratory, 2006

Pollutant	Sources Other Than Materials and Fuels Complex	Materials and Fuels Complex
	(metric tons per year)	
Nitrogen dioxide	67	5.3
PM_{10}	2.5	0.27
Sulfur dioxide	7.1	1.9
Volatile organic compounds	1.8	0.05

Note: To convert metric tons to tons, multiply by 1.1023.

Key: PM_{10}=particulate matter with an aerodynamic diameter less than or equal to 10 micrometers.

Source: Depperschmidt 2007.

Some monitoring data have also been collected by the National Park Service at the Craters of the Moon Wilderness Area. The monitoring program has shown no exceedances of the 1-hour ozone standard, although there was some degradation in concentrations between 1993 and 2002 (NPS 2003:5). Concentrations in 2006 were about 50 percent of the ambient standard for 1-hour values and less than 60 percent of the 8-hour standard (EPA 2007).

The existing ambient air concentrations attributable to sources at INL are presented in Table 3–11. These concentrations are based on dispersion modeling at the INL site boundary and public roads. The modeled pollutant concentrations presented in the *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement* for assessing cumulative impacts were adapted as a baseline. Sources considered included existing INL facilities with actual 1997 emissions, plus reasonably foreseeable sources such as the Advanced Mixed Waste Treatment Project and the CPP-606 steam production boilers. To account for the contribution of the CPP 606 boilers, the cumulative concentrations for the Continued Operation Alternative evaluated in the aforementioned EIS were used as the baseline (DOE 2002d:C.2-43). Concentrations shown in Table 3–11 represent a small percentage of those established as ambient air quality standards. Given these limited contributions from INL sources and low background concentrations of criteria pollutants, it may be concluded that INL emissions should not result in air pollutant concentrations that violate the ambient air quality standards.

EPA has established PSD increments for certain pollutants such as sulfur dioxide, nitrogen dioxide, and PM. The increments specify a maximum allowable increase above a certain baseline concentration for a given averaging period and apply only to sources constructed or modified after a specified baseline date. These sources are known as increment-consuming sources, and the baseline date is the date of submittal of the first application for a PSD permit in a given area. Increment consumption for the CPP-606 boilers, for example, was analyzed in connection with its PSD permit application for INL (DOE 2002d).

EPA has also established PSD area classifications distinguished in terms of allowable increases in pollution. The PSD Class I area nearest to INL is the Craters of the Moon Wilderness Area in Idaho, 53 kilometers (33 miles) west-southwest of the center of the site. There are no other Class I areas within 100 kilometers (62 miles) of INL. INL and its vicinity are classified as a Class II area (DOE 2002d).

3.5.4.2 Noise

Major noise sources within INL include various industrial machines and equipment (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles). Most INL industrial facilities are far enough from the site boundary that noise from these sources is either unmeasurable or barely distinguishable from background levels at the site boundary (DOE 2002d:4-69).

Existing INL-related noises of public significance result from the transportation of people and materials to and from the site and in town facilities via buses, trucks, private vehicles, and freight trains. Noise measurements along U.S. Route 20, about 15 meters (50 feet) from the roadway, indicate that traffic sound levels range from 64 to 86 dBA and that the primary source is buses (71 to 80 dBA). While few people reside within 15 meters (50 feet) of the roadway, INL traffic noise might be objectionable to members of the public residing near principal highways or busy bus routes. Noise levels along these routes may have decreased somewhat with reductions in employment and bus service at INL over the last few years. The acoustic environment along the INL site boundary is typical of a rural location removed from traffic noise; the average day-night sound level is in the range of 35 to 50 dBA. Playas and remote lava flows at INL are exposed to low ambient sound levels in the range of 35 to 40 dBA (Leonard 1993:3-18–3-21). Except for the prohibition of nuisance noise, neither the State of Idaho nor local governments have established regulations that specify acceptable community noise levels applicable to INL. It is expected that, for most residences near INL, day-night average sound levels are compatible with residential land use, although noise levels may be higher than 65 dBA for some residences along major roadways.

3.5.5 Ecological Resources

3.5.5.1 Terrestrial Resources

INL lies in a cool desert ecosystem dominated by some of the best-condition shrub-steppe communities in the United States. Most land within the site is relatively undisturbed and provides important habitat for species native to the region. Facilities and operating areas occupy 2 percent of INL; approximately 60 percent of the area on the periphery of the site is grazed by sheep and cattle. Although sagebrush communities occupy about 90 percent of INL, a total of 11 plant communities have been identified. Vegetation and habitat on INL may be grouped into six types: shrub-steppe; juniper woodlands; grasslands; modified ephemeral playas, bare ground, and disturbed areas; lava; and wetland-like areas. More than 90 percent of INL falls into the shrub-steppe vegetation type (DOE 2002d:4-58).

INL supports numerous animal species, including 46 mammals, 204 birds, 10 reptiles, 2 amphibians, and 740 insects (DOE 2002d:4-62). Common animals on the site include the short-horned lizard, Great Basin gopher snake, sage sparrow, Townsend's ground squirrel, and black-tailed jackrabbit. Important game animals include the greater sage grouse, mule deer, elk, and pronghorn. During some winters, 4,500 to 6,000 pronghorn, or about 30 percent of Idaho's total pronghorn population, may be found at INL. Although pronghorn may be found across INL at any time of the year, their important wintering areas are in the northeastern portion of the site, the area of the Big Lost River sinks, the west-central portion of the site along the Big Lost River, and the south-central portion of the site. Numerous raptors, such as the golden eagle and prairie falcon, as well as carnivores, such as the coyote and bobcat, are also found at INL. A variety of migratory birds have been found at INL (DOE 2002c:4-136, 4-138).

Radioactive Waste Management Complex

Land near the proposed mercury storage facility at RWMC is disturbed. Species occurring in this area would be restricted to those capable of existing with human disturbances. Likely mammals include the coyote, yellow-bellied marmot, and badger, while likely birds include the horned lark, western meadowlark, and sage thrasher.

Idaho Nuclear Technology and Engineering Center

Similar to RWMC, the land surrounding the proposed mercury storage facility at INTEC is also disturbed and developed. Species occurring at INTEC are also expected to be similar to those found at RWMC.

3.5.5.2 Wetlands

National wetland inventory maps have been completed by USFWS for most of INL. These maps indicate that there are 55 hectares (135 acres) of wetland areas within INL. The primary wetland areas are associated with the Big Lost River and the river's spreading areas and sinks, although smaller (less than about 0.4 hectares [1 acre]), isolated wetlands also occur. Wetlands associated with Big Lost River are classified as riverine/intermittent, indicating a defined stream channel with flowing water during only part of the year. The only areas of jurisdictional wetlands are the Big Lost River sinks (DOE 2002c:4-138; O'Rourke 2006:21).

Radioactive Waste Management Complex and Idaho Nuclear Technology and Engineering Center

No wetlands are found within either the RWMC or INTEC areas. The nearest wetlands are associated with the riparian zones of the Big Lost River, located about 2.4 kilometers (1.5 miles) to the northwest of RWMC and less then 0.8 kilometers (0.5 miles) to the northwest of INTEC.

3.5.5.3 Aquatic Resources

Aquatic habitat at INL is limited to the Big Lost River, the Little Lost River, Birch Creek, and a number of liquid waste disposal ponds. All three streams are intermittent and drain into four sinks in the north-central part of the site. Six species of fish have been observed within water bodies on site. Species observed in the Big Lost River include brook trout, rainbow trout, mountain whitefish, speckled dace, shorthead sculpin, and kokanee salmon. The Little Lost River and Birch Creek enter the site only during periods of high flow. The liquid waste disposal ponds at INL, while considered aquatic habitat, do not support fish (DOE 2002c:4-138).

Radioactive Waste Management Complex

Aquatic resources found within the boundary of RWMC are limited to drainage basins, evaporation ponds, and other manmade structures. Although usually dry, the Big Lost River, located about 2.4 kilometers (1.5 miles) to the northwest of the facility, is the closest aquatic resource.

Idaho Nuclear Technology and Engineering Center

Aquatic resources found within the boundaries of INTEC are also limited to drainage basins, evaporation ponds, and other manmade structures. During wet years, the Big Lost River flows along the northwestern corner of INTEC but is located outside of the facility boundary.

3.5.5.4 Threatened and Endangered Species

With the delisting of the gray wolf as an experimental, nonessential population in Idaho, no listed, proposed, or candidate species and no proposed or designated critical habitat are currently known to occur in the INL area (Foss 2009). However, the bald eagle is listed as threatened by the state (IFG 2009).

Radioactive Waste Management Complex and Idaho Nuclear Technology and Engineering Center

Due to the developed nature of the land at RWMC and INTEC, no special status species are expected to be in the vicinity of the proposed mercury storage facilities.

3.5.6 Cultural and Paleontological Resources

INL has a well-documented record of cultural and paleontological resources due in part to a longstanding Cultural Resource Management Program outlined in the *Idaho National Laboratory Cultural Resource Management Plan* (DOE 2009f) and adopted by a programmatic agreement between DOE's Idaho Operations Office, the Idaho SHPO, and the Advisory Council on Historic Preservation. Past surveys have encompassed 8 to 10 percent of INL. These surveys have identified more than 2,200 prehistoric and historic archaeological resources and yielded an inventory of more than 200 DOE-administered buildings potentially eligible for inclusion in the NRHP. In addition, consultations with local Shoshone-Bannock tribal members have served to identify traditional cultural properties.

Cultural sites were often occupied continuously or intermittently over substantial timespans. For this reason, a single location may have been used during both prehistoric and historic periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented. The sum of these resources, however, may be greater than the total number of sites identified due to the dual-use history of various sites.

3.5.6.1 Prehistoric Resources

Approximately 1,980 prehistoric archaeological resources have been identified at INL (DOE 2005c). Most of the prehistoric sites are lithic scatters or locations. Resources appear to be concentrated along

Big Lost River and Birch Creek, atop buttes, and within craters or caves. These include residential bases; campsites; caves; hunting blinds; rock alignments; and limited-activity locations, such as lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. Most sites at INL have not been formally evaluated for nomination to the NRHP, but are considered to be potentially eligible. Given the rather high density of prehistoric sites at INL, additional sites are likely to be identified as surveys continue (DOE 2002c:4-140).

There have been no prehistoric sites identified within the RWMC or INTEC areas.

3.5.6.2 Historic Resources

Approximately 200 historic archaeological sites are known to exist at INL, and at least 200 historic architectural properties have been identified during surveys of nearly 500 buildings administered by the Idaho Operations Office (DOE 2005c). These resources represent European-American activities such as fur trapping and trading, immigration, transportation, mining, agriculture, and homesteading, as well as more-recent military, scientific, and engineering research and development activities. Examples of historic resources include Goodale's Cutoff (a spur of the Oregon Trail), remnants of homesteads and ranches, irrigation canals, and a variety of structures from the World War II era.

The Experimental Breeder Reactor I, the first reactor to achieve a self-sustaining chain reaction using plutonium instead of uranium as the principal fuel component, is listed in the NRHP and is designated as a National Historic Landmark. Many other INL structures built between 1949 and 1974 are considered eligible for inclusion in the NRHP because of their exceptional scientific and engineering significance and their major role in the development of nuclear science and engineering since World War II. Additional historic sites are likely to exist in unsurveyed portions of INL (DOE 2002c:4-141).

In 2007, 40 known resources, five projects, and three ground disturbing activities were reviewed at INL for compliance with its *Cultural Resource Management Plan*. There were no adverse effects on historic properties during the 2007 timeframe. Several U.S. Navy–built brick buildings from the World War II period were monitored to update their documented condition. No new negotiations with the SHPO were required for 2007 as no new properties not previously identified and negotiated have been impacted (DOE 2008b:2.11).

There have been no historic resources identified within the RWMC or INTEC areas.

3.5.6.3 American Indian Resources

American Indian resources at INL are associated with the two groups of nomadic hunter-gatherers that used the region at the time of European-American contact: the Shoshone and Bannock Tribes. Both of these used the area that now encompasses INL as they harvested plant and animal resources and obsidian from Big Southern Butte and Howe Point. Because the INL site is considered part of the Shoshone-Bannock Tribes' ancestral homeland, it contains many localities that are important for traditional, cultural, educational, and religious reasons. These include not only prehistoric archaeological sites that are important in the context of a religious or cultural heritage, but also features of the natural landscape and air, plant, water, and animal resources that have special significance (DOE 2002c:4-141).

DOE entered into an Agreement in Principle with the Shoshone-Bannock Tribes in 2002. In addition to defining a broad range of interests and working relationships and reaffirming the tribes' rights under the Fort Bridger Treaty of 1868, the agreement devotes particular attention to the management of INL cultural resources. Its overall intent is to foster confidence on the part of the Shoshone-Bannock Tribes that INL cultural resources are managed in a spirit of protection and stewardship. To achieve this, the agreement provides for routine tribal participation in new and ongoing INL projects, with an open invitation to comment on, visit, observe, and assist in cultural resource management work (DOE 2009f; Ringe Pace et al. 2005).

DOE allows pre-approved access to certain areas of INL to Shoshone-Bannock tribal members for activities related to maintenance of tribal heritage, education of tribal members, and exercise of traditional cultural activities (IMNH 1991:5.7-28).

In 2007, several sites of tribal sensitivity were monitored with tribal participation. Sites included caves, buttes, craters, and locations of known remains. No evidence of unauthorized human activity was observed; details of sites are kept to a minimum to ensure protection of ancestral properties and resources (DOE 2007c:2.12).

There have been no American Indian resources identified within the RWMC or INTEC areas.

3.5.6.4 Paleontological Resources

The region encompassing INL also has abundant and varied paleontological resources, including plant, vertebrate, and invertebrate remains in soils and lake and river sediments and organic materials found in caves and archaeological sites. Fossils of several time periods, from ancient marine invertebrates in limestone to middens and trees, have been found near and within INL boundaries. Fossils of interest from the Pleistocene and Holocene have been recovered from lake, marsh, and river deposits of the Snake and Lost River systems (DOE 2009f:15).

Vertebrate fossils recovered from the Big Lost River floodplain consist of isolated bones and teeth from large mammals of the Pleistocene epoch, or Ice Age. These fossils were discovered during excavations and well-drilling operations. Fossils have been recorded in the vicinity of the Naval Reactors Facility. Occasional skeletal elements of fossil mammoth, horse, and camel have been retrieved from the Big Lost River diversion dam and the RWMC on the southwestern side of the INL site and from river and alluvial fan gravels and Lake Terreton sediments near Test Area North. A mammoth tooth dating from the Pleistocene epoch was recovered from the ATRC. In total, 24 paleontological localities have been identified at INL (DOE 2002d:4-10).

There have been no paleontological resources identified within the RWMC or INTEC areas.

3.5.7 Site Infrastructure

In addition to the description provided below, a summary of INL's sitewide infrastructure characteristics is presented in Table 3–12.

3.5.7.1 Ground Transportation

INL is located in eastern Idaho between the city of Arco and the city of Idaho Falls. U.S. Routes 20 and 26 are the main access routes to the southern portion of the site. U.S. Route 26 intersects with U.S. Route 20 within the south-central part of INL. Idaho State Routes 22, 28, and 33 pass through the northern portion of INL. Rail service is provided by the Union Pacific Railroad, whose tracks enter the INL site from the south. A DOE rail spur runs south to north through INTEC, the Central Facilities Area, and the Naval Reactors Facility portions of INL. There are 23 kilometers (14 miles) of railroad track at INL (DOE 2005b).

RWMC and INTEC can be accessed from U.S. Routes 20 and 26. As stated, a DOE rail spur runs south to north through INTEC (DOE 2005b).

Table 3–12. Idaho National Laboratory Infrastructure Characteristics

Resource	Current Site Usage	Site Capacity
Transportation (kilometers)		
Roads	769[a]	769[a]
Railroads	23	23
Electricity		
Energy consumption (megawatt-hours per year)	197,000	481,800[b]
Fuel		
Natural gas (cubic meters per year)	(c)	(c)
Fuel oil (liters per year)	8,404,000	(e)
Diesel fuel (liters per year)	3,262,000[d]	(e)
Gasoline (liters per year)	115,000[d]	(e)
Propane (liters per year)	1,087,000	(e)
Water (liters per year)	1,061,000,000[f]	43,000,000,000[g]

a Includes 441 kilometers of internal paved roads and 327 kilometers of Federal and state highways.
b Assumes power demand up to 1.320 megawatts per year.
c Fuel resource not used on site.
d Includes fleet and nonfleet vehicles.
e Limited only by the ability to transport resource to the site.
f Total water pumped to and used at Idaho National Laboratory regardless of treatment or credit for water returned to the aquifer.
g Water right allocation.

Note: All values based on reported use in fiscal year 2008. To convert kilometers to miles, multiply by 0.6214; cubic meters to cubic feet, by 35.315; and liters to gallons, by 0.26417.
Source: Fossum and Ischay 2009; INL 2009c.

3.5.7.2 Electricity

Electricity is supplied to INL by the Idaho Power Company at the site and Idaho Falls Power in town. The Idaho Power Company allows for power demand of up to 45 megawatts, which can be increased to 55 megawatts by notifying the company in advance. Power demand above 55 megawatts is possible but would have to be negotiated with Idaho Power. Idaho Power transmits electricity to INL via a 230-kilovolt line to the Antelope Substation, which is owned by PacifiCorp (Utah Power Company). PacifiCorp also has transmission lines to this substation, which provide backup in case of problems with the Idaho Power system. At the Antelope Substation, the voltage is dropped to 138 kilovolts, and then transmitted to the DOE-owned Scoville Substation via two redundant feeders. The INL transmission system is a 138-kilovolt, 105-kilometer (65-mile) loop configuration that encompasses seven substations, where the power is reduced to distribution voltages for use at the various INL facilities. The loop allows for a redundant power feed to all substations and facilities (DOE 2005b:3-9). A separate 10-kilometer (6.2-mile) 138-kilovolt line feeds the RWMC area with a capacity in excess of 20 megawatts (O'Rourke 2006:15).

Annual electricity consumption at the site as a whole was 197,000 megawatt-hours per year in fiscal year 2008. INL electrical capacity was 481,800 megawatt-hours per year based on the contract load limit of 55 megawatts per 8,760 hours. Annual electrical consumption at INTEC was 46,270 megawatt-hours, while that at RWMC was 3,000 megawatt-hours (INL 2009c).

3.5.7.3 Fuel

Fuel consumed at INL includes fuel oil, diesel fuel, gasoline, and propane. All fuels are transported to the site for use. Fuel storage is provided for each facility, and the inventories are restocked as necessary (DOE 2005b). There are no gas or oil lines on the INL site (O'Rourke 2006:15).

In fiscal year 2008, the annual consumption of fuel oil at INL was about 8 million liters (2 million gallons); diesel fuel consumption was about 3.3 million liters (872,000 gallons); gasoline consumption was 115,000 liters (30,000 gallons); and propane consumption was about 1.1 million liters (291,000 gallons) (INL 2009c).

Fuel consumption at INTEC includes fuel oil, diesel fuel, and propane. The annual consumption of fuel oil at INTEC in fiscal year 2008 was about 3.5 million liters (925,000 gallons); diesel fuel consumption was about 33,000 liters (8,700 gallons); and propane consumption was about 151,000 liters (40,000 gallons). Fuel consumption at RWMC was not reported (INL 2009c).

3.5.7.4 Water

The Snake River Plain Aquifer is the source of all water used at INL. The water is provided by a DOE-administered system of about 30 wells, together with pumps and storage tanks. DOE holds the Federal Reserved Water Right of 43 billion liters (11.4 billion gallons) per year for the site (DOE 2002d:4-79). While all water pumped from the aquifer can be treated and used as potable water, only a portion is actually so treated and used. All remaining water is considered raw water and is used for a variety of industrial and process purposes. Most of this raw water usage is returned to the aquifer through the use of rapid infiltration ponds and settling ponds (Fossum and Ischay 2009).

INL reported a total of 3.8 billion liters (1 billion gallons) of water use during fiscal year 2007 (Fossum and Ischay 2009). INL site capacity is 43 billion liters (11.4 billion gallons), which includes a water right allocation (DOE 2002d).

Water use at INTEC was reported as 500 million liters (132 million gallons), in fiscal year 2007, while that at RWMC was 40 million liters (10.6 million gallons) (Fossum and Ischay 2009).

3.5.8 Waste Management

As a function of routine site activity and ongoing remediation efforts, INL manages the following types of waste: HLW, TRU waste, LLW, MLLW, hazardous waste, and nonhazardous waste. The waste is managed using appropriate treatment, storage, and disposal technologies, in compliance with all applicable Federal and state statutes and DOE orders (DOE 2005c:3-45).

Waste generation rates and the inventory of stored waste from routine activities at INL are provided in Table 3–13.

Table 3–13. Waste Generation Rates and Inventories at Idaho National Laboratory, Fiscal Year 2009

Waste Type	Generation Rate (cubic meters)[a]	Inventory (cubic meters)[b]
Transuranic	21[c]	36,066[c, d, e]
Low-Level Radioactive	2,098[e]	2,898[e]
Mixed Low-Level Radioactive	238[e]	3,373[e]
Hazardous	72[e]	1,027[e]
Nonhazardous		
Liquid	2,642,966[f]	Not applicable[g]
Solid	30,208[e, h]	Not applicable[g]

[a] As of fiscal year 2009.
[b] As of September 30, 2009.
[c] Transuranic waste includes alpha low-level radioactive waste.
[d] Transuranic waste inventory based on 65,000 cubic meters, which was reduced by 28,934 cubic meters that was shipped to the Waste Isolation Pilot Plant in New Mexico to date. Volume does not include the buried transuranic waste, which is estimated at 62,000 cubic meters.
[e] Excludes Comprehensive Environmental Response, Compensation, and Liability Act waste generation, which is nonrecurring.
[f] Includes both industrial and sanitary waste volumes.
[g] Generally, nonhazardous wastes are not held in long-term storage.
[h] Calendar year 2008 data.
Note: To convert cubic meters to cubic yards, multiply by 1.308.
Source: Perry 2009.

3.5.8.1 Waste Generation and Management

High-Level Radioactive Waste

INL no longer generates liquid HLW. Liquid HLW from past site operations has been blended and treated, through a fluidized bed technology called calcination, to produce granular calcine. Approximately 4,400 cubic meters (5,750 cubic yards) of HLW calcine are stored in stainless steel bins that are housed in concrete vaults at INTEC. The remaining 3,406,000 liters (900,000 gallons) of sodium-bearing liquid waste have been consolidated into three underground tanks in the tank farm for interim storage (DOE 2002d:2-16).

Low-Level Radioactive Waste

INL currently operates a Radioactive Liquid Waste Treatment Facility at the Materials and Fuels Complex that can receive low-level radioactive liquids from other complex facilities. Routine generators such as the Fuel Conditioning Facility and the Hot Fuel Examination Facility are pumped directly to the Radioactive Liquid Waste Treatment Facility, but other facilities can ship liquids to the facility. There is currently an offsite contract for liquid LLW treatment (DOE 2005c:3-47).

Solid LLW is stored temporarily at generator facilities. In 2009, approximately 2,098 cubic meters (2,744 cubic yards) of solid LLW was generated at INL (see Table 3–13).

Transuranic Waste

Approximately 21 cubic meters (27.5 cubic yards) of solid TRU waste is generated at INL each year. This newly generated waste is currently being stored at the RWMC for processing at the Advanced Mixed Waste Treatment Project and eventual shipment to WIPP for disposal (DOE 2005c:3-47).

Mixed Low-Level Radioactive Waste

About 3,373 cubic meters (4,412 cubic yards) of MLLW is inventoried at INL. In addition to the waste in the site inventory, approximately 238 cubic meters (311 cubic yards) of MLLW is generated annually (Perry 2009), but this does not include any waste from operations at the Advanced Mixed Waste Treatment Project. The Advanced Mixed Waste Treatment Project could add another 378 cubic meters (494 cubic yards) of MLLW to the annual generation rate, primarily from the generation of blowdown salts and from high-efficiency particulate air filters (DOE 1999c). MLLW, including PCB–contaminated LLW, is stored at several onsite areas awaiting the development of treatment methods.

Hazardous Waste

Approximately 1 percent of the total waste generated at INL (not including liquid nonhazardous waste) is hazardous waste. The hazardous waste stream consists of a variety of materials, including mercury, chromate, lead, paint solvents, and lab equipment (DOE 2005c:109). The site waste generator normally holds hazardous waste in a temporary accumulation area until it is shipped directly to the offsite commercial treatment facility.

Nonhazardous Waste

Approximately 90 percent of the solid waste generated at INL is classified as industrial waste and is disposed of on site in a landfill complex in the Central Facilities Area or off site at the Bonneville County Landfill. The onsite landfill is 4.9 hectares (12 acres), but it is being expanded by 91 hectares (225 acres) to provide capacity for at least 30 years. The average annual volume of waste disposed of from 2000 through 2004 was approximately 40,000 cubic meters (52,000 cubic yards) (DOE 2005c:109).

Sewage is disposed of in surface impoundments in accordance with terms of the October 7, 1992, consent order (DOE 2005d). Wastewater in the impoundments is allowed to evaporate, and the resulting sludge is placed in the landfill.

3.5.8.2 Waste Minimization

INL has an active Waste Minimization and Pollution Prevention Program to reduce the total amount of waste generated and disposed of. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. In 2002, INL reported 38 pollution prevention projects, which resulted in a waste reduction of 13,906 metric tons (15,329 tons) (DOE 2005c:3-48).

3.5.9 Occupational and Public Health and Safety

3.5.9.1 Normal Operations

Activities at INL have the potential to release small quantities of hazardous chemicals and radionuclides to the environment. These releases could result in exposures of members of the public to concentrations of chemicals or radionuclides. Types and quantities of radionuclides released from INL operations in 2007 are listed in the *Idaho National Laboratory Site Environmental Report, Calendar Year 2007* (DOE 2008b:4-4–4-10). The doses to the public resulting from these releases are also discussed. These doses from INL fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those from background radiation (DOE 2008b:8.3).

Adverse health impacts on the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur during normal operations at INL via inhalation of air containing hazardous chemicals released to the atmosphere by INL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are potential pathways; the water pathway is considered an unlikely source of exposure at INL because no surface water flows off the site and radioactive contaminants have not been found in drinking water (DOE 2008b:8.2, 8.3).

Chemical exposure pathways to INL workers during normal operations may include inhalation, drinking INL potable water, and physical contact with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, personal protective equipment, monitoring, and management controls. INL workers are also protected by adherence to Occupational Safety and Health Administration and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Monitoring that reflects the frequency and amount of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

Epidemiological studies for INL are summarized in the *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE 2009c:3-159–3-160).

In 1997, DOE began providing free medical screening for former and current workers at certain DOE sites, including INL. The goal of this program, which is ongoing, is to detect work-related illnesses at an early stage, when medical intervention may be helpful. It also helps workers determine if a current health condition is the result of work-related exposure (WHPP 2008).

The infrastructure currently available in the proposed mercury storage warehouses at RWMC consists of concrete floors and sheet metal roofing. The buildings are vented and there is a dry pipe fire suppression system and chemical fire extinguishers (INL 2009d:1).

3.5.9.2 Facility Accidents

Since the early 1950s there have been eight criticality accidents at INL (DOE 2002d:4-150). These accidents occurred during processing, control rod maintenance, critical experiment setups, and intentional destructive power excursions. Accidents connected with experiments typically involved power excursions that were significantly larger than expected. The accidents at the site resulted in various levels of radiation exposure to the involved workers and in impacts on equipment ranging from little or no damage to total loss. Exposure of the public from these accidents was minimal.

As described in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a), DOE conducted a historical dose evaluation study to estimate the offsite radiation doses for the entire operating history of INL (Wenzel, Peterson, and Dickson 1993). Radiological releases resulted from a variety of tests and experiments, as well as a few accidents. The study concluded that the offsite radiation doses from operations and accidents were small compared with doses from background radiation. Releases have declined in frequency and size since the time of the study; in fact, for more than a decade of INL operation, there have been no serious unplanned releases of radioactivity or other hazardous substances.

Incidents with worker health implications over the period from 2000 through 2006, as identified through Occurrence Reporting and Processing System records (DOE 2007a), include exposures to asbestos, crystalline silica, high noise levels, iron oxide, manganese, plutonium, and unknown vapors/fumes.

Each DOE site, including INL, has established an Emergency Management Program that would be activated in the event of an accident. This program was developed and is maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The Emergency Management Program includes emergency planning, training, preparedness, and response.

Government agencies whose plans are interrelated with the INL Emergency Plan for Action include the State of Idaho; Bingham, Bonneville, Butte, Clark, and Jefferson Counties; the U.S. Bureau of Indian Affairs; and the Fort Hall Reservation. INL contractors are responsible for responding to emergencies at their facilities. Specifically, the Emergency Action Director is responsible for recognition, classification, notification, and protective action recommendations. At INL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, at the INL Warning Communication Center, and at the INL Site Emergency Operations Center. Seven INL medical facilities are available to provide routine and emergency service. In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997 (DOE 2005b:3-43).

3.5.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to the site and employee traffic. These include death or injury from accidental release of nonradioactive and radioactive materials, effects of air pollutants and low levels of radiation emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of nonradioactive or radioactive materials. Collision rates for transportation in Idaho and risks related to normal radioactive transportation to INL are discussed in the *Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement*. Collective doses for offsite incident-free radioactive materials transportation were estimated to correspond to 0.70 latent cancer fatalities for the general population (DOE 2002d:4-66–4-68).

3.5.10 Socioeconomics

INL is located in southeastern Idaho, approximately 39 kilometers (24 miles) west of Idaho Falls. Over 90 percent of people employed at INL reside in four counties: Bannock, Bingham, Bonneville, and Jefferson. Therefore, these four counties are identified as the ROI in this socioeconomics analysis. In 2008, INL employed 8,485 persons (Wiser 2008).

3.5.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of the ROI increased by approximately 14 percent to 123,680. By July 2009 the unemployment rate of the ROI was 6.5 percent, which was lower than the unemployment rate for Idaho (8.3 percent) (BLS 2009).

3.5.10.2 Demographic and Housing Characteristics

In 2008, the estimated population of the four-county ROI was 247,710. From 2000 to 2008, the ROI population grew by 13 percent, compared with 18 percent growth throughout the state of Idaho (DOC 2009b). The percentage of the ROI population under the age of 18 was 30 percent; women ages 18 to 39 composed 15 percent (DOC 2009c). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. There were 92,302 housing units in the ROI in 2007 (DOC 2008), 69 percent of which were owner occupied, 24.3 percent were renter occupied, and 6.9 percent were vacant (DOC 2009c).

3.5.10.3 Local Transportation

There are two interstate highways in the INL region. The primary north-south route is Interstate 15, which is located approximately 39 kilometers (24 miles) east of the site near Idaho Falls. Interstate 15 intersects Interstate 86, the primary route to points west, approximately 64 kilometers (40 miles) south in Pocatello. Access routes to the southern portion of the site are provided by U.S. Routes 20 and 26. State Route 33 provides access to the northern portion of INL. In 2007, the average annual daily traffic along the segment of U.S. Route 20 most accessible to the RWMC was 2,200 vehicles per day. The average annual daily traffic for the segment of State Route 33 most accessible to the INTEC was 620 vehicles per day (ITD 2008). Rail access is provided to the southern portion of INL by the Mackay Branch of the Union Pacific Railroad. The Scoville Spur connects the Mackay Branch to the Union Pacific main line, the railroad's primary artery to the northwest (INL 2009a:1-18). There are two regional airports near INL with passenger and cargo service. The closest is the Idaho Falls Regional Airport, approximately 39 kilometers (24 miles) to the east, followed by the Pocatello Regional Airport, approximately 64 kilometers (40 miles) to the southeast.

3.5.11 Environmental Justice

The 16-kilometer (10-mile) radius surrounding the storage locations at INL encompasses parts of two counties in Idaho: Bingham and Butte. Figure 3–10 shows populations residing in the two-county area, as reported in the 1990 and 2000 censuses (DOC 2009d, 2009e). In this figure, lightly shaded bars show populations in 1990, while the darker bars show those in 2000. In the decade between 1990 and 2000, the total population of Bingham and Butte Counties increased by approximately 10 percent to 44,634; the minority population increased by approximately 45 percent to 9,104; and the low-income population decreased by 9 percent to 5,659. Demographic data from the 2000 census show that the population self-identified as "some other race" (meaning those who provided write-in entries such as Mexican, Puerto Rican, or Cuban) residing in the two-county area composed approximately 37 percent of the county's total minority population, while those identified as American Indian and Alaska Native composed 31 percent of the total minority population. Persons who declared that they are of Hispanic or Latino origin are included in the "total Hispanic" population, regardless of race. They composed approximately 62 percent of the total minority population residing in Bingham and Butte Counties in 2000.

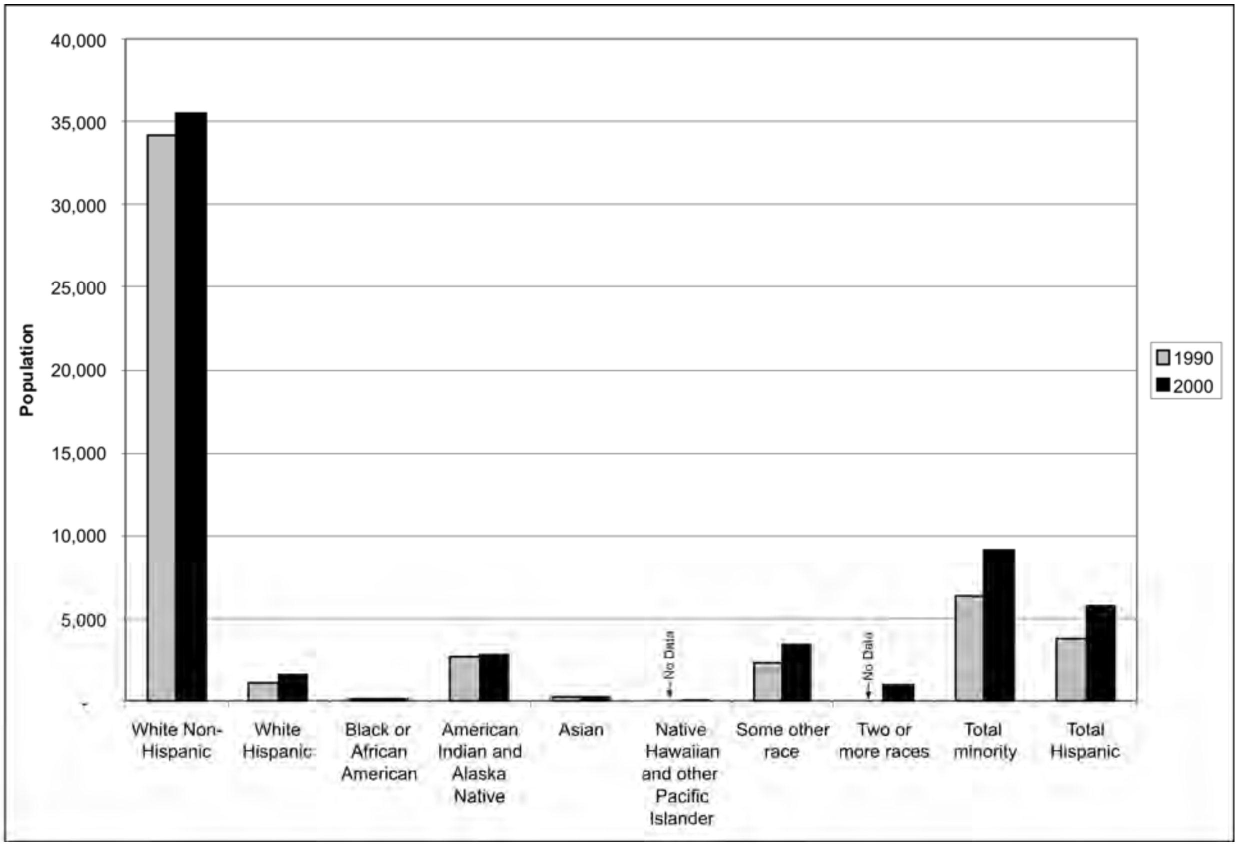


Figure 3–10. Populations Residing in the Two-County Area Surrounding Idaho National Laboratory in 1990 and 2000

Data for Butte and Bingham Counties from the *2007 ACS 1-Year Estimates* are unavailable due to a population threshold of 65,000 people. Data for Butte County from the *2005–2007 ACS 3-Year Estimates* are unavailable due to a population threshold of 20,000 people. The Census Bureau does include Bingham County in the *2005–2007ACS 3-Year Estimates*; however, detailed demographic data of race and Hispanic origin for Bingham County are unavailable due to an insufficient number of sample cases. According to the *2005–2007 ACS 3-Year Estimates*, the total population of Bingham County increased by 3 percent since 2000 to 43,148. During this time, the number of low-income individuals in the county increased by 10 percent to 5,628.

Radioactive Waste Management Complex

Approximately 255 people lived within 16 kilometers (10 miles) of the RWMC in 2000 (DOC 2009d). This area included an estimated 12 percent minority and 25 percent low-income population. By comparison, Bingham and Butte Counties included a 20 percent minority and 13 percent low-income population, and Idaho included a 12 percent minority and 12 percent low-income population. There are four census block groups located within the 16-kilometer (10-mile) radius surrounding the RWMC, none of which contained a disproportionately high number of minority or low-income individuals. Figure 3–11 shows the cumulative populations living at a given distance from the RWMC. The total population living within 16 kilometers (10 miles) of the RWMC is primarily concentrated to the south and east along the outskirts of Idaho Falls and Blackfoot. The low-income population is concentrated more to the southwest, toward Atomic City. No one resides within approximately 3.2 kilometers (2 miles) of the RWMC (DOC 2009d). The Fort Hall Reservation is located approximately 71 kilometers (44 miles) southeast of the RWMC.

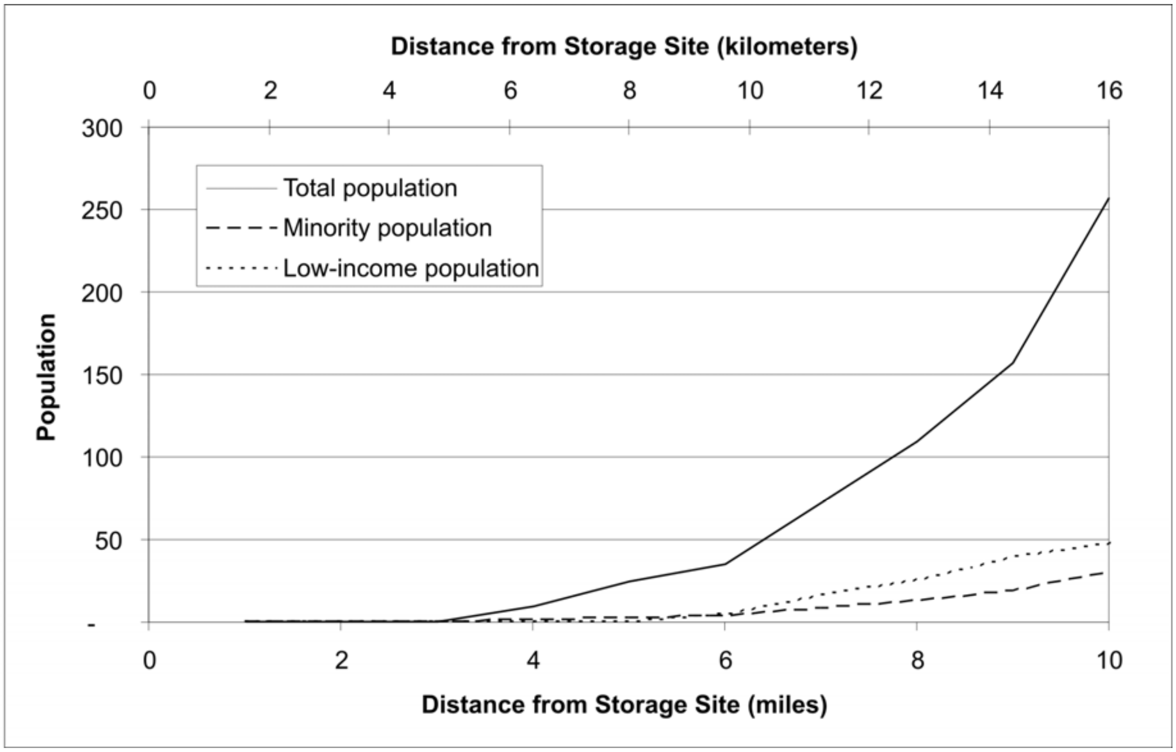


Figure 3–11. Cumulative Populations Residing Within 16 Kilometers (10 Miles) of the Radioactive Waste Management Complex in 2000

Idaho Nuclear Technology and Engineering Center

Approximately 201 people lived within 16 kilometers (10 miles) of INTEC in 2000 (DOC 2009d). This area included an estimated 13 percent minority and 19 percent low-income population. By comparison, Bingham and Butte Counties included a 20 percent minority and 13 percent low-income population, and Idaho included a 12 percent minority and 12 percent low-income population. There are four census block groups located within the 16-kilometer (10-mile) radius surrounding INTEC, none of which contained a disproportionately high amount of minority or low-income individuals. Figure 3–12 shows the cumulative populations living at a given distance from INTEC at INL. The total population living within 16 kilometers (10 miles) of INTEC is primarily concentrated to the south and east along the outskirts of Idaho Falls and Blackfoot. The low-income population is concentrated more to the southwest, toward Atomic City. No one resides within approximately 3.2 kilometers (2 miles) of the INTEC (DOC 2009d). The Fort Hall Reservation is located approximately 69 kilometers (43 miles) southeast of INTEC.

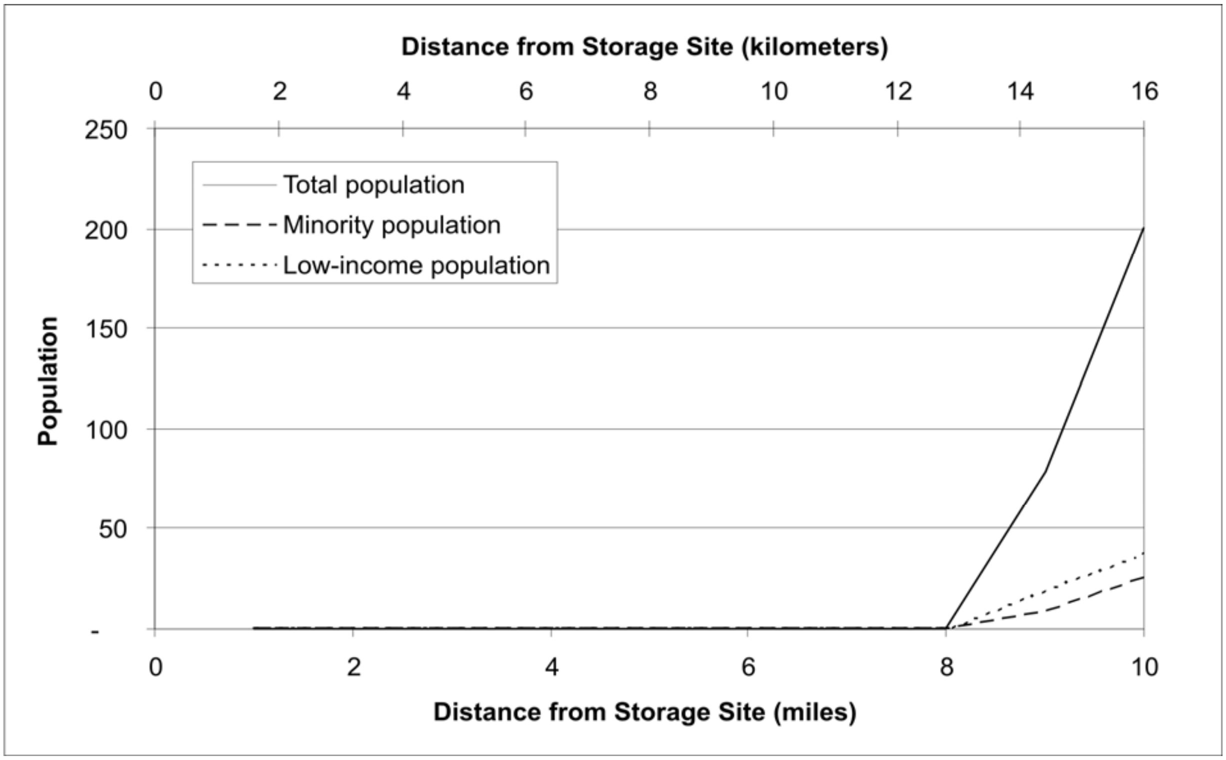


Figure 3–12. Cumulative Populations Residing Within 16 Kilometers (10 Miles) of the Idaho Nuclear Technology and Engineering Center in 2000

3.6 KANSAS CITY PLANT

3.6.1 Land Use and Visual Resources

3.6.1.1 Land Use

KCP occupies approximately 55 hectares (136 acres) of the 125-hectare (310-acre) Bannister Federal Complex, which is located within the corporate city limits of Kansas City, Missouri, approximately 13 kilometers (8 miles) south of the city center (GSA and NNSA 2008:21). The complex is bordered on the east by the Blue River and Blue River Road, on the south by Bannister Road and Indian Creek, on the west by Troost Avenue, and on the north by a wooded bluff and parkland. KCP is located on a very compact, highly developed site that it shares with other Federal agencies, including the U.S. General Services Administration (GSA) and the U.S. Marine Corps. The Federal complex is zoned for heavy industry. KCP currently manufactures mechanical, plastic, and other nonnuclear components of nuclear weapons and provides short term (less than 90 days) storage for various hazardous materials and wastes, including toxic metals (DOE 2006c:1, 2; NNSA 2008a:55).

The Bannister Federal Complex has 53 buildings, 38 of which are used by the National Nuclear Security Administration (NNSA) and 15 by GSA. Many buildings are contiguous. There are no residences within and no agricultural activities or farmlands at the Bannister Federal Complex (GSA and NNSA 2008:21). The KCP portion of the Bannister Federal Complex consists of the large Main Manufacturing Building, an associated support building, warehouse space, and an office building (NNSA 2008a:55). In 2008, GSA and NNSA evaluated the proposed relocation of NNSA operations from the Bannister Federal Complex to a new facility approximately 13 kilometers (8 miles) south of the existing plant that would better accommodate the continued consolidation of NNSA's nonnuclear component production and procurement activities. Following this proposed relocation, the existing facilities at the Bannister Federal

Complex could be used for other industrial purposes, sold, and/or undergo redevelopment (GSA and NNSA 2008:5, 12, 103).

The adjoining property is zoned for residential use and for some commercial tracts. There are also public-use recreation areas along the eastern and northern sides of the complex (DOE 2006c:1, 2). The surrounding area is further characterized by single- and multiple-family dwellings, commercial establishments, industrial districts, and public-use lands (NNSA 2008a:55).

3.6.1.2 Visual Resources

KCP and the Bannister Federal Complex are compactly developed with limited open space, consistent with BLM's VRM Class IV. Class IV includes areas in which major modifications to the character of the landscape have occurred and are the dominant features of the view and the major focus of viewer attention (DOI 1986:App. 2).

The viewshed around KCP is urban in nature, consisting mainly of residential units, public recreational space, and commercial, industrial, or vacant properties (DOE 1996c:4-131). This viewshed is generally consistent with VRM Class III (where visible changes to the character of the landscape are moderate and could attract the attention of the casual observer) and Class IV.

3.6.2 Geology, Soils, and Geologic Hazards

3.6.2.1 Geology

KCP is located in the Glaciated Plains section of the Central Lowland physiographic province, which is part of the Central Stable Region (DOE 1996c:4-142). The site is fairly level, averaging around 244 meters (800 feet) above mean sea level. Blue River alluvium comprises the surficial strata underlying KCP. The alluvium is approximately 12 to 14 meters (40 to 45 feet) thick. Bedrock immediately underlying the alluvium consists of shales and sandstones of the Pleasanton Group of Pennsylvanian age. The overlying Kansas City Group has been eroded away beneath the site, and the erosional surface of the Pleasanton Group is in direct contact with the alluvium and slopes gently to the east towards the Blue River (GSA and NNSA 2008:23).

The Knobtown Sandstone member of the Pleasanton Group underlies the alluvium across the central portion of the Bannister Federal Complex. This sandstone is a well-sorted, very fine-grained, well-cemented unit of marine origin. Knobtown Sandstone ranges in thickness from approximately 1.5 to 3 meters (5 to 10 feet) and is present in the upper 9 meters (30 feet) of the Pleasanton Group, except where it has been removed by Quaternary erosion. The surrounding unnamed shales of the Pleasanton Group show transitional features due to their formation in nearshore sands to offshore muds. Approximately 6 meters (20 feet) of shale are present over the underlying Hepler Sandstone member, with at least 6 meters (20 feet) of shales present below the Hepler, based on logs of historical bedrock wells at the facility (GSA and NNSA 2008:23, 24).

Geologic resources are limited in the immediate vicinity of the site as the area is developed. Construction sand and gravel is produced from sites across Jackson County, and the site is located within Missouri's western heavy-oil-producing region (MDNR 2001).

3.6.2.2 Soils

Due to the extensive amount of construction on the Bannister Federal Complex, native soils are rare or nonexistent across the site. In many parts of KCP, fill material has been added over the years and comprises the near-surface material (GSA and NNSA 2008:24). Soil unit mapping by the NRCS denotes the site as largely within the Urban Land, Bottomland, 0 to 3 Percent Slopes Unit. This unit denotes areas comprising nearly 100 percent urban land on alluvium parent material (NRCS 2009c).

Three SWMUs, addressed by DOE as a part of environmental restoration activities performed under RCRA, are located within potential reuse areas at the site. In addition, Building 50, currently being investigated by GSA for contaminant releases, is also located in areas that could be subject to GSA reuse. SWMU 18 (North Lot) is an area of the north parking lot north of Building 1 that was used to store drums and equipment. However, environmental investigations of SWMU 18 revealed no evidence of contamination. As a result, EPA granted a "No Further Action" determination for this SWMU. SWMU 16 is associated with the Former Sales Building that was razed in 1981 and the area paved with asphalt. Degreasing solvents may have been used inside the building while it was used as a storage building and may have contributed to groundwater contamination in the area. SWMU 40 is associated with the Former Aluminum Chip Handling Building. Metal chips soaked in oil and solvents were stored at this site. The building was razed in 1974 and the area paved with asphalt (GSA and NNSA 2008:24).

Subsurface contamination was identified at SWMUs 16 and 40 during environmental investigations. Specifically, groundwater contamination by chlorinated solvents was found during cleanup activities that started in 1998. Cleanup activities include the collection of groundwater, treatment in an onsite system, and discharge of the treated groundwater to the sanitary sewer. Groundwater in the vicinity of SWMUs 16 and 40 is captured by building footing tile drains located in the basement of the Main Manufacturing Building. This captured groundwater is discharged to sanitary sewer ejector pits that pump to the sanitary sewer. Data collected in 1991 indicate that soil contamination at SWMUs 16 and 40 had not been detected at levels above site cleanup standards at depths less than approximately 4.3 meters (14 feet) below land surface. However, the presence of shallow soil contamination cannot be precluded based on the limited data collected in 1991. Therefore, excavation in the area of the Former Sales Building and the former Aluminum Chip Handling Building may expose workers to pockets of soil contamination. Excavations in contaminated soil at KCP are managed through institutional controls implemented as a part of the facility's Missouri Hazardous Waste Management Facility Part I Permit (GSA and NNSA 2008:24, 25).

Building 50 was constructed in the early- to mid-1950s and was used as a fuel components laboratory for jet engine development work and also housed laboratory facilities. There were two aboveground storage tanks on the northeast side of the building. Environmental releases from this building are being addressed pursuant to a Memorandum of Agreement between GSA, NNSA, and the U.S. Army Corps of Engineers. A number of voluntary environmental investigations have been conducted at Building 50 over the past 10 years. Releases to soil and groundwater primarily consisting of chlorinated solvents, PCBs, and petroleum hydrocarbons, have been documented by these investigations. Based on GSA investigations conducted to date, the GSA has concluded that the primary source of VOC contamination at Building 50 is located near the northeast corner of the building, either just outside or beneath it. This contamination has impacted groundwater in the vicinity of the building. Groundwater flows west and south from the building. This contaminated groundwater is believed to be captured by building footing tile drains near the West Boilerhouse and the Main Manufacturing Building (Building 1). Additional investigatory work continues at the site primarily relating to an evaluation of potential indoor air impacts from chlorinated solvents and PCBs in the soil. GSA also has concluded that petroleum hydrocarbon contamination exists in soils at the site, derived from a former underground tank farm that occupied the area. The tanks have been removed and the Missouri Department of Natural Resources has stated that no further work with regard to petroleum derived from the former tank farm is required. Upon completion of all investigations, it is anticipated that regulatory concurrence will be required to formalize the adequacy of work performed to date at Building 50. It is expected that institutional controls similar to those already in place for NNSA-controlled areas would be implemented for releases at Building 50 (GSA and NNSA 2008:25, 26).

3.6.2.3 Geologic Hazards

Most of Missouri's earthquake activity has been concentrated in the southeast corner of the state, which lies within the New Madrid seismic zone. In contrast, the northwestern portion of the state and the

Kansas City area is seismically stable (DOE 1996c:4-143). The written record of earthquakes in Missouri prior to the nineteenth century is virtually nonexistent; however, there is geologic evidence that the New Madrid seismic zone has had a long history of activity. The New Madrid earthquake sequence of 1811–1812 ranks as one of the largest in the United States since European settlement. Based on event reconstruction, four to perhaps five earthquakes occurred in the period from December 16, 1811, through February 7, 1812, with epicenters in northeast Arkansas and near New Madrid, Missouri. The three largest shocks produced shaking as high as MMI XI to XI at their epicenters, with estimated magnitudes ranging from 7.2 to 8.1. Severe topographic and hydrologic changes were noted near the epicenters. The first event was felt distinctly in Washington, D.C., and frightened many people, and was also felt as far away as Boston, nearly 1,800 kilometers (1,100 miles) away. Shaking from the events across northwestern Missouri and encompassing KCP is estimated to have been in the MMI VI to VII range. The New Madrid seismic zone has experienced numerous earthquakes since the 1811–1812 series, and at least 35 earthquakes of MMI V or greater have been recorded in Missouri since 1811. Numerous earthquakes originating outside of the state's boundaries have also affected Missouri (USGS 2009i). Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects.

Since 1973, only three earthquakes have been recorded within a radius of 100 kilometers (62 miles) of KCP. The closest of these was determined to be non-tectonic in origin. Of the remaining two, the closest was a magnitude 3.3 earthquake on May 18, 2005, that was located about 76 kilometers (47 miles) southeast of the site. It had an MMI of IV (USGS 2009j).

Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity). As previously described in Section 3.2.2.3, the latest probabilistic PGA data from the USGS are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For KCP, the calculated PGA is approximately 0.05 *g* (USGS 2009d).

3.6.3 Water Resources

3.6.3.1 Surface Water

KCP is located on the drainage divide between the Blue River immediately to the east and a major tributary stream, Indian Creek, which runs along the southern border of the site complex (see Figure 2–19). From the south of Kansas City, the Blue River flows north past the site for some 24 kilometers (15 miles) to the Missouri River (GSA and NNSA 2008:9, 10, 28). USGS has operated a stream gauging station on the Blue River since 1939, which is located on the Bannister Road Bridge just to the east of the site. During the period of record, the annual flow of the Blue River has averaged 4.9 cubic meters (172 cubic feet) per second. In 2007, the average flow was approximately 7.3 cubic meters (257 cubic feet) per second (USGS 2009k).

The site complex is drained by a combination of four NPDES-permitted storm sewer systems, six non-permitted (i.e., non-industrial) storm sewers, and surface drainage ditches. Selected fire protection system test flows, HVAC condensate, and rainwater from building roofs and paved areas drain into a network of underground laterals, which connect to storm sewer system mains and then to the outfall areas that empty into the Blue River and Indian Creek. Some parking and undeveloped areas within the facility are drained through a ditch system along the western, southeastern, and a portion of the northern site boundaries. In addition to the two bordering streams, surface waters around the site complex consist of intermittent stormwater runoff in the drainage ditches. Sampling by DOE is periodically performed at locations along the streams and at the four permitted storm sewer outfalls, in compliance with the NPDES permit (GSA and NNSA 2008:28).

While DOE does not routinely monitor ambient surface-water quality in the Blue River and Indian Creek, extensive monitoring data are available. Studies by the USGS have documented water quality impairment in the Blue River Basin resulting from intensive urbanization, flood control, and the combined effects of nonpoint source pollution on water quality, stream habitat, and aquatic biota. Generally, more than one-half of the base flow in the Blue River downstream from the junction with Indian Creek originates as wastewater effluent (Wilkison et al. 2005:1, 2). In accordance with state and Federal law, the State of Missouri classifies surface waters of the state and designates beneficial uses of waters and criteria to protect those uses. The reach of the Blue River from East Bannister Road, bordering the site to the north, is designated Class P (i.e., a stream that maintains permanent flow during drought conditions). However, the reach from East Bannister Road south and west from the site to the Kansas state line is Class “C” (i.e., a stream that may cease flow in dry periods but maintains permanent pools, which support aquatic life). The entire length of Indian Creek is also designated Class C. In the vicinity of KCP, both the Blue River and Indian Creek are further designated as Metropolitan No-Discharge Streams (i.e., meaning no water contaminant except uncontaminated cooling water or permitted storm water discharge) (10 CSR 20-7.031; MDNR 2009a).

The Blue River and Indian Creek are subject to frequent flooding due to intense urban development, especially in the lower basin of the river. This has caused even moderate flood flows to become a serious problem. The Blue River and Indian Creek leave their banks several times a year; however, the water generally flows onto undeveloped land, including currently vacant portions of the Bannister Federal Complex (i.e., primarily the northeast portion of the property). A flood protection system completed in 1994 is designed to prevent 500-year floods from reaching any of the structures located within the site complex (GSA and NNSA 2008:28). Effective operation of the flood protection system requires manual closing of floodgates and placement of stop logs and sandbags. It has been estimated that it would take 32 workers approximately 4 hours to close the floodgates.

Facilities at KCP do not withdraw surface water for use. The existing KCP uses potable water supplies from the Kansas City municipal system. Water use is further discussed in Section 3.6.7.4.

Operating under an industrial wastewater discharge permit issued by Kansas City, the existing plant discharges approximately 893,000 liters (236,000 gallons) per day of wastewater to the Blue River Wastewater Treatment Facility, Kansas City’s largest publicly owned treatment works. Wastewater generated from onsite groundwater treatment, as well as water from regulated process and industrial discharges, is treated at the onsite industrial wastewater pretreatment facility prior to discharge. The remainder of the regulated industrial wastewater is treated prior to reuse as cooling tower makeup water or discharge to the sanitary sewer system. The relocation of DOE manufacturing and support facilities would result in significant reductions in industrial wastewater discharges. This would result in reductions to both the total discharge to the Blue River Wastewater Treatment Facility and the volume of industrial wastewater treated at the onsite pretreatment facility (GSA and NNSA 2008:28).

3.6.3.2 Groundwater

The Western Interior Plains aquifer system underlies most of Kansas, the eastern and southern parts of Nebraska, and a small area in west-central Missouri. The aquifer system consists of lower units in rocks of the Ordovician and Cambrian age, a shale confining unit of Mississippian and Devonian age, and an upper aquifer unit composed of Mississippian limestone. The thickness of the aquifer (including the confining unit) ranges from less than 150 meters (500 feet) to more than 914 meters (3,000 feet). The aquifer system is thin or absent on structural uplifts and is thickest in downwarps (GSA and NNSA 2008:27).

Regional groundwater in the aquifer system flows towards the southeast and east. Much of the water discharges from the aquifer system in the transition zone between the Western Interior Plains and the Ozark Plateaus aquifer systems. The aquifer system is considered to have a low permeability. Total dissolved-solids concentrations of water in the Western Interior Plains aquifer system are typically greater than 1,000 milligrams per liter. In thick, deeply buried parts of the aquifer system, dissolved-solids concentrations of more than 200,000 milligrams per liter have been reported. The elevated concentrations are due in part to the slow movement of groundwater in the aquifer system. Consequently, the Western Interior Plains aquifer system is not generally developed for potable use because it is deeply buried and contains highly mineralized water. Locally, deeply buried parts of the aquifer system contain oil and gas and brine introduced from disposal wells as a byproduct of hydrocarbon production (GSA and NNSA 2008:27).

Background groundwater quality in the alluvial aquifer is considered poor due to high iron, naturally occurring arsenic, and manganese concentrations. However, there are no users of the alluvial aquifer near KCP. Three separate groundwater contaminant plumes have been identified within the boundaries of KCP. These contaminant plumes are the result of past activities at the site. Potentially contaminated groundwater sites include SWMUs 16 and 40, where the depth to groundwater ranges from approximately 2.4 to 4.6 meters (8 to 15 feet) below ground surface, but may be shallower during times of high precipitation. Residual groundwater contamination also is present at these SWMUs. A number of voluntary environmental investigations have been conducted at Building 50 over the past 10 years. These have detected the presence of groundwater contamination consisting of VOCs in the vicinity of Building 50. This contamination is being addressed by GSA pursuant to a Memorandum of Agreement among GSA, NNSA, and the U.S. Army Corps of Engineers (GSA and NNSA 2008:27).

3.6.4 Meteorology, Air Quality, and Noise

3.6.4.1 Meteorology and Air Quality

The climate of the KCP area is humid continental, with warm summers, moderately cold winters, and moderate annual precipitation. The average annual rainfall is 96.5 centimeters (37.98 inches). Maximum rainfall occurs in May at the Kansas City National Weather Service Station which is about 40 kilometers (25 miles) north of KCP (NOAA 2009d). Damaging hailstorms rarely occur in Jackson County (NCDC 2009d). The average annual snowfall is 51.1 centimeters (20.1 inches) (NOAA 2009d).

Thirty-one tornadoes were reported in Jackson County between January 1950 and May 2009. Several occurrences of high winds typically occur every year (NCDC 2009d). The average annual windspeed is 4.7 meters per second (10.5 miles per hour). The prevailing wind direction is south-southwest (NOAA 2009d). The maximum windspeed, based on the highest 1-minute average value, is 26 meters per second (58 miles per hour) (NOAA 2009b:66). The mean number of days per year with thunderstorm activity is 51.3 (NOAA 2009d).

The average annual temperature is 15.3 °C (59.5 °F). Temperatures range from a monthly average minimum temperature of –7.4 °C (18.7 °F) in January to a monthly average maximum of 31.6 °C (88.9 °F) in July. The maximum recorded temperature is 43 °C (109 °F) (NOAA 2009d).

KCP is in an area that is designated better than national standards for sulfur dioxide and better than national standards or unclassifiable for nitrogen dioxide. The area is unclassifiable/attainment regarding attainment of the standard for carbon monoxide and is attainment for ozone. EPA has not assigned an attainment status designation for lead. For $PM_{2.5}$, the area is unclassifiable/attainment (40 CFR 81.326).

The nearest PSD Class I area is Hercules Glades Wilderness Area, about 282 kilometers (175 miles) to the southeast (NPS 2009). KCP and its vicinity are classified as a Class II area. No PSD permits are required for any emission source at KCP (KCP 2009).

The primary sources of criteria pollutants at KCP are nitrogen oxide from boilers, process heaters and manufacturing operations. The plant is designated as a major source under the National Emission

Standards for Hazardous Air Pollutants regulations. KCP is operated under an operating permit application that covers these sources, as required under the Federal Clean Air Act (42 U.S.C. 7401 et seq.) and companion State of Missouri regulations (GSA and NNSA 2008).

There are nearby monitors in Jackson County for nitrogen dioxide, sulfur dioxide, and PM pollutants. Monitored concentrations in the region are well below ambient standards. The nearest monitor reported by the Missouri Department of Natural Resources is at Richard-Gebaur Airport in Cass County (MDNR 2009b) for ozone. There are no nearby monitors for lead (EPA 2009e). The nearest monitor for mercury reported by EPA is in Clay County. For 2008, the mean mercury concentration was 0.0012 micrograms per cubic meter, and the fourth highest 24-hour concentration was 0.002 micrograms per cubic meter (EPA 2009f).

3.6.4.2 Noise

Major noise emission sources within KCP include various equipment and machines—HVAC equipment, material-handling equipment, and vehicles. Most industrial operations occur far enough from the site boundary that noise at the boundary from these sources is barely distinguishable from background levels. However, it is assumed that some noise from operations can be heard by residents living south of the complex (GSA and NNSA 2008:22). The closest residence is approximately 150 meters (500 feet) west of KCP. Traffic is the primary source of noise at the site boundaries.

Kansas City has established community noise standards, which specify acceptable noise levels applicable at site boundaries (KCC Ch. 46, Art. IV). Sound level measurements have not been recorded recently at KCP, but it is expected that noise levels are typical of an urban or industrial setting. The traffic generated by activities at the site includes employee vehicles and trucks used for shipping. This contributes to traffic on nearby roads and the associated traffic noise. Roads that provide access to the site include East Bannister Road, Blue River Road, and Troost Avenue; annual average daily traffic is discussed in Section 3.6.10.3.

3.6.5 Ecological Resources

3.6.5.1 Terrestrial Resources

KCP is located within the highly developed Bannister Federal Complex and is within the city limits of Kansas City, Missouri. The Bannister Federal Complex is a highly developed area and includes parking lots, buildings, and other manmade structures. Due to the developed nature of the landscape, little natural habitat or native vegetation remains. The majority of the site’s vegetation consists of nonnative species capable of growing in disturbed soils. Although several small patches of native vegetation are scattered throughout, a larger, more-intact patch exists in the northwest corner of the complex near the border (GSA and NNSA 2008:29).

Wildlife occurring within the Bannister Federal Complex is limited to those species tolerant of human activity. Mammals observed include whitetail deer, fox, raccoon, opossum, and gray squirrel. Bird species observed includes the turkey, American robin, house sparrow, and European starling. Raptors have been observed flying over the complex, but none are expected to nest or forage within the boundaries. Common reptiles include the garter snake, black rat snake, and five-lined skink (GSA and NNSA 2008:29).

3.6.5.2 Wetlands

Although a small amount of wetlands exist nearby within the riparian zones of the Big Blue River, no wetlands occur within the boundaries of the Bannister Federal Complex or in the area of the proposed mercury storage facility (GSA and NNSA 2008:29).

3.6.5.3 Aquatic Resources

Although not located within the boundary of the Bannister Federal Complex, the Blue River and Indian Creek border the complex and constitute the most substantial aquatic resources in the vicinity. Common fish species found within theses two streams include channel catfish, carp, and gar. Within the complex, aquatic features are limited to manmade structures such as retention ponds and drainage basins. Although aquatic organisms may be found in nearby streams and rivers, none are expected to occur within the complex (GSA and NNSA 2008:29).

3.6.5.4 Threatened and Endangered Species

Due to the disturbed nature of Bannister Federal Complex, no sensitive species are known to occur. As such, no species with a Federal or state listing status is expected to occur, breed, or forage within the Bannister Federal Complex or its vicinity (GSA and NNSA 2008:29).

3.6.6 Cultural and Paleontological Resources

3.6.6.1 Prehistoric Resources

The prehistoric chronology of the KCP area consists of five time periods: Paleo-Indian (12,000 to 8000 B.C.), Dalton (8000 to 7000 B.C.), Archaic (7000 to 1000 B.C.), Woodland (1000 B.C. to A.D. 900), and Mississippian (A.D. 900 to 1700). Site types that may exist in the area include villages, campsites, limited-activity sites, and burial mounds (DOE 1996c:4-144). A cultural resource assessment of the entire Bannister Federal Complex was performed in 2007. Due to the fact that the property has been previously disturbed by construction of the existing complex, there is a low probability for finding any American Indian or European-American archaeological sites within the site (GSA and NNSA 2008:4-29). One cultural resource survey was conducted in areas adjacent to KCP, and no prehistoric resources were identified; however, two prehistoric sites and a multicomponent site have been previously recorded along the terraces of the Blue River (DOE 1996c:4-144).

3.6.6.2 Historic Resources

Some of the facilities at KCP lack architectural integrity, are not representative of a particular style, and are not considered contributing features to the broad themes of World War II defense production. Consequently, these facilities are not likely to be considered eligible for inclusion in the NRHP. However, some facilities at KCP may be eligible based on their association with the Cold War (DOE 1996c:4-144).

Although individual facilities at KCP may not be eligible for NRHP listing, the site as a whole may be eligible under Criteria A (Events) because plant facilities were used to build Pratt & Whitney’s engines during World War II and KCP played a role in the development of the nuclear program and under Criteria C (Architecture) for facility design. Agency consultation with the Missouri SHPO will determine the level of protection necessary (GSA and NNSA 2008:4-30).

3.6.6.3 American Indian Resources

Three American Indian groups occupied or traversed the KCP area: the Osage, the Missouri, and the Kansa. American Indian resources in the area may include remains of villages, trails, springs, vision quest sites, and burial sites. Most of the historic American Indian villages were not located in the KCP area, but south on the Osage River or north and east along the Mississippi River (DOE 1996c:4-144).

A previous cultural resource assessment (see Section 3.6.6.1) indicated a low probability for finding any American Indian archaeological sites within the KCP area.

3.6.6.4 Paleontological Resources

KCP is located on alluvium from the Blue River floodplain, which is bordered by outcrops of Pennsylvania limestone and shale. Some fossils may exist in the limestone and shale (DOE 1996c:4-144).

3.6.7 Site Infrastructure

In addition to the description provided below, a summary of KCP's sitewide infrastructure characteristics is presented in Table 3–14.

Table 3–14. Kansas City Plant Infrastructure Characteristics

Resource	Current Site Usage	Site Capacity
Transportation (kilometers)		
Roads	25	25
Railroads	1.6	1.6
Electricity		
Energy consumption (megawatt-hours per year)	116,600[a]	Not available
Fuel		
Natural gas (cubic meters per year)	17,000,000	(b)
Fuel oil (liters per year)	20,000	(b)
Diesel fuel (liters per year)	7,570	(b)
Gasoline (liters per year)	2,000	(b)
Propane (liters per year)	(c)	(c)
Water (liters per year)	572,000,000[d]	638,000,000

[a] Assumes 1 kilovolt-ampere equals 1 kilowatt (power factor of 1.0).
[b] Limited only by the ability to transport resource to the site.
[c] Fuel resource not used on site.
[d] The amount of potable water from the City of Kansas City.
Note: To convert kilometers to miles, multiply by 0.6214; cubic meters to cubic feet, by 35.315; and liters to gallons, by 0.26417.
Source: DOE 1996c; GSA and NNSA 2008; Honeywell 2008:56-59.

3.6.7.1 Ground Transportation

KCP is located approximately 13 kilometers (8 miles) south of Interstate 70 and 2.4 kilometers (1.5 miles) north of Interstate 435. The site is accessed from adjacent local roadways (i.e., Troost Avenue to the west and Blue River Road to the east) with onsite roads leading to numerous parking lots and site facilities. Currently, there are 1.6 kilometers (1 mile) of railroad tracks at KCP. A Union Pacific rail line runs through the Bannister Federal Complex, and Kansas City Southern rail intersects the Union Pacific rail line north of the site (GSA and NNSA 2008:21, 23).

3.6.7.2 Electricity

Utility services for the Bannister Federal Complex are operated and managed by DOE. The site has two primary energy needs: electricity and boiler fuel (see Section 3.6.7.3). DOE purchases electricity from the Kansas City Power and Light Company to power production machinery, water chillers, pumps, compressors, fans, lights, and general office equipment. Power is supplied to the Bannister Federal Complex by two 161-kilovolt overhead transmission lines from the Kansas City Power and Light Company Southtown and Tomahawk Substations. Two Kansas City Power and Light Company–owned onsite transformers step the voltage down to 13.8 kilovolts, which is delivered to two main busses for distribution at the main switchgear. The main switchgear distributes this power to multiple substations serving the GSA buildings and the NNSA-controlled areas. System reliability is maintained through system upgrades, maintenance, and redundancy and installation of reserve capacity (Honeywell 2008:56-57).

The annual energy consumption at the site as a whole is approximately 117,000 megawatt-hours per year. The site electrical capacity is not available (DOE 1996c:4:135).

3.6.7.3 Fuel

Natural gas is the primary fuel and is purchased through a U.S. Department of Defense nationwide contract. It is then delivered to KCP through local pipelines. Natural gas is the primary combustion fuel for the steam boilers that provide heat to the Bannister Federal Complex (except the GSA building at 2306 Bannister Road). Pipeline capacities are sufficient to meet KCP demand during extreme weather conditions and periods of high usage (Honeywell 2008:56, 59).

There are two powerhouses on site. The West Powerhouse produces steam, compressed air, and chilled water for environmental and process control in support of KCP's mission; the East Powerhouse produces chilled water (Honeywell 2008:56).

Fuel oil, drawn from onsite storage tanks, is used as a backup boiler fuel for periods when natural gas is not available. Fuel oil is purchased from commercial suppliers by competitive bid and is stored in two 946,000-liter (250,000-gallon) storage tanks adjacent to the West Powerhouse (Honeywell 2008:56, 59).

The annual consumption of natural gas at KCP is 17 million cubic meters (600 million cubic feet); the annual consumption of fuel oil is 20,000 liters (about 5,280 gallons). Additionally, diesel fuel usage is 7,570 liters (about 2,000 gallons) and gasoline usage is 2,000 liters (about 530 gallons).

3.6.7.4 Water

Water and sanitary sewer service are supplied by Kansas City. Three independent mains feed KCP on the south, northwest, and northeast sides of the Banister Federal Complex, providing redundancy. Each feed is capable of meeting KCP demand individually. Domestic water is used as makeup for the steam, chilled water, condenser water, and fire protection systems and for sanitary applications (toilets, sinks, eyewashes, showers, drinking fountains, and cafeteria). Potable uses are protected from industrial uses by an isolation cross-connection control program. The internal distribution system is in generally good condition and is adequate to serve the plant loads (Honeywell 2008:58).

Approximately 91,000 liters (24,000 gallons) of water from the onsite groundwater treatment facility is discharged to the publicly owned treatment works daily. KCP discharges 893,000 liters (236,000 gallons) per day of wastewater to the Blue River Wastewater Treatment Facility (GSA and NNSA 2008:29).

KCP uses approximately 572 million liters (151 million gallons) of potable water per year from the City of Kansas City Water Services Department. Site capacity is 638 million liters (169 million gallons) (GSA and NNSA 2008:29).

3.6.8 Waste Management

Hazardous waste, nonhazardous waste, and LLW are generated and managed at KCP as a result of routine industrial operations, environmental stewardship activities, and construction activities (GSA and NNSA 2008:30). All KCP site wastes are managed using appropriate treatment, storage, and disposal technologies, in compliance with applicable Federal and state statutes.

3.6.8.1 Waste Generation and Management

In total, KCP generates and manages 1,055 metric tons (1,163 tons) of hazardous and nonhazardous waste per year. Routine site operations (nonnuclear electrical/mechanical assembly, machining, plastic fabrication plating) generate 15 metric tons (16.5 tons) of RCRA-regulated waste and 730 metric tons (804 tons) of nonhazardous waste each year. Non-routine site operations (site construction, environmental stewardship activities) generate 7 metric tons (7.5 tons) of RCRA-regulated waste and 303 metric tons (334 tons) of nonhazardous waste each year (NNSA 2008b). To manage hazardous waste generation, KCP operates an RCRA 90-day storage facility prior to offsite disposal at properly licensed commercial disposal facilities. KCP currently manages mercury alloy for use in plant operations (Holecek 2009). Other hazardous wastes generated during routine site operations include various acidic and alkaline liquids, solvents, oils, and coolants (DOE 1996c:App. H).

Nonhazardous wastes generated at KCP include industrial scrap and waste, office waste, lunchroom waste, and janitorial waste. Nonhazardous wastes are collected by commercial waste–hauling contractors and disposed of at the municipal Johnson County Mixed Solid Waste Landfill. Site sanitary wastewater is discharged into the Kansas City, Missouri, municipal sanitary sewer in compliance with sewer permit discharge limits (DOE 1996c:App. H).

Approximately 1 cubic meter (35.3 cubic feet) of LLW is generated each year at KCP as a result of routine laboratory and industrial processes. The LLW is shipped to the Nevada Test Site or a commercial facility for disposal (GSA and NNSA 2008:30).

3.6.8.2 Waste Minimization

KCP implements a Health, Safety and Environment Management System to define the overall scope of operations, risk, and systems to maintain worker safety and protection of the public and the environment. The environmental portion of the Health, Safety and Environment Management System is based upon the International Organization for Standardization 14001-2004, Environmental Management System Standard. The International Organization for Standardization 14001-2004 standard establishes a framework for requiring compliance with Federal and state waste management requirements, including waste minimization. Federal Manufacturing and Technologies provides an annual site environmental summary to NNSA containing relevant environmental monitoring data, including waste minimization data. In fiscal year 2007, KCP recycled 886 metric tons (977 tons) of hazardous and nonhazardous waste (Honeywell 2007).

3.6.9 Occupational and Public Health and Safety

3.6.9.1 Normal Operations

KCP contains various nonnuclear manufacturing operations and solid waste management units, which have been addressed under RCRA corrective action and require continuing maintenance (GSA and NNSA 2008:4-6). Soil and groundwater conditions are described in Sections 3.6.2.2 and 3.6.3.2.

The infrastructure currently available in the proposed mercury storage warehouses consists of a concrete floor with epoxy sealant and concrete and gravel composite roofing. The building has a sprinkler system for fire protection (KCP 2009:2.1).

3.6.9.2 Facility Accidents

The candidate facilities at KCP have not had any spills, fires, explosions, leaks, or other such incidents (KCP 2009:2.8.3).

KCP has an established spill prevention, control, and countermeasures plan and integrated contingency plan to maintain adequate response preparedness for fire and hazardous materials releases. Fire and emergency services are provided by local agencies in Kansas City (KCP 2009:2.8.2). However, after NNSA moves operations from this location (planned for 2013), emergency planning/response support would no longer be provided by NNSA, but fire and emergency service would continue to be provided by local agencies.

3.6.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to the site and employee traffic. These include death or injury from accidental release of nonradioactive materials, effects of air pollutant emissions emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of nonradioactive materials. Risks related to ongoing nonradioactive transportation to and from KCP have not been estimated.

3.6.10 Socioeconomics

KCP is located in Kansas City, Missouri, approximately 13 kilometers (8 miles) south of the city center. KCP employs approximately 2,400 persons. Over 90 percent of the people employed at KCP reside in four counties: Cass, Clay, and Jackson in Missouri and Johnson in Kansas. Therefore, these four counties are identified as the ROI in this socioeconomics analysis (GSA and NNSA 2008:22).

3.6.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of the four-county ROI increased by approximately 5.0 percent to 801,414. By July 2009, the unemployment rate of the ROI was 8.9 percent, which was nearly identical to the unemployment rate across the two-state area of Missouri and Kansas (8.8 percent) (BLS 2009).

3.6.10.2 Demographic and Housing Characteristics

In 2008, the estimated population of the four-county ROI was 1,516,646. From 2000 to 2008, the ROI population grew by 11 percent, compared with 5.2 percent growth throughout the two-state region of Missouri and Kansas (DOC 2009b). The percentage of the ROI population under the age of 18 was 26 percent; women ages 18 to 39 composed 15 percent of the population (DOC 2009c). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. There were 654,718 housing units in the ROI in 2007 (DOC 2008), 63 percent of which were owner occupied, 28 percent were renter occupied, and 9.4 percent were vacant (DOC 2009c).

3.6.10.3 Local Transportation

Primary access to KCP is located to the south on East Bannister Road. The average daily traffic on the segment of East Bannister Road approaching the site was 21,135 vehicles per day in 2008. There are several interstate highways in the Kansas City area, the closest of which is Interstate 435, which forms a beltway around the downtown area. The southern tier of Interstate 435 is located about 1.6 kilometers (1 mile) south of the site. The 2008 average annual daily traffic on this segment of Interstate 435 was 122,090 vehicles per day (MODOT 2008). The beltway intersects several interstate highways heading in all directions, including Interstates 470, 70, 35, and 29. There are two commercial airports located in the Kansas City metropolitan area. The closest to the site is the Charles B. Wheeler Downtown Airport; however, the majority of operations at this facility now include corporate, charter, and recreational uses. The main commercial airport in the area is the Kansas City International Airport (located just beyond the ROI in nearby Platte County), which is accessible off the northeastern tier of the beltway. There are 10 additional public use general aviation airports located in the ROI (FAA 2009).

3.6.11 Environmental Justice

The 16-kilometer (10-mile) radius surrounding the storage location at KCP encompasses parts of four counties: Cass and Jackson in Missouri and Johnson and Wyandotte in Kansas. Figure 3–13 shows populations residing in the four-county area, as reported in the 1990 census, the 2000 census, and the *2005–2007 ACS 3-Year Estimate*s (DOC 2009c, 2009d, 2009e). In this figure, lightly shaded bars show populations in 1990, white bars show those 2000, and darker bars show those in 2005 through 2007. In the decade between 1990 and 2000, the total population of Cass, Jackson, Johnson, and Wyandotte Counties increased by approximately 11 percent to 1,345,940; the minority population increased by approximately 40 percent to 342,267; and the low-income population decreased by 3 percent to 122,568. Between 2000 and 2007, the total population increased by 7 percent to 1,444,298, and the total low-income population increased by 30 percent. Detailed demographic data of race and Hispanic origin for Cass County, Missouri, and Wyandotte County, Kansas, from the *2007 ACS 1-Year Estimates* are unavailable due to an insufficient number of sample cases. However, the *2005–2007 ACS 3-Year Estimates* do include detailed demographic data of race and Hispanic origin for all counties included in the 16-kilometer (10-mile) radius surrounding the proposed storage location. The *2005–2007 ACS 3-Year Estimates* show that the Black or African American population residing in the four-county area accounted for approximately 55 percent of the county's total minority population. Persons who declared that they are of Hispanic or Latino origin are included in the "total Hispanic" population shown in Figure 3–13, regardless of race. They composed approximately 29 percent of the total minority population residing in Cass, Jackson, Johnson, and Wyandotte Counties during the 2005 through 2007 timeframe.

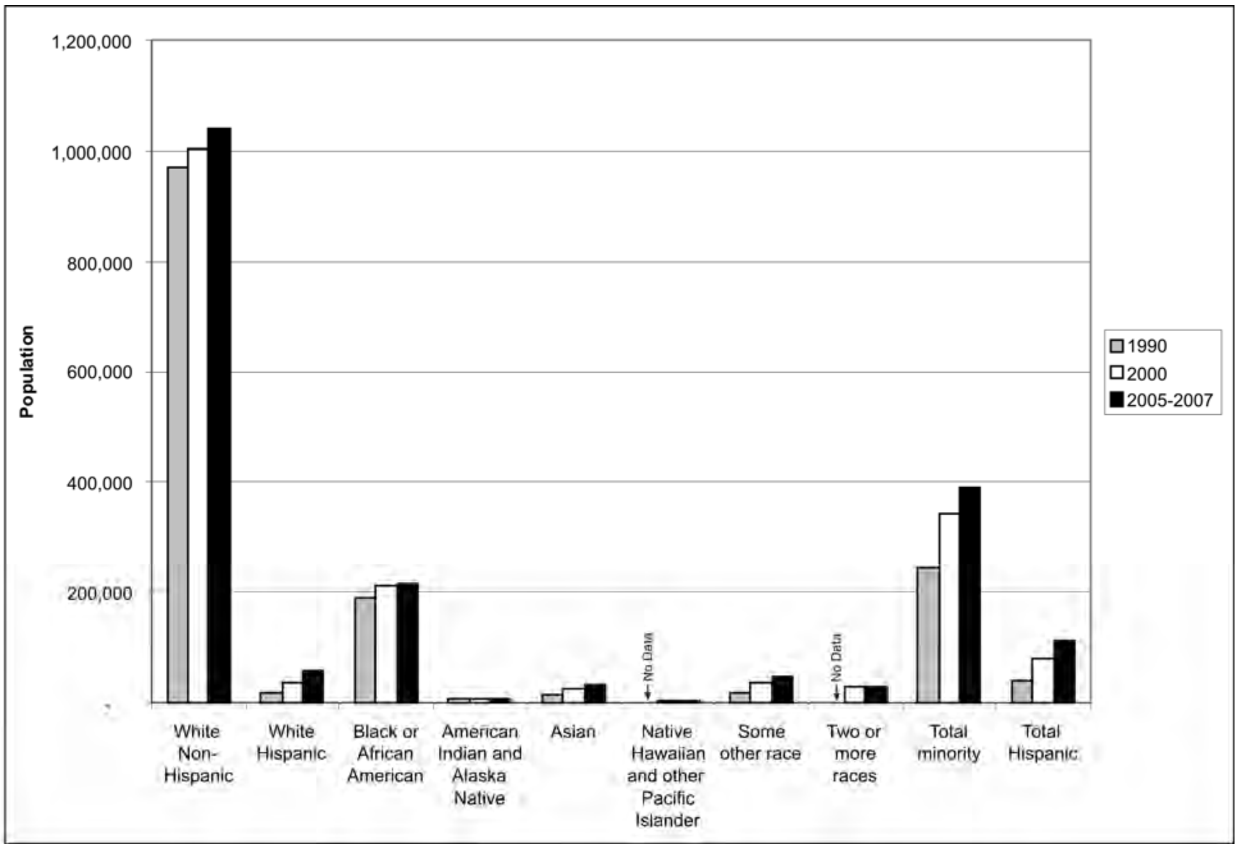
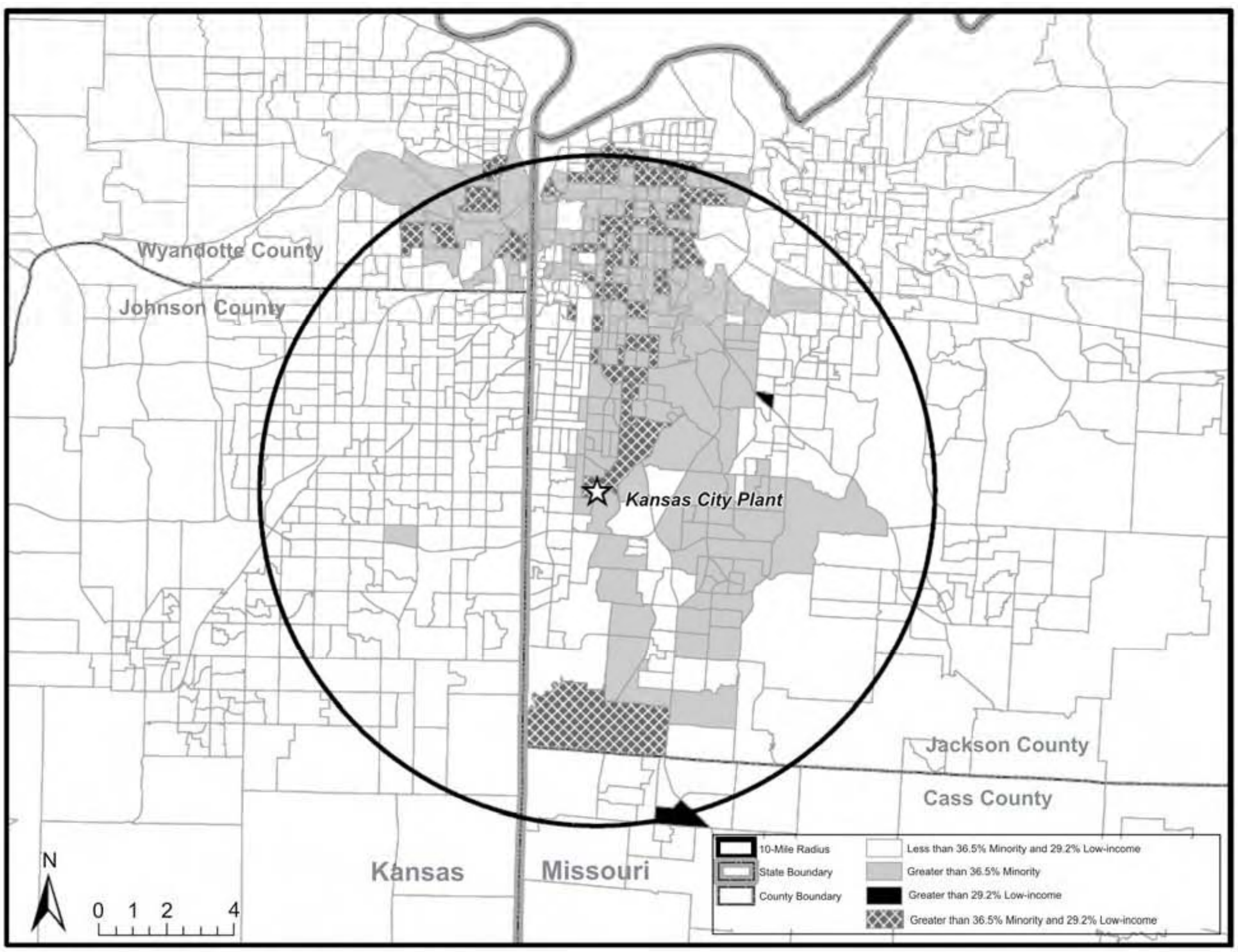


Figure 3–13. Populations Residing in the Four-County Area Surrounding the Kansas City Plant in 1990, 2000, and 2005 Through 2007

Approximately 700,041 people lived within 16 kilometers (10 miles) of KCP in 2000 (DOC 2009d). This area included an estimated 31 percent minority and 10 percent low-income population. By comparison, the four-county area included a 25 percent minority and 9 percent low-income population, and the two-state area included a 16 percent minority and 11 percent low-income population. There are 671 census block groups located within the 16-kilometer (10-mile) radius surrounding KCP; of this total, 172 contained a disproportionately high number of minority individuals, 2 contained a disproportionately high number of low-income individuals, and 74 contained a disproportionately high number of both minority and low-income individuals. Four hundred twenty-three block groups did not contain a disproportionately high number of low-income of minority individuals. Figure 3–14 displays the proximity of minority and low-income communities to KCP. Figure 3–15 shows the cumulative populations living at a given distance from the disposal site. The population living within 16 kilometers (10 miles) of KCP is mostly concentrated in the Kansas City, Missouri, Metropolitan Statistical Area.



Note: To convert miles to kilometers, multiply by 1.60934.

Figure 3–14. Block Groups Containing Minority and Low-Income Populations Within a 16-Kilometer (10-Mile) Radius of the Kansas City Plant

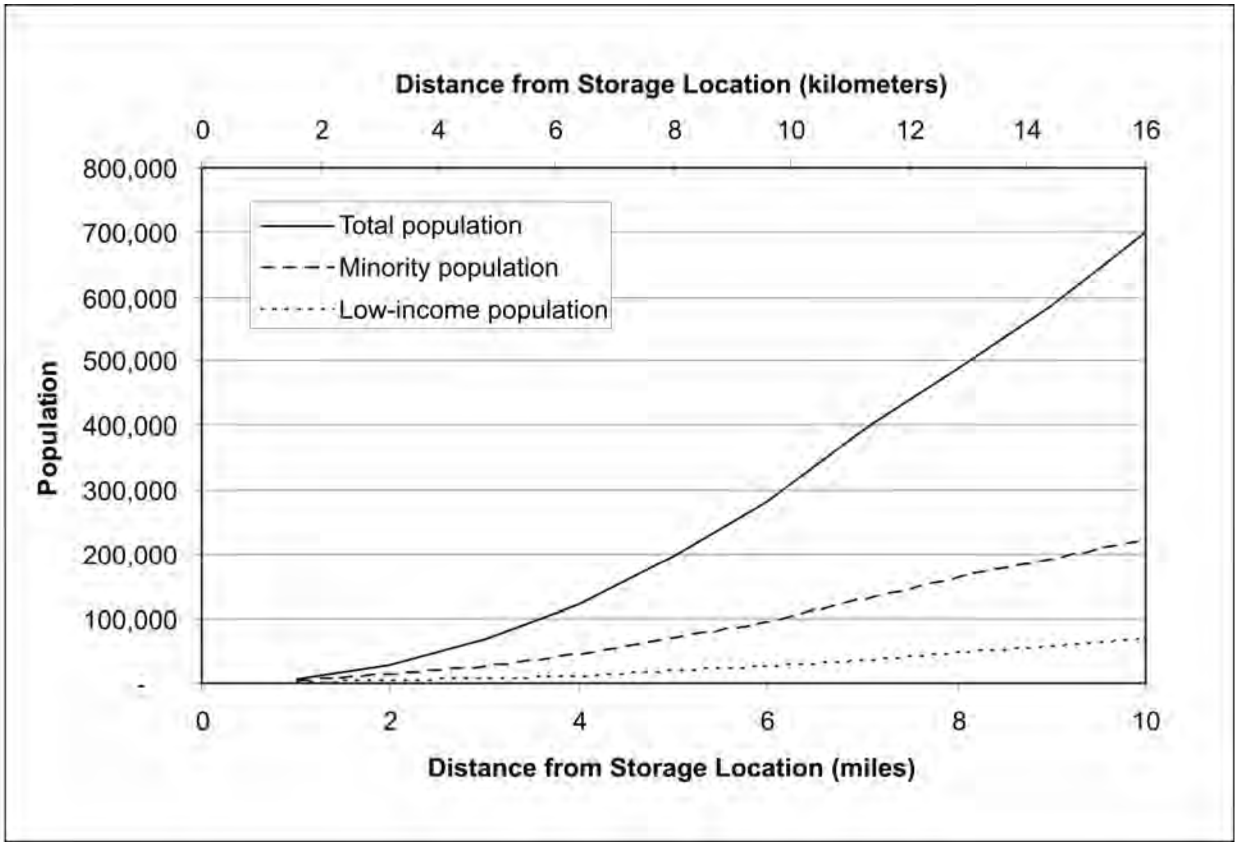


Figure 3–15. Cumulative Populations Living Within 16 Kilometers (10 Miles) of the Kansas City Plant

Approximately 28,184 people lived within approximately 3.2 kilometers (2 miles) of KCP in 2000 (DOC 2009d). This area included an estimated 42 percent minority and 11 percent low-income population. There are 41 census block groups located within this ROI; of this total, 16 contained a disproportionately high number of minority individuals and 1 contained both a disproportionately high number of minority and low-income individuals. Twenty-four block groups did not contain a disproportionately high number of minority or low-income individuals.

POTENTIALLY SUSCEPTIBLE POPULATIONS

Environmental justice concerns were considered in greater detail in areas that have been identified as containing a disproportionately high number of minority or low-income individuals. This section presents information regarding factors that may contribute to disproportional impacts, such as age and access to health care.

Figure 3–16 displays a breakdown of potentially susceptible demographics for the 16-kilometer (10-mile) ROI, the 3.2-kilometer (2-mile) ROI, the two-state region, and the four-county region surrounding KCP. For purposes of this analysis, the demographics of primary concern are children under the age of 18, women ages 18 to 39, and individuals ages 65 and up. As the figure shows, there is not a disproportionately high number of individuals under 18 within either the 16-kilometer (10-mile) or 3.2-kilometer (2-mile) ROI. The populations of women ages 18 to 39 and individuals ages 65 and up are noticeably larger in the 3.2-kilometer (2-mile) ROI than in the surrounding areas. In all cases, the differences do not appear to be appreciable.

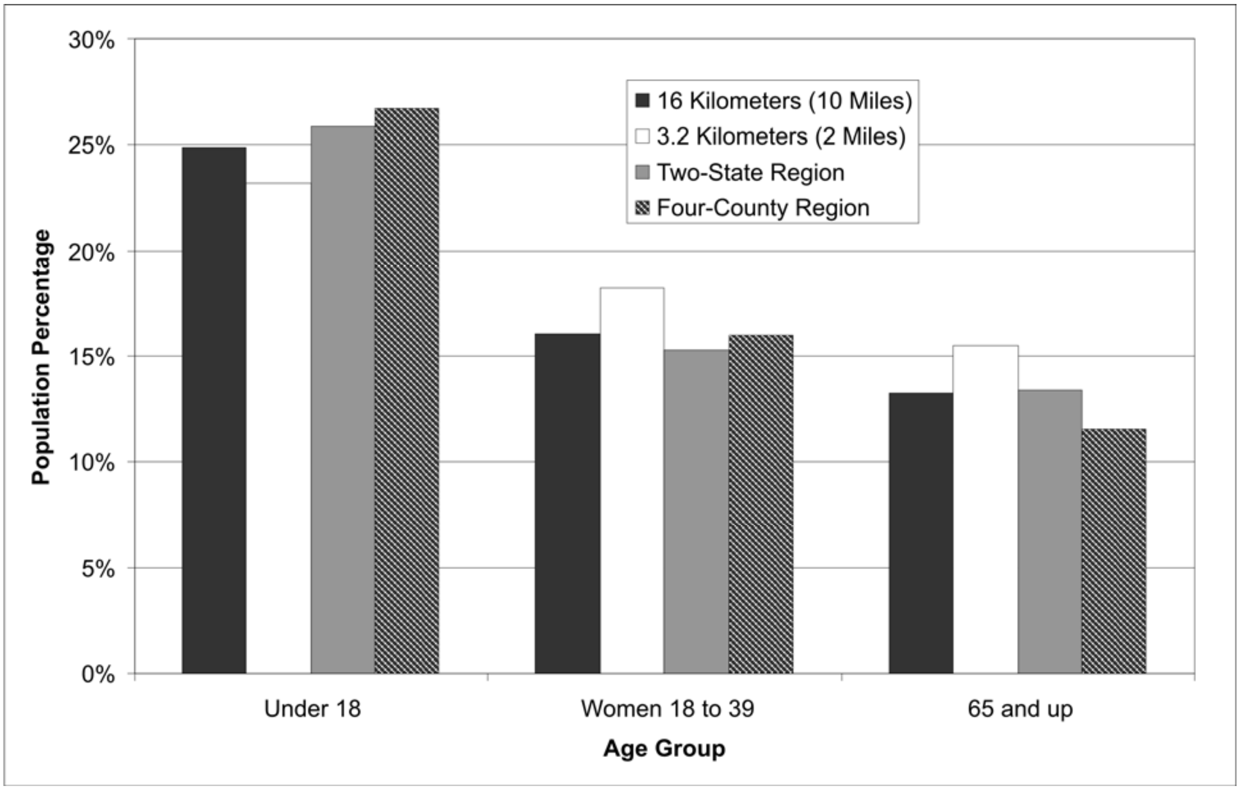


Figure 3–16. Percentage of Age Groups Within the 16-Kilometer (10-Mile) and 3.2-Kilometer (2-Mile) Regions of Influence and the Two-State and Four-County Areas Surrounding the Kansas City Plant

Health Professional Shortage Areas (HPSAs) are designated by the Health Resources and Services Administration. An HPSA is defined as an area "having a shortage of primary medical care, dental or mental health providers. They may be defined as urban or rural areas, population groups or medical or other public facilities" (HRSA 2009a). These data are presented at the greatest level of spatial resolution available for each county within the 16-kilometer (10-mile) ROI. HPSA designations have been identified for population groups in census tracts and comprehensive health centers in Jackson County. Of the 158 census tracts in Jackson County that are located within the 16-kilometer (10-mile) ROI, 125 are designated as primary medical care HPSAs for low-income populations. There are 18 census tracts within the approximate 3.2-kilometer (2-mile) ROI, 14 of which are designated as primary medical care HPSAs for low-income populations. Figure 3–17 identifies the census tracts within the 16-kilometer (10-mile) ROI designated as low-income population primary medical care HPSAs. Two medical facilities in Jackson County have been identified as primary medical care, dental, and mental health HPSAs (HRSA 2009b).

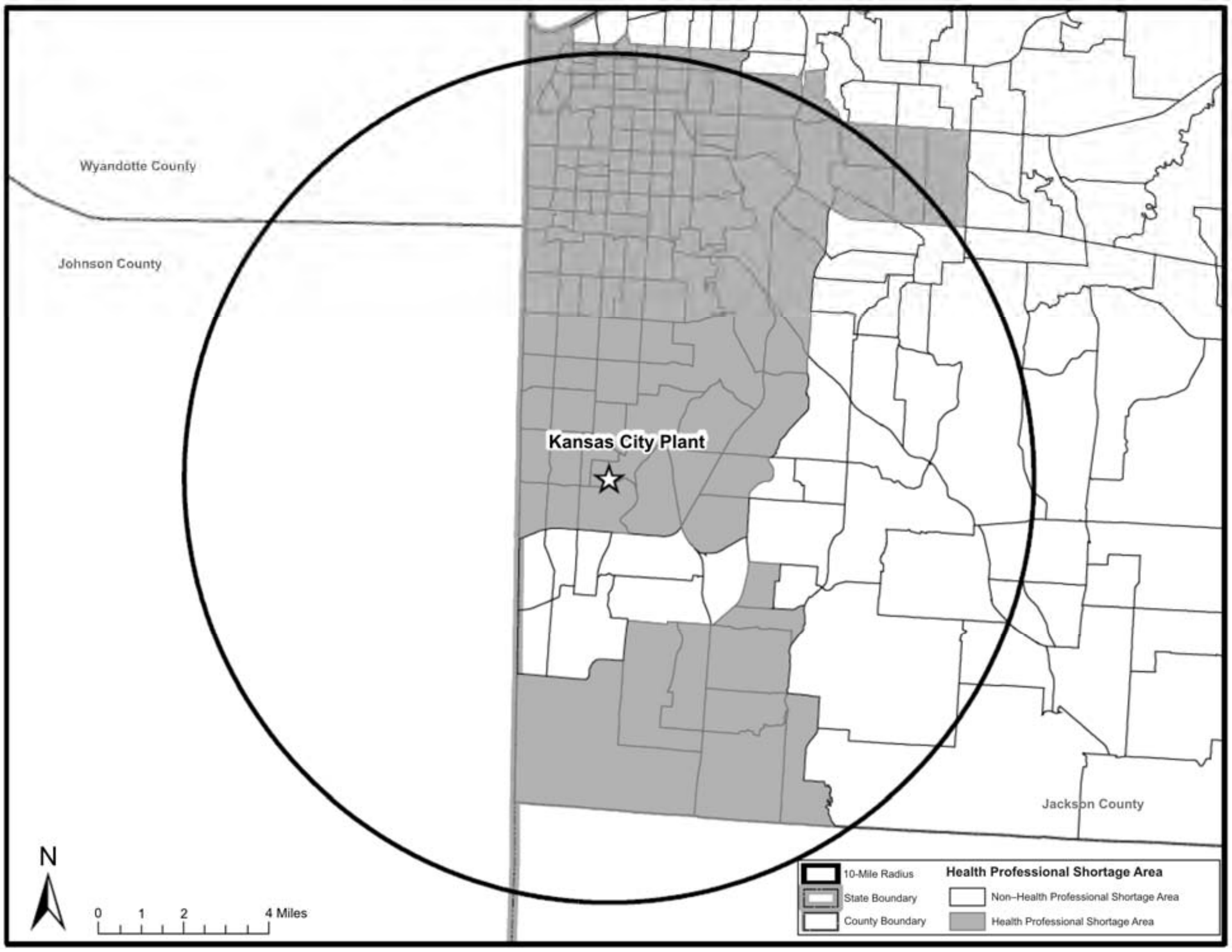


Figure 3–17. Jackson County Census Tracts Within the 16-Kilometer (10-Mile) Region of Influence Designated As Primary Medical Care Health Professional Shortage Areas For Low-Income Populations

In Cass County, four medical facilities are designated as primary medical care HPSAs, and the entire county is designated as a mental health HPSA. There are no dental HPSAs in Cass County. All of Wyandotte County is designated as a primary medical care HPSA for the Medicaid-eligible population and as a dental HPSA for the low-income population. There are no mental health HPSA designations in Wyandotte County. No primary medical, dental, or mental health HPSAs are designated in Johnson County (HRSA 2009b).

3.7 SAVANNAH RIVER SITE

3.7.1 Land Use and Visual Resources

3.7.1.1 Land Use

SRS is located in south-central South Carolina and occupies an area of approximately 80,290 hectares (198,400 acres) in Aiken, Allendale, and Barnwell Counties. The site, bordered by the Savannah River to the southwest, is approximately 24 kilometers (15 miles) southeast of Augusta, Georgia, and 19 kilometers (12 miles) south of Aiken, South Carolina (DOE 2008c:4-341). SRS is a controlled area, with public access being limited to through traffic on South Carolina Highway 125 (SRS Road A), U.S. Route 278 (SRS Road 1), and the CSX railway line (DOE 1999b:3-161). Approximately 10 percent of the land at SRS has been developed to support production, infrastructure, research and development, and waste management facilities. The balance of the site consists mainly of planted pine forest, managed for timber production by the U.S. Forest Service under an interagency agreement with DOE (DOE 2008c:4-341). DOE has prepared a number of documents addressing the future of the site, including the *Savannah River Site End State Vision* report (DOE 2005e).

In 1972, DOE designated all of SRS as a National Environmental Research Park to be used by the national scientific community to study the impacts of human activities on the cypress swamp and hardwood forest ecosystems. DOE has also set aside approximately 5,670 hectares (14,000 acres) of SRS exclusively for nondestructive environmental research (SREL 2008).

Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. The site has been divided into six land management areas based upon existing biological and physical conditions, operations capability, and suitability for mission objectives (see Figure 3–18). The 15,558-hectare (38,444-acre) Industrial Core Management Area contains major SRS facilities and includes E Area. The primary objective of the Industrial Core Management Area is to support facilities and site missions, although additional objectives are to promote conservation and restoration, provide research and educational opportunities, and generate revenue from the sale of forest products. Protection of the red-cockaded woodpecker dominates natural resource decisions in the 35,290-hectare (87,200-acre) Red-Cockaded Woodpecker Management Area and the 19,060-hectare (47,100-acre) Supplemental Red-Cockaded Woodpecker Management Area. The Crackerneck Wildlife Management Area and Ecological Preserve are 4,530 hectares (11,200 acres) in size, and it is managed by the South Carolina Department of Natural Resources. The primary objective of this management area is to enhance wildlife habitat through forestry and wildlife management practices. The management objective of the 4,050-hectare (10,000-acre) Savannah River Swamp and 1,780-hectare (4,400-acre) Lower Three Runs Corridor Management Area is to improve the physical and biological quality of the wetland environment (DOE 2005f:4-6).

Predominant regional land uses in the vicinity of SRS include urban, residential, industrial, agricultural, and recreational. Forest and agricultural land predominantly border SRS, with only limited urban and residential development. Open water and nonforested wetlands occur along the Savannah River Valley. Major recreational areas nearby include Sumter National Forest (40 kilometers [25 miles] northwest), Congaree National Park (64 kilometers [40 miles] northeast, Santee National Wildlife Refuge (89 kilometers [55 miles] east-northeast), and Clark’s Hill/Strom Thurmond Reservoir (56 kilometers [35 miles] northwest). The Crackerneck Wildlife Management Area, which includes a portion of SRS along the Savannah River, is open to the public for hunting and fishing (Caudell 2000:30).

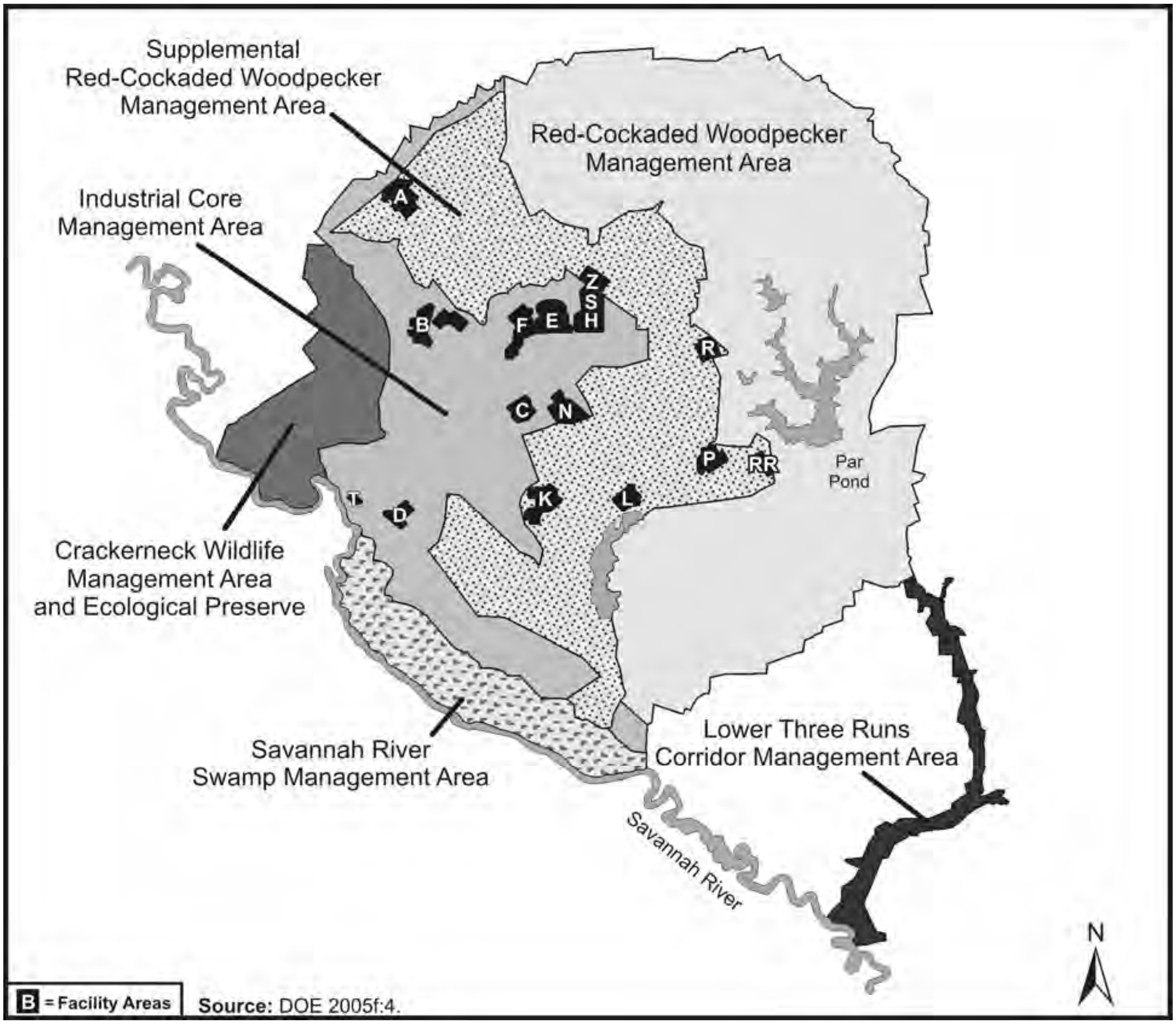


Figure 3–18. Generalized Land Use at the Savannah River Site

E AREA

E Area is located in the Industrial Core Management Area between the F and H Area Separations Areas. It consists of approximately 134 hectares (330 acres). E Area includes the Old Burial Ground, Mixed Waste Management Facility, TRU waste pads, and E Area Vaults, and receives solid LLW, TRU waste, and mixed waste from across SRS. E Area facilities are maintained to manage previously received waste and to prepare for the receipt of waste from new site operations. The current land use for E Area is industrial (DOE 2005e:53).

3.7.1.2 Visual Resources

The dominant viewshed in the vicinity of SRS consists mainly of agricultural land and forest, with limited industrial and residential areas. The industrial areas, including the reactors and large facilities, are primarily located in the interior of the site away from public access. Excluding the Savannah River National Laboratory, SRS facilities are not generally visible off site or from public access roads due to the distance to the boundary from the industrialized areas, the gently rolling terrain, and heavy vegetation. Typically, the reactors and principal processing facilities are large concrete structures as much as 30 meters (100 feet) tall adjacent to shorter administrative and support buildings and parking lots. The limited public areas that have views of some SRS structures (other than the administrative areas) are approximately 8 kilometers (5 miles) or more away from viewable structures. These views have low visual sensitivity levels because most of these structures were built as many as 40 years ago and are well established in the viewer's expectations (DOE 1999b:3-164, 2008c:4-343).

The developed areas and utility corridors (transmission lines and aboveground steam pipelines) of SRS are consistent with a VRM Class IV designation. The remainder of SRS is consistent with a VRM Class II or III. Management activities within Class II and III areas may be seen, but should not dominate the view; management activities in Class IV areas dominate the view and are the focus of viewer attention (DOI 1986:6, 7).

E AREA

E Area is located within the Industrial Core Management Area at SRS, where developed portions are consistent with a VRM Class IV designation. Due to its distance from public access roads, E Area is not visible to the general public.

3.7.2 Geology, Soils, and Geologic Hazards

3.7.2.1 Geology

SRS is situated on the Aiken Plateau of the Upper Atlantic Coastal Plain physiographic region, about 40 kilometers (25 miles) southeast of the Fall Line that separates the Atlantic Coastal Plain from the Piedmont physiographic province. The Aiken Plateau is highly dissected and characterized by broad, flat areas between streams and narrow, steep-sided valleys. It slopes from an elevation of approximately 198 meters (650 feet) at the Fall Line to an elevation of about 76 meters (250 feet) on the southeast edge of the plateau. Elevations across SRS range from approximately 27 meters to 128 feet (89 to 420 feet) above mean sea level (DOE 2008c:4-352, 4-353).

There are no active geologic faults on SRS, but several fault systems occur off site, northwest of the Fall Line. Faults identified on site include the Pen Branch, Steel Creek, Advanced Tactical Training Area, Crackerneck, Ellenton, and Upper Three Runs. The Upper Three Runs Fault, which passes approximately 1.6 kilometers (1 mile) northwest of F Area, is a Paleozoic fault that does not cut through or displace Atlantic Coastal Plain sediments. None of the faults discussed are considered potentially active or capable faults (10 CFR 100; DOE 2002e:3-5, 3-6, 2008c:4-353, 4-354).

Surficial geologic strata at the site consist of Atlantic Coastal Plain sediments, which dip gently seaward from the Fall Line and thicken from essentially 0 at the Fall Line to more than 1,220 meters (4,000 feet) at the coast. These sediments occupy the Dunbarton Basin, which is the controlling structural feature of the region. The uppermost sedimentary unit (known as the Tinker/Santee Formation) consists of 18 meters (60 feet) of Paleocene-age clayey and silty quartz sand, and silt. Within this layer, there are occasional beds of clean sand, gravel, clay, or carbonate. This layer is noteworthy because it contains small, discontinuous, thin calcareous sand zones (i.e., sand containing calcium carbonate) that are potentially subject to dissolution by water. These "soft-zone" areas have the potential to subside, causing settling of the ground surface. Deposits of pebbly, clayey sand, conglomerate, and Miocene- and Oligocene-age clay occur at higher elevations. The Tinker/Santee Formation is underlain by about 210 meters (700 feet) of Upper Cretaceous-age quartz sand, pebbly sand, and kaolinitic clay. The underlying bedrock consists of sandstones of Triassic age and older metamorphic and igneous rocks that form the basement complex of the Dunbarton Basin (DOE 1999b:3-147, 2008c:4-352–4-353).

Geologic resources across SRS are generally limited to sandy, silty, and clayey soils and sediments extracted from onsite borrow areas to support onsite construction backfill and environmental restoration project needs (DOE 2004b:1, 3).

3.7.2.2 Soils

The surface soils at SRS have developed from Atlantic Coastal Plain sediments. Soils across SRS are primarily sands and sandy loams with sporadic clay layers overlying a subsoil containing a mixture of sand, silt, and clay. These soils are gently sloping to moderately steep (0 to 10 percent grade) and have a slight erosion hazard. Some soils on uplands are nearly level, and those on bottomlands along the major streams are level. Soils in small, narrow drainage valleys are steep. Most of the upland soils are well drained to excessively drained. The well-drained soils have a thick, sandy surface layer that extends to a depth of 2.1 meters (7 feet) or more in some areas. The soils on bottomlands range from well drained to very poorly drained. Some soils on the abrupt slope breaks have dense, brittle subsoil (DOE 2008c:4-353). No soils are subject to designation as prime farmland or other important farmland soils.

3.7.2.3 Geologic Hazards

The Atlantic Coastal Plain tectonic province in which SRS is located is characterized by generally low seismic activity that is expected to remain subdued. The most active seismic zones in the southeastern United States are all located over 160 kilometers (100 miles) away from the site (DOE 2008c:4-353, 4-354). Two major earthquakes have occurred within 299 kilometers (186 miles) of SRS. The Charleston, South Carolina, earthquake of 1886 had an estimated magnitude of 6.9 to 7.3 and produced shaking of MMI VII to VIII; it occurred approximately 145 kilometers (90 miles) from the SRS area. The Union County, South Carolina, earthquake of 1913 had an estimated magnitude of 6.0 and occurred about 159 kilometers (99 miles) from the site (DOE 2008c:4-354; SCEEPP 2009). Other minor earthquakes that occurred off site all had magnitudes of less than 4.0. In recent years, three minor earthquakes occurred within the SRS boundary. In 1985, an earthquake occurred with a local magnitude of 2.7 and produced shaking of MMI III. Another occurred in 1988 with a magnitude of 2.5. The most recent earthquake within the SRS boundary was in 2001 with a magnitude of 2.0 (DOE 2008c:4-353, 4-354; USGS 2009l). In total, since 1973, 16 earthquakes (most ranging in magnitude from 2.5 to 3.7) have been recorded within a radius of 100 kilometers (62 miles) of SRS (USGS 2009l). Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects.

Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity). As previously described in Section 3.2.2.3, the latest probabilistic PGA data from the USGS are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For SRS, the calculated PGA is approximately 0.17 *g* (USGS 2009d). By comparison, the Charleston, South Carolina, earthquake of 1886 produced an estimate horizontal PGA of 0.1 *g* across the area (DOE 2008c:4-354).

Subsidence (lowering of the ground surface) and soil liquefaction (liquefying of wet, unconsolidated sediments that can occur during an earthquake) are two geologic processes that are potentially problematic in selected areas at SRS. Sedimentary strata under some areas of SRS include layers of calcareous sand (i.e., sand containing calcium carbonate) that are subject to dissolution, which would cause subsidence. Sites underlain by these "soft zones" are considered unsuitable for structural formations unless extensive soil stabilization is done. Because the topography is generally flat to gently rolling across SRS, landslides are unlikely occurrences except along the banks of drainage valleys that are widely spaced across SRS (DOE 2008c:4-353).

E AREA

Sediments comprising clayey and silty quartz sand and silt up to 18 meters (60 feet) thick immediately underlie E Area. Soil unit mapping by the NRCS identifies the majority of the area as Udorthents, friable substratum soils. The area also comprises urban land. Across SRS, Udorthents represent well-drained, heterogeneous soil materials that are the spoil or refuse from excavations and major construction activities and are often heavily compacted (DOE 2007d:129). Some Udorthents have slight limitations for site development due to shrink-swell when the soils are dried out or wetted, respectively. Further, soils that are very limited for development due to either flooding or slope are mapped along the northern boundary of the site; these soils are associated with Upper Three Runs (NRCS 2009d).

3.7.3 Water Resources

3.7.3.1 Surface Water

Regional surface-water drainage is dominated by the north- to south-running Savannah River. This major river drains a watershed of approximately 27,400 square kilometers (10,577 square miles) in the mountains of North Carolina, South Carolina, and Georgia. From the headwaters of the Savannah River to the Atlantic Ocean near Savannah, Georgia, the river traverses more than 480 kilometers (300 miles) from the Blue Ridge Mountains to the lower Coastal Plain (DOE 2008c:4-347).

There are five main streams that originate on or pass through SRS before discharging into the Savannah River Swamp. These are Upper Three Runs, Steel Creek, Pen Branch, Fourmile Branch, and Lower Three Runs (see Figure 3–19). Most notably, Upper Three Runs is a 39-kilometer-long (24-mile-long) backwater that drains an area of approximately 526 square kilometers (203 square miles). The mean monthly discharge for Upper Three Runs ranges from a low of about 5.7 cubic meters (201 cubic feet) per second in July to a high of 8.3 cubic meters (293 cubic feet) per second in March. Fourmile Branch follows a southwesterly route for approximately 24 kilometers (15 miles) and drains an area of 57 square kilometers (22 square miles). The mean monthly discharge at the USGS station at Road A212.2 ranges from a low of 3.3 cubic meters (116 cubic feet) per second in October to a high of 4.5 cubic meters (160 cubic feet) per second in January. Finally, Lower Three Runs drains about 741 square kilometers (286 square miles) and flows about 39 kilometers (24 miles) before entering the Savannah River. The mean monthly discharge for Lower Three Runs ranges from a low of about 0.71 cubic meters (25 cubic feet) per second in October to a high of about 1.4 cubic meters (48 cubic feet) per second in March. In the 1950s, DOE built the Par Pond Dam on Lower Three Runs to form a cooling reservoir for cooling water discharges from P- and R-Reactors (DOE 2008c:4-348, 4-349).

There are two major artificial bodies of water on site, Par Pond and L-Lake. Par Pond covers 1,068 hectares (2,640 acres) and has an average depth of 6 meters (20 feet); L-Lake covers 405 hectares (1,000 acres) (DOE 2008c:4-347).

The Savannah River is classified by the South Carolina Department of Health and Environmental Control (SCDHEC) as freshwater (Class FW) that is suitable for primary and secondary contact recreation, drinking after appropriate treatment, balanced native aquatic species development, and industrial and agricultural purposes. Primary contact is direct contact with the water, such as that experienced while swimming. Secondary contact is having some direct contact with the water in a capacity where swallowing is unlikely to occur, such as that experienced while fishing (DOE 2008c:4-349). As such, under SCDHEC regulations, the same use classification and standards apply to SRS tributaries as apply to the Savannah River (SCR 61-69).

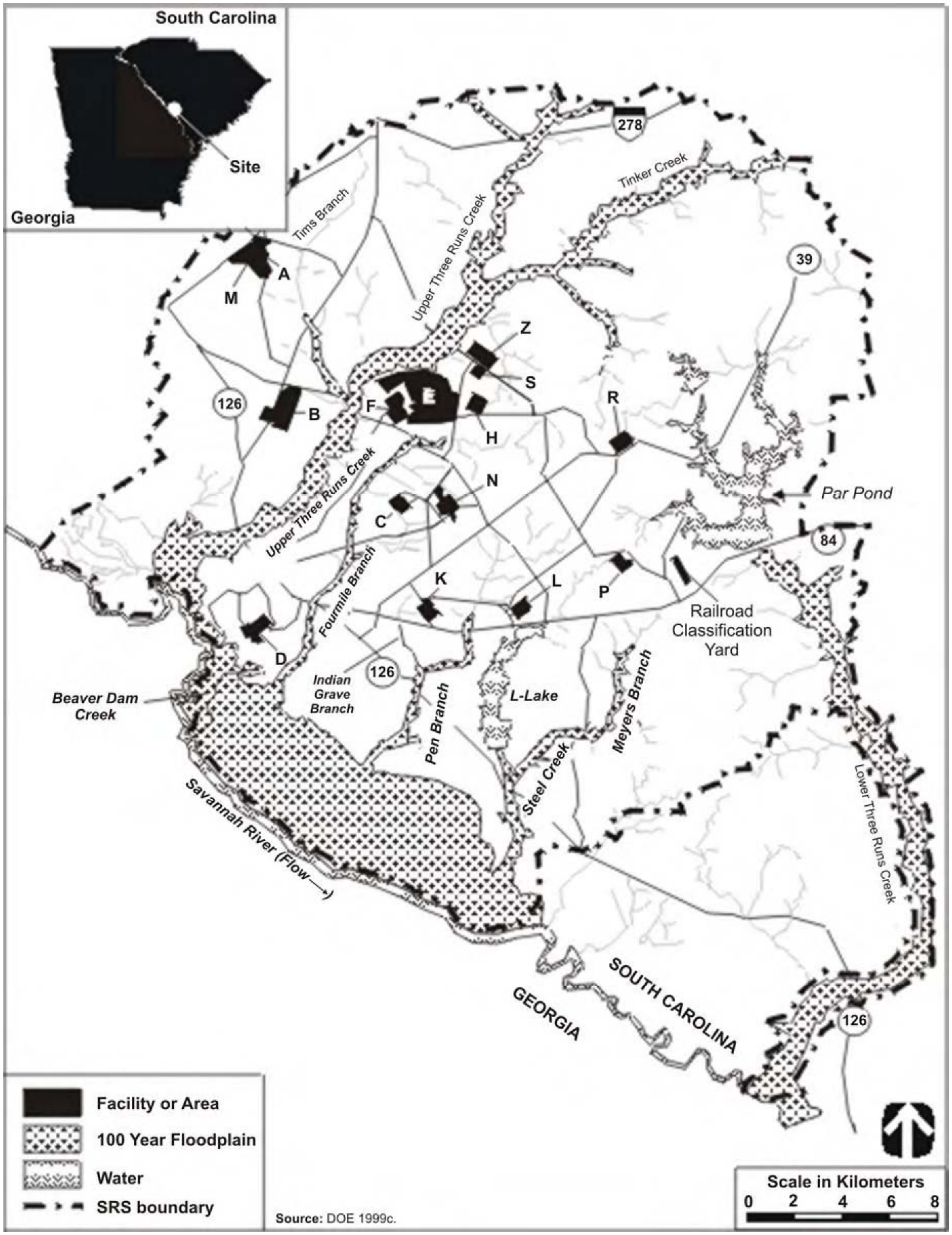


Figure 3–19. Surface-Water Features and Floodplains at Savannah River Site

SRS is covered by five NPDES permits. Two permits address industrial wastewater discharges (SC0047431, which covers the D Area Powerhouse, and SC0000175, which covers the remainder of the site). The site is also covered under three general permits, one for industrial stormwater discharges (SCR000000), one for construction stormwater discharges (SCR100000), and another for utility water discharges. In 2005, SCDHEC issued a stormwater general permit (SCR000000) that required SRS stormwater discharges to meet more-stringent guidelines. Nineteen of SRS's stormwater outfalls exceeded EPA benchmarks for iron, copper, zinc, and other trace metals. Nine of these outfalls had sufficient problems that prompted the state to request that SRS submit an individual permit application for them. The remaining ten outfalls have been brought into compliance with applicable EPA benchmarks through the use of best management practices. Based on an October 2005 agreement with SCDHEC, SRS remains in compliance with the industrial stormwater general permit (Mamatey 2008:3-8).

SRS conducts an extensive Environmental Surveillance and Monitoring Program that encompasses surface water and groundwater. Releases of radioactive materials to surface water were highest during the early- and mid-1960s. Tritium, cesium-137, and strontium-90 were the main radioactive materials of concern for releases to selected surface streams at SRS. Other contaminants of concern that have been detected in the waters at SRS are trichloroethylene, cadmium, hydrogen sulfide, lead, mercury, nickel, and nitrate. Tritium is the predominant radionuclide detected above background levels in the Savannah River (DOE 2008c:4-350). Continuous surveillance monitoring occurs downstream of several process areas to detect and quantify levels of radioactivity in effluents transported to the Savannah River. No significant trends or differences in results were observed between 2007 and previous years (Mamatey 2008:5-3).

3.7.3.2 Groundwater

SRS is underlain by unconsolidated sediments of the Atlantic Coastal Plain that range from Late Cretaceous to Miocene in age and comprise layers of sand, muddy sand, and clay with subordinate calcareous sediments. The hydrostratigraphic units of primary interest beneath SRS are part of the Southeastern Coastal Plain Hydrogeologic Province. Within this sequence of aquifers and confining units are two principal subcategories, the overlying Floridan Aquifer System and the underlying Dublin-Midville Aquifer System. These systems are separated from one another by the Meyers Branch Confining System. In turn, each of the systems is subdivided into two aquifers, which are separated by a confining unit (DOE 2008c:4-351).

In the central to southern portion of SRS, the Floridan Aquifer System is divided into the overlying Upper Three Runs Aquifer and the underlying Gordon Aquifer, which are separated by the Gordon Confining Unit. The water table surface can be as deep as 49 meters (160 feet) below ground surface, but intersects the ground surface in seeps along site streams. The top of the Gordon Aquifer typically is encountered at depths of 46 to 76 meters (150 to 250 feet) below ground surface. North of Upper Three Runs, these units are collectively referred to as the "Steed Pond Aquifer," in which the Upper Three Runs Aquifer is referred to as the "M Area Aquifer Zone," and the Gordon Aquifer is referred to as the "Lost Lake Aquifer Zone." There is an aquitard that separates them, referred to as the "Green Clay Confining Zone" unit, above which the water table usually occurs at SRS; hence, it is referred to informally as the "Water Table" aquifer (DOE 2008c:4-352).

The Dublin-Midville Aquifer System is divided into the overlying Crouch Branch Aquifer and the underlying McQueen Branch Aquifer, which are separated by the McQueen Branch Confining Unit. The top of the Crouch Branch Aquifer typically is encountered at depths of about 107 to 150 meters (350 to 500 feet) below ground surface. The top of the McQueen's Branch Aquifer typically is encountered at depths of 198 to 229 meters (650 to 750 feet) below ground surface. In aquitards, groundwater flow velocities range from several centimeters (inches) to a couple of meters (several feet) per year and in aquifers, from a few meters (tens of feet) to tens of meters (hundreds of feet) per year (DOE 2008c:4-352).

SRS derives its own drinking and process water supply from groundwater. SRS domestic and process water systems are supplied from a network of approximately 40 wells in widely scattered locations across the site, 8 of which supply the primary drinking water system for the site. Virtually all site process and drinking water is pumped from the Crouch Branch and McQueen's Branch Aquifers. The amount of groundwater pumped at SRS has had only localized effects on water levels in these aquifers, and it is unlikely that water usage at the site will ever cause drawdown problems that could impact surrounding communities. Since 1997, water supply production and treatment has been consolidated into three systems located in A Area, D Area, and K Area. Treated well water is supplied to the larger site facilities by the A Area, D Area, and K Area domestic water systems. Each system has wells, a treatment plant, elevated storage tanks, and distribution piping. The wells range in capacity from about 760 to 5,680 liters (200 to 1,500 gallons) per minute. The A Area, D Area, and K Area systems supply an average of about 3.8 million liters (1 million gallons) per day of domestic water to customers in these areas. The site Groundwater Protection Program integrates information learned about the properties of SRS aquifers with site demand for drinking and process water. SRS ensures a high level of drinking water supply protection by monitoring above and beyond SCDHEC requirements and by periodically evaluating production wells (Mamatey 2008:7-5, 7-6). Water is further discussed in Section 3.7.7.4.

In selected areas the shallower groundwater aquifers underneath SRS are contaminated with a variety of elements that range from organic compounds to metals and radionuclides. The sources of the detected groundwater contamination include burial grounds, waste management facilities, canyon buildings, seepage basins (now closed), and saltstone disposal facilities. The shallower Upper Three Runs Aquifer is contaminated with solvents, metals, and low levels of radionuclides near several SRS areas and facilities, including the F Area. Tritium has been reported in the Gordon Aquifer under the Separations Areas (F and H Areas). The deep Crouch Branch Aquifer is generally unaffected by site operations, except for a location near A Area, where trichloroethylene contamination has been found. One of the most contaminated areas at SRS is near the F Area seepage basins and inactive process sewer line. Near the F Area tank farm, tritium, mercury, nitrate-nitrite (as nitrogen), cadmium, gross alpha, and lead were detected in concentrations that exceeded drinking water standards in one or more wells. A contaminant plume comprised of tritium, lead, and copper values exceeding drinking water standards in one or more wells originates inside F Area and extends beneath the MOX [mixed oxide] Fuel Fabrication Facility site. DOE uses more than 200 wells in this area's Groundwater Monitoring program and some of the contaminated wells lie within 0.8 kilometers (0.5 miles) of the site boundary. While DOE believes that the major component of groundwater flow is not directly toward the site boundary, flow in the area is complex and difficult to predict. This area has been the subject of extensive groundwater cleanup efforts (DOE 2008c:4-351, 4-352).

E AREA

E Area is positioned on a topographic and hydrologic divide between Upper Three Runs and its 100-year floodplain immediately to the north and the headwaters to Fourmile Branch located just to the south. However, E Area facilities are located outside the 100-year floodplain (DOE 1999b:3-151). Depth to the water table aquifer beneath the area ranges from 17 to 20 meters (55 to 65 feet) (WSRC 2008:1-54). Based on 2007 monitoring, groundwater contaminants exceeding MCLs (40 CFR 141) in the vicinity of E Area include trichloroethylene, tritium, gross alpha, and beta emitters (Mamatey 2008:7-9).

3.7.4 Meteorology, Air Quality, and Noise

3.7.4.1 Meteorology and Air Quality

SRS has a temperate climate with short, mild winters and long, humid summers. The climate is frequently affected by warm, moist maritime air masses. The average annual temperature at SRS is 18 °C (64.4 °F); temperatures vary from an average daily minimum of 0 °C (32 °F) in January to an average daily maximum of 33.2 °C (91.7 °F) in July. The average annual precipitation is about 124 centimeters

(49 inches). Precipitation is distributed fairly evenly throughout the year, with the highest in summer and the lowest in autumn. There is no predominant wind direction at SRS. The average annual windspeed at Augusta National Weather Service Station is 2.5 meters per second (5.7 miles per hour) (DOE 1999b:3-128; NOAA 2009e; WSRC 2007a:13). The maximum windspeed in Augusta, Georgia (highest 1-minute average), is 23 meters per second (52 miles per hour) (NOAA 2009b:65). The Augusta station is about 19 kilometers (12 miles) west of SRS.

Damaging hailstorms rarely occur in Aiken County (NCDC 2009e). The average annual snowfall is 3.6 centimeters (1.4 inches) (NOAA 2009e).

Thirty-two tornadoes were reported in Aiken County between January 1950 and March 2009. There are typically several occurrences of high winds every year (NCDC 2009e). Hurricanes struck South Carolina 36 times during the period from 1700 to 1992, which equates to an average recurrence frequency of one hurricane every 8 years. A hurricane-force wind of 34 meters per second (75 miles per hour) has been observed at SRS only once, during Hurricane Gracie in 1959 (DOE 2002e:3-20, 3-22).

SRS is near the center of the Augusta-Aiken Interstate Air Quality Control Region No. 53. None of the areas within SRS or its surrounding counties are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (40 CFR 81.311, 81.341).

There are no PSD Class I areas within 100 kilometers (62 miles) of SRS (DOE 1996a:3-233). SRS has two Title V operating permits. A PSD construction permit for a new biomass-fired cogeneration plant at A Area of SRS was obtained from SCDHEC. The facility was subject to the PSD permit process as a result of carbon monoxide emissions (Bulgarino 2008) and started operation in 2008 (SRNS 2008).

The primary sources of air pollutants at SRS are the biomass boilers in A Area, the coal-burning boilers in D Area, the two fuel-oil burning package boilers in K Area that produce steam and electricity, diesel-powered equipment, the Defense Waste Processing Facility, soil vapor extractors, groundwater air strippers, and various other processing facilities. Other emissions and sources include fugitive particulates from coal piles and coal processing facilities, vehicles, controlled burning of forestry areas, and temporary emissions from various construction-related activities (DOE 1996a:F-17, F-18; NRC 2005; SRS 2009; WSRC 2006a:25, 2007b).

Table 3–15 presents the applicable ambient standards and ambient air pollutant concentrations attributable to sources at SRS. These concentrations are based on emissions for the year 2006 (SRNL 2007; WSRC 2007b). Other toxic air pollutants are discussed in the modeling report (SRNL 2007). Concentrations shown in Table 3–15 attributable to SRS are in compliance with applicable guidelines and regulations. Estimated mercury emissions at SRS in 2006 were 0.0514 metric tons per year (0.0567 tons per year) (SRS 2008). Data for 2007 and 2008 from nearby ambient air monitors in Aiken and Barnwell Counties in South Carolina and Richmond County in Georgia are presented in Table 3–16. The data indicate that the NAAQS for PM, sulfur dioxide, and nitrogen dioxide are not exceeded in the area around SRS. The 3-year average 8-hour ozone value exceeds the standard in the city of Augusta, Georgia. The highest monitored concentration at Augusta for mercury in 2008 was 0.015 micrograms per cubic meter (SCDHEC 2009a, 2009b).

Table 3–15. Modeled Nonradiological Ambient Air Pollutant Concentrations from Savannah River Site Sources and Ambient Air Quality Standards

Pollutant	Averaging Period	Most Stringent Standard or Guideline[a]	Maximum Savannah River Site Concentration[b]
		micrograms per cubic meter	
Criteria Pollutants			
Carbon monoxide	8 hours	10,000[c]	40
	1 hour	40,000[c]	215
Nitrogen dioxide	Annual	100[c]	10.1
Ozone	8 hours	147[d]	(f)
PM_{10}	Annual	50[e, g]	4.6
	24 hours	150[c]	74
$PM_{2.5}$	Annual	15[c]	4.3
	24 hours	35[c]	34
Sulfur dioxide	Annual	80[c]	7.7
	24 hours	365[c]	125
	3 hours	1,300[c]	884
Lead	Calendar quarter	1.5[c]	0.001
Other Regulated Pollutants			
Total suspended particulates	Annual	75[e]	56
Hazardous and Other Toxic Compounds			
Mercury	24 hours	0.25[e]	0.002

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those standards based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean $PM_{2.5}$ standard is attained when the expected annual arithmetic mean concentration (3-year average) is less than or equal to the standard. The 24-hour $PM_{2.5}$ standard is met when the 98th percentile over 3 years of 24-hour average concentrations is less than or equal to the standard value. The 24-hour PM_{10} standard is met when the 99th percentile over 3 years of 24-hour concentrations is less than or equal to the standard value.

[b] Site contributions based on a 2006 emissions inventory.

[c] Federal and state standard.

[d] Federal standard.

[e] State standard.

[f] No concentration reported.

[g] The U.S. Environmental Protection Agency revoked the annual PM_{10} standard.

Note: South Carolina has additional standards for gaseous fluorides that are not shown because they are not emitted by the facilities evaluated in this environmental impact statement. Emissions of other air pollutants not listed here have been identified at SRS, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a). Values may differ from those of the source document due to rounding. Concentrations were based on the permit allowable emissions and meteorological data for 2003 through 2005 as discussed in the air dispersion modeling report (SRNL 2007). To convert cubic meters to cubic feet, multiply by 35.315.

Key: PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Source: 40 CFR 50; SCDHEC 2006, 2008; SRNL 2007.

Table 3–16. Ambient Air Quality Standards and 2007 and 2008 Monitored Levels in the Vicinity of the Savannah River Site

Pollutant	Averaging Period	Ambient Standard (micrograms per cubic meter)	Concentration (micrograms per cubic meter)	Location
Carbon monoxide	8 hours	10,000	(a)	(a)
	1 hour	40,000	(a)	(a)
Nitrogen dioxide	Annual	100	6.5[b] 4.5[b]	Aiken, South Carolina Barnwell, South Carolina
Ozone	8 hours	147	147 143[b] 149	Aiken, South Carolina Barnwell, South Carolina[b] (Augusta) Richmond, Georgia
PM_{10}	Annual	50	21[b] 22[b] 23	Barnwell, South Carolina Aiken, South Carolina (Augusta) Richmond, Georgia
	24 hours	150	47[b] 61[b] 33	Barnwell, South Carolina Aiken, South Carolina (Augusta) Richmond, Georgia
$PM_{2.5}$	Annual	15	(a) (a)	Aiken, South Carolina (Augusta) Richmond, Georgia
	24 hours	35	(a) (a)	Aiken, South Carolina (Augusta) Richmond, Georgia
Sulfur dioxide	Annual	80	3.9[b]	Barnwell, South Carolina
	24 hours	365	13.1[b]	Barnwell, South Carolina
	3 hours	1,300	34.1[b]	Barnwell, South Carolina

[a] No data are available in the vicinity of the Savannah River Site.

[b] 2007 data.

Key: PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Source: 40 CFR 50; EPA 2009g, 2009h; SCDHEC 2006, 2008, 2009a, 2009b.

E AREA

The meteorological conditions described previously for SRS are considered representative of E Area. Information on air pollutant emissions from this area is included in the overall site emissions discussed previously. There are no nonradiological air pollutant sources in E Area that require permits (SCDHEC 2003).

3.7.4.2 Noise

Major noise sources at SRS occur primarily in developed or active areas and include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles). Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations. Existing SRS-related noise sources of importance to the public are those related to transportation of people and materials to and from the site, including trucks, private vehicles, helicopters, and trains

(DOE 1996a:3-233–3-235). Primary access routes are highways through the nearby towns of New Ellenton, Jackson, and Aiken, South Carolina.

Most industrial facilities at SRS are far enough from the site boundary that noise at the boundary from these sources is either unmeasurable or barely distinguishable from background levels.

The States of Georgia and South Carolina and counties in which SRS is located have not established any noise regulations that specify acceptable community noise levels, with the exception of a provision in the Aiken County Zoning and Development Standards Ordinance that limits daytime and nighttime noise by frequency band (DOE 1996a:3-235).

E AREA

No distinguishing noise characteristics in E Area have been identified. Facilities in E Area are far enough from the site boundary that noise at the boundary from these sources would either be unmeasurable or barely distinguishable from background levels.

3.7.5 Ecological Resources

3.7.5.1 Terrestrial Resources

Terrestrial cover types at SRS can be classified as both forested and nonforested. Forested cover types include bottomland hardwood, pine forest, mixed forest, and forested wetland. Nonforested cover types include scrub-shrub, emergent wetlands, industrial, grassland, clear cut, bare soil/borrow pit, and open water. Approximately 80 to 85 percent of the land cover at SRS is composed of pine forest, mixed pine/hardwood forest, and bottomland hardwood forest; 1,322 plant species have been documented on SRS. Common wetland species include bald cypress, water tupelo, and button bush, while upland species included red oak, hackberry, and greenbriar (WSRC 2006b:5-12, 6-11).

The biodiversity within SRS is extensive due to the variety of plant communities and the mild climate. Animal species known to inhabit SRS include 54 species of mammals, 255 species of birds, 59 species of reptiles, and 44 species of amphibians. Common species include the eastern box turtle, Carolina chickadee, common crow, eastern cottontail, and gray fox. Game animals include a number of species, three of which, the eastern wild turkey, white-tailed deer, and feral hogs, are hunted on the site. Raptors, such as the Cooper's hawk and the black vulture, and carnivores, such as the gray fox, are ecologically important groups at SRS (DOE 1999b:3-157).

E AREA

Due to the highly developed nature of E Area, native vegetation is limited, and wildlife includes those species adapted to such an environment. Mammal species include the raccoon, striped skunk, and coyote. Bird species include the house sparrow, European starling, and killdeer.

3.7.5.2 Wetlands

SRS wetlands, most of which are associated with floodplains, streams, and impoundments, include bottomland hardwood, cypress-tupelo, scrub-shrub, emergent vegetation, Carolina bays, and open water. Swamp forest is the most extensive wetland vegetation type along the Savannah River (DOE 1999b:3-159).

E AREA

Most of the land within E Area has been developed for industrial use. As a result, no wetlands currently exist within this location; however, wetlands are located adjacent to E Area.

3.7.5.3 Aquatic Resources

Aquatic habitat includes manmade ponds, Carolina bays, reservoirs, and the Savannah River and its tributaries. There are more than 50 manmade impoundments throughout the site that support populations of bass and sunfish. Carolina bays, a type of wetland unique to the southeastern United States, are natural shallow depressions that occur in interstream areas. These bays can range from lakes to shallow marshes, herbaceous bogs, shrub bogs, or swamp forests. Among the 299 Carolina bays found throughout SRS, fewer than 20 have permanent fish populations. Redfin pickerel, mud sunfish, lake chubsucker, and mosquito fish are present in these bays. Although sport and commercial fishing is not permitted at SRS, the Savannah River is used extensively for both. Important commercial species are the American shad, hickory shad, and striped bass, all of which are anadromous, meaning they live in the sea and breed in freshwater. The most important warm-water game fish are bass, pickerel, crappie, bream, and catfish (DOE 1999b:3-157).

E AREA

Most of the land within E Area has been developed for industrial use. As a result, no aquatic resources currently exist within this location.

3.7.5.4 Threatened and Endangered Species

Eight federally or state-listed threatened or endangered species may be found in the vicinity of SRS. No critical habitat, as defined by the USFWS, exists on the site (DOE 1999b:3-159; WSRC 2006b:3-43). Table 3–17 lists the federally and state-listed endangered and threatened species that are known to occur at SRS.

Table 3–17. Federally and State-Listed Species Potentially Occurring at the Savannah River Site

Common Name	Scientific Name	Federal Status	State Status
Plants			
Smooth purple coneflower	*Echinacea laevigata*	Endangered	Endangered
Pondberry	*Lindera melissifolia*	Endangered	Endangered
Animals			
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered
Wood stork	*Mycteria americana*	Endangered	Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered	Endangered
American swallow-tailed kite	*Elanoides forficatus*	Not listed	Endangered
Gopher tortoise	*Gopherus polyphemus*	Not listed	Endangered
Southeastern big-eared bat	*Corynorhinus rafinesquii*	Not listed	Endangered

Source: SCDNR 2006; WSRC 2006b:3-45.

E AREA

Due to the highly developed nature of E Area, threatened and endangered species are not expected to occur.

3.7.6 Cultural and Paleontological Resources

3.7.6.1 Prehistoric Resources

An extensive Archaeological Survey Program that began at SRS in 1974 involved numerous field studies consisting of reconnaissance surveys, shovel test transects, and intensive site tests and excavations. More than 60 percent of the site has received some level of cultural resources evaluation involving both prehistoric and historic resources. More than 800 prehistoric sites or sites with prehistoric components have been identified. Although most of these sites have not been formally evaluated for eligibility for listing in the NRHP, 67 sites have been identified as potentially eligible. Prehistoric sites at SRS consist of village sites, base camps, limited-activity sites, quarries, and workshops (DOE 2008c:4-357).

E AREA

There have been no prehistoric sites identified in E Area.

3.7.6.2 Historic Resources

Approximately 400 historic sites or sites with historic components have been identified within SRS. Historic sites include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farm dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. Of these sites, approximately 10 percent have been evaluated for NRHP eligibility. Systematic historic building surveys have not yet been conducted at SRS. Many of the pre-SRS historic structures were demolished during the initial establishment of the site in 1950. No nuclear production facilities have been nominated for inclusion in the NRHP and there are no plans for nomination. Existing SRS facilities lack architectural integrity and do not contribute to the broad historic theme of the Manhattan Project or World War II era nuclear materials (DOE 2008c:4-357).

SRS has been involved in tritium operations and other nuclear material production for more than 40 years. Some existing facilities and engineering records may become significant as they attain the 50-year age criterion. DOE's Savannah River Operations Office and the NNSA's SRS Office recognized that site operations may impact Cold War NRHP-eligible properties and that a plan was needed to avoid, minimize, or mitigate adverse effects on these properties. As a result, the *Cold War Built Environment Cultural Resources Management Plan* was developed. This plan contains a process for reaching decisions concerning the future treatment of SRS Cold War NRHP-eligible historic properties (DOE 2008c:4-358).

E AREA

Previous construction within the developed, fenced portion of E Area was determined to have no effect on archaeological resources because this area has been previously disturbed and no important sites were discovered (DOE 1995:4-98).

3.7.6.3 American Indian Resources

American Indian groups with traditional ties to the SRS area include the Apalachee, Cherokee, Chicksaw, Creek, Shawnee, Westo, and Yuchi. At various times, each of these groups settled in the area. During the 1800s, most of the remaining American Indians residing in the area were relocated to the Oklahoma Territory (DOE 2008c:4-358).

American Indian resources in the region include the remains of villages or townsites, ceremonial lodges, burials, cemeteries, and areas containing plants used for religious ceremonies. No specific sites have been identified at SRS (DOE 2008c:4-358).

In 1991, DOE conducted a survey of American Indian concerns regarding religious rights in the central Savannah River Valley. During the study, six American Indian groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian People's Muskogee Tribal Town Confederacy, the Pee Dee Indian Nation, the Ma Chis Lower Alabama Creek Indian Tribe, and the United Keetoowah Band of Cherokee, expressed continuing interest in the sites and items of religious significance within SRS, including plant species used for ceremonies. DOE has continued to consult with the interested tribal organizations by notifying them about major planned actions at SRS and providing for review and comment environmental reports that address proposed actions at the site (DOE 2008c:4-358).

E AREA

Due to the fact that E Area has been previously disturbed, there is a low probability of the area being of interest to American Indian groups.

3.7.6.4 Paleontological Resources

Paleontological materials from the SRS area date largely from the Eocene Age (39 to 54 million years ago) and include fossil plants; invertebrate fossils; and deposits of giant oysters, other mollusks, and bryozoa. All paleontological materials at SRS are marine invertebrate deposits and, with the exception of the giant oysters, are relatively common fossils and therefore have low research potential (DOE 2008c:4-357).

E AREA

No paleontological resources have been identified in E Area.

3.7.7 Site Infrastructure

In addition to the description provided below, a summary of SRS's sitewide infrastructure characteristics is presented in Table 3–18.

Table 3–18. Savannah River Site Infrastructure Characteristics

Resource	Current Site Usage	Site Capacity
Transportation (kilometers)		
Paved roads	2,161[a]	2,161[a]
Railroads	103	103
Electricity		
Energy consumption (megawatt-hours per year)	370,000	4,400,000
Fuel		
Natural gas (cubic meters per year)	(b)	(b)
Fuel oil (liters per year)	1,895,000	(c)
Diesel fuel (liters per year)	501,000	(c)
Gasoline (liters per year)	525,000	(c)
Coal (metric tons per year)	771,000	(c)
Propane (liters per year)	3,790	(c)
Water (liters per year)	1,780,000,000	3,870,000,000

[a] Includes both paved and unpaved roads on the site.
[b] Fuel resource not used on site.
[c] Limited only by the ability to transport resource to the site.
Note: To convert kilometers to miles, multiply by 0.6214; cubic meters to cubic feet by 35.312; liters to gallons by 0.26417; and metric tons to tons, by 1.1023.
Source: DOE 1999b:3-165, 2008c:4-343–4-344.

3.7.7.1 Ground Transportation

SRS is located in south-central South Carolina approximately 24 kilometers (15 miles) southeast of Augusta, Georgia, and 19 kilometers (12 miles) south of Aiken, South Carolina. There are three principal access roads to the north of the site (i.e., South Carolina Highways 19, 57, and 125) and three to the east and south of the site (i.e., South Carolina Highways 39, 64, and 125). Within SRS, there are approximately 231 kilometers (143 miles) of primary and 1,944 kilometers (1,200 miles) of secondary roads (DOE 2008c:4-344,4-375). Rail access is provided by the CSX Transportation line. Within SRS, there are approximately 103 kilometers (64 miles) of track (DOE 1999b:3-165, 2005e:3). Ground transportation information specific to E Area is not available.

3.7.7.2 Electricity

SRS uses a 115-kilovolt power line system in a ring arrangement to supply electricity to the operations areas, administrative areas, and independent and support function areas. That system includes about 160 kilometers (100 miles) of transmission lines. Power is supplied by three transmission lines from the South Carolina Electric and Gas Company. SRS is situated in, and draws power from, the Virginia-Carolina Sub Region, an electric power pool area that is part of the Southeastern Electrical Reliability Council (DOE 1999b:3-165, 2008c:4-343).

The total SRS usage of electrical power was 370,000 megawatt-hours per year with a site capacity of 4.4 million megawatt-hours per year (DOE 2008c:4-343). Electricity consumption information specific to E Area is not available.

3.7.7.3 Fuel

Wood, coal, and oil are used at SRS to power steam plants located in A, D, H, and K Areas. The produced steam is distributed across the site in an aboveground pipeline distribution system. Coal is delivered by rail and is stored at coal piles in D and H Areas. Fuel oil is delivered by truck and is used in K Area. Natural gas is not used at SRS (DOE 2008c:4-343). Additionally, biomass fuel is used in the A Area steam plant and is proposed as a fuel source for the Biomass Cogeneration Facility currently under construction (DOE 2008d:4, 7, 17).

The annual consumption of fuel oil was approximately 1.9 million liters (500,000 gallons); diesel fuel consumption, 500,000 liters (130,000 gallons); gasoline consumption, 525,000 liters (139,000 gallons); coal consumption, 771,000 metric tons (850,000 tons); and propane consumption, 3,790 liters (1,000 gallons) (DOE 2008c:4-344). Fuel use information specific to E Area is not available.

3.7.7.4 Water

Domestic water supplies at SRS come from a system composed of several wells and water treatment plants. The system includes three wells and a water treatment plant in A Area and two wells and a backup water treatment plant in B Area. A 43-kilometer (27-mile) pipe loop provides domestic water from A and B Areas to other SRS operations areas (DOE 2008c:4-344).

Annual water consumption (predominately groundwater) at SRS was approximately 1.8 billion liters (470 million gallons). Site capacity is approximately 3.9 billion liters (1.0 billion gallons) (DOE 1999b:3-165). Water consumption and capacity information is not available for E Area.

3.7.8 Waste Management

As a function of onsite routine activity and ongoing remediation efforts, SRS manages HLW, TRU waste, LLW, MLLW, hazardous waste, and nonhazardous waste. All site wastes are managed in accordance with appropriate treatment, storage, and disposal technologies, in compliance with applicable Federal and state law (DOE 2008c:4-378).

3.7.8.1 Waste Generation and Management

Table 3–19 lists routine waste generation volumes at SRS. SRS waste treatment, storage, and disposal is performed at over 30 facilities across the site.

Table 3–19. Solid Waste Generation Rates at the Savannah River Site, 2003–2007[a]

Waste Type	Generation Rate (cubic meters)	
	5-Year Average	Fiscal Year 2007
Transuranic[b]	140	130
Low-level radioactive	20,000	13,000
Mixed low-level radioactive	270	55
Hazardous	180	34
Sanitary[c]	76,000	42,000
Construction and demolition debris[d]	45,000	52,000

[a] Fiscal years 2003 through 2007.
[b] Includes mixed transuranic waste.
[c] Includes sanitary waste and debris sent to the Three Rivers Landfill and assumes 0.1186 metric tons per cubic meter on an as-generated basis.
[d] Includes construction and demolition debris sent to the SRS Construction and Demolition Landfill and assumes 1 metric ton per cubic meter.
Note: To convert cubic meters to cubic feet, multiply by 35.315; metric tons to tons, by 1.1023.
Source: SRS 2009.

High-Level Radioactive Waste

Currently, SRS manages nearly 136 million liters (36 million gallons) of HLW in 49 underground storage tanks. The HLW is managed in two waste forms: (1) sludge that contains most of the radioactivity settled at the bottom of each tank and (2) a liquid supernate that resides above the sludge within each tank. Evaporators are used to reduce the volume of supernate and ultimately aid in the formation of a solid salt cake (DOE 2008c:4-379).

Sludge material from underground storage tanks is transferred to the onsite Extended Sludge Processing Facility, where it is washed to reduce the concentration of sodium salts. The Defense Waste Processing Facility further processes the washed sludge and vitrifies it with glass frit. The immobilized HLW glass is sealed in steel canisters. Canisters are stored in Glass Waste Storage Buildings (underground reinforced-concrete vaults with a capacity of storing up to 4,400 canisters) (DOE 2008c:4-379). As of May 2007, the Defense Waste Processing Facility had poured more than 2,200 canisters and removed over 5.3 million liters (1.4 million gallons) of radioactive waste from 11 tanks (WSRC 2007b:6). The Salt Waste Processing Facility is projected to come on line in 2013 to process cesium-bearing salt cake and supernate for vitrification in the Defense Waste Processing Facility from the underground storage tanks (DOE 2008c:4-379).

Transuranic Waste

SRS is currently characterizing and certifying TRU waste for disposal at WIPP. SRS made its first TRU waste shipment to WIPP in May 2001, and nearly 800 shipments were made through 2007. Over 24,000 containers, or 5,000 cubic meters (6,540 cubic yards), of the original TRU waste inventory have been shipped as of the end of 2007 (WSRC 2007c). TRU waste at SRS is contractor managed using three mobile systems: a real-time radiography trailer, nondestructive assay trailer, and drum headspace gas sampling system (DOE 2008c:4-379).

Low-Level Radioactive Waste

Both liquid and solid LLW is treated at SRS. Most aqueous LLW streams are sent to the F and H Area Effluent Treatment Project (formerly called the Effluent Treatment Facility) and treated by pH adjustment, submicron filtration, organic removal, reverse osmosis, and ion exchange to remove the chemical and radioactive contaminants other than tritium. This facility is designed to process 380,000 to 950,000 liters (100,000 to 250,000 gallons) of LLW daily. The maximum permitted facility capacity is 1.6 million liters (430,000 gallons) per day. Actual processing is approximately 208,000 liters (55,000 gallons) per day (WSRC 2006c, 2007d). After treatment, the effluent is discharged to Upper Three Runs through an NPDES-permitted outfall. The treatment residuals are concentrated by evaporation and stored in the H Area tank farm for eventual treatment in the Z Area Saltstone Facility, where wastes are immobilized with grout for onsite disposal (WSRC 2007e).

Mixed-Low Level Radioactive Waste

Storage facilities for MLLW are located in several different SRS areas. These facilities are regulated under RCRA or as Clean Water Act–permitted tank systems (DOE 2002e:3-43). In 2005, 262 cubic meters (343 cubic yards) of MLLW was shipped off site for disposal at Nevada Test Site, which is under RCRA permit. Mixed waste not suitable for existing treatment and disposal facilities remained stored at SRS (DOE 2008c:4-378).

Hazardous Waste

SRS operations accumulate hazardous waste at the generating location, as permitted by appropriate regulations, or store it U.S. Department of Transportation–approved containers in four RCRA-permitted hazardous waste storage buildings and on three storage pads in N Area. The hazardous waste streams consists of a variety of materials, including mercury, chromate, lead, paint solvents, and lab equipment. Most of the waste is shipped off site to commercial RCRA-permitted treatment and disposal facilities (DOE 2008c:4-379).

Nonhazardous Waste

Sanitary wastewater is collected and treated prior to discharge to NPDES-permitted outfalls. Solid sanitary waste is sent to the Three Rivers Regional Landfill, which is located within SRS and serves as a regional municipal landfill for Aiken, Allendale, Bamberg, Calhoun, Edgefield, McCormick, Orangeburg, and Saluda Counties (DOE 2008c:4-379). Construction and demolition debris is disposed of near N Area (SRS 2009).

3.7.8.2 Waste Minimization

SRS supports a variety of programs focused on minimizing waste and preventing pollution. SRS's Pollution Prevention Program supports source reduction and recycling over treatment, storage, and disposal. In 2004, SRS implemented 51 pollution prevention projects, resulting in an annualized avoidance of 7,093 cubic meters (9,277 cubic yards) of waste (DOE 2008c:4-378).

3.7.9 Occupational and Public Health and Safety

3.7.9.1 Normal Operations

SRS operations in 2007 resulted in minimal impact on the offsite public and the surrounding environment. The site's chemical and radioactive discharges to air and water were well below regulatory maximums for environmental and public health protection; its air and water quality met appropriate requirements; and radiation doses from its discharges were well below dose standards. The largest radiation dose that an offsite, hypothetical, maximally exposed individual could have received from SRS operations during 2007 was estimated to be 0.10 millirem. These doses fall within the limits established in DOE Order 5400.5. Health effects of SRS operations are described in detail in Chapter 6 of the *Savannah River Site Environmental Report for 2007* (Mamatey 2008:xv, 6-1–6-12).

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur through inhalation of air containing hazardous chemicals released to the atmosphere during normal SRS operations. Risks to public health from other pathways, such as ingestion of contaminated drinking water or food, are also potential modes of exposure; risk from direct exposure is lower than that from inhalation or ingestion.

In 2007, elevated concentrations of mercury were found in samples of fish tissue collected in the Savannah River near SRS compared with concentrations in reference samples. The highest concentration was above the EPA recommended consumption limit (1.9 parts per million for methylmercury) (EPA 2009i:4-5; Mamatey 2008:5-12).

During normal operations, SRS workers may be exposed to hazardous materials by inhaling contaminants in the workplace atmosphere or through direct contact with contaminants. The potential for health impacts varies among facilities and workers. Workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to the Occupational Safety and Health Administration Process Safety Management and workplace limits and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensure that these standards are not exceeded. Additionally, DOE requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm.

3.7.9.2 Facility Accidents

Accidents reported at SRS in recent years are briefly described in this section, although they do not represent accident scenarios that would be credible for the actions considered in this EIS. Between 1974 and 1988, there were 13 inadvertent tritium releases from SRS tritium facilities. These releases were attributed to aging equipment in the Tritium-Processing Facility—now no longer operating—and were a major factor in the decision to replace it with the new Tritium Extraction Facility at SRS. A detailed description and study of these incidents and the corresponding consequences to the offsite population have been documented by SRS. The most significant were in 1981, 1984, and 1985, when, respectively, 32,934; 43,800; and 19,403 curies of tritiated water vapor were released (DOE 1996a:3-259). From 1989 through 1992, there were 20 inadvertent releases, all with little or no offsite dose consequences. The largest of the recent releases occurred in 1992, when 12,000 curies of tritium were released (WSRC 1993:260).

In 1993, there was an inadvertent release of 0.18 microcuries of plutonium-238 and plutonium-239. Emergency response models estimated an exposure of 0.0019 millirem to a hypothetical person at the site boundary (WSRC 1994:178).

3.7.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to the site and employee traffic. These include death or injury from accidental release of nonradioactive and radioactive materials, effects of air pollutants and low levels of radiation emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of nonradioactive or radioactive materials. Risks related to nonradioactive transportation to and from SRS and normal radioactive transportation to and from SRS have been estimated for specific activities such as surplus plutonium disposition. There is no current risk assessment available for overall transportation of material to and from SRS.

Risks related to normal radioactive shipments to SRS discussed in the *Surplus Plutonium Disposition Final Environmental Impact Statement* were estimated, using the currently recommended dose conversion factor, to be about 0.029 latent cancer fatalities among transportation workers and about 0.041 latent cancer fatalities in the total affected population. DOE estimated that 0.019 nonradiological fatalities could occur as a result of vehicular emissions from those activities. DOE also estimated the impacts of accident scenarios—in all cases the risk of a fatality was less than one (DOE 1999b:4-66; 2008c:4-376).

3.7.10 Socioeconomics

SRS is located approximately 19 kilometers (12 miles) south of Aiken, South Carolina, and 24 kilometers (15 miles) southeast of Augusta, Georgia. Based on local employment statistics compiled by the Census Bureau, it is estimated that approximately 90 percent of the people employed at SRS reside in four counties: Aiken and Barnwell in South Carolina and Columbia and Richmond in Georgia (DOC 2009a). Therefore, these four counties are identified as the ROI in this socioeconomics analysis. As of April 2009, SRS employed approximately 11,000 persons (SRNS 2009).

3.7.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of the four-county ROI increased by 9.7 percent to 235,987. As of July 2009, the unemployment rate of the ROI was 10 percent, which was lower than the unemployment rate across the two-state area of South Carolina and Georgia (11 percent) (BLS 2009).

3.7.10.2 Demographic and Housing Characteristics

In 2008 the estimated population of the four-county ROI was 487,056. From 2000 to 2008, the ROI population grew by 7.0 percent, compared with 16 percent growth throughout the two-state area of Georgia and South Carolina (DOC 2009b). The percentage of the ROI population under the age of 18 was 26 percent; women ages 18 to 39 composed 15 percent (DOC 2009c). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. There were 207,983 housing units in the ROI in 2007 (DOC 2008), 61 percent of which were owner occupied, 27 percent were renter occupied, and 12 percent were vacant (DOC 2009c).

3.7.10.3 Local Transportation

There are two interstate highways near SRS. Interstate 20 is the major east-west route, connecting the Augusta region to Columbia in the east and Atlanta to the west. The other is Interstate 520, also known as the Bobby Jones Expressway, which connects Interstate 20 at the western end of Augusta and loops around the city, crossing U.S. Route 78 and U.S. Route 1 in Georgia and eventually connecting to U.S. Route 1 in South Carolina just north of the Savannah River. Vehicle access to SRS is provided by

South Carolina Highways 19, 57, 64, and 125. The segment of Highway 19 south of the city of Aiken had an average daily traffic volume of 13,000 vehicles per day in 2008. The segment of Highway 64 most accessible to the site had an average daily traffic volume of 1,200 vehicles per day. Highway 125 had an average annual daily traffic volume of 2,700 vehicles per day on the segment between Secondary Road 62 in the town of Jackson, in Aiken County, and Barnwell County. Average annual daily traffic data for South Carolina Highway 57 are unavailable (SCDOT 2009). There is no public transportation to SRS.

Rail service is provided by the Norfolk Southern Corporation and CSX Transportation. SRS is provided rail access via Robbins Station on the CSX Transportation Line. Waterborne transportation is available via the Savannah River. Currently, the Savannah River is used primarily for recreation. SRS has no commercial docking facilities, but it has a boat ramp that has accepted large transport barge shipments (DOE 1999c:3-142).

The Augusta Regional Airport at Bush Field in the city of Augusta, Georgia, receives commercial air traffic from both national and local carriers. Numerous general aviation airports are also located in the area. The City of Aiken, South Carolina, owns and operates the Aiken Municipal Airport, Barnwell County, South Carolina, owns and operates the Barnwell Municipal Airport, and the City of Augusta, Georgia, owns and operates the Daniel Field Airport.

3.7.11 Environmental Justice

The 16-kilometer (10-mile) radius surrounding the proposed storage locations at SRS encompasses parts of four counties: Aiken and Barnwell in South Carolina and Burke and Richmond in Georgia. Figure 3–20 shows populations residing in the four-county area, as reported in the 1990 and 2000 censuses (DOC 2009d, 2009e). In this figure, lightly shaded bars show populations in 1990, while darker bars show those in 2000. In the decade between 1990 and 2000, the total population of Aiken, Barnwell, Burke, and Richmond Counties increased by approximately 10 percent to 388,048; the minority population increased by approximately 28 percent to 175,866; and the low-income population increased by approximately 14 percent to 67,950. Demographic data from the 2000 census show that the Black or African American population residing in the four-county area accounted for approximately 89 percent of the total minority population. Persons who declared that they are of Hispanic or Latino origin are included in the “total Hispanic” population shown in Figure 3–20, regardless of race. They composed approximately 5 percent of the total minority population residing in the four-county region.

Data for Burke County, Georgia, and Barnwell County, South Carolina, from the *2007 ACS 1-Year Estimates* are unavailable due to a population threshold of 65,000 people necessary for inclusion. However, the *2005–2007 ACS 3-Year Estimates* report data for all four counties included in the 16-kilometer (10-mile) radius surrounding the proposed storage location. According to the *2005–2007 ACS 3-Year Estimates*, since 2000, the total population of the four-county area increased by 1.4 percent to 393,385, and the low-income population increased by 5.1 percent to 71,449. Detailed demographic data on race and Hispanic origin for Burke and Barnwell Counties from the *2005–2007 ACS 3-Year Estimates* are unavailable due to an insufficient number of sample cases. Data for Aiken and Richmond Counties show an increase in the total minority population of 4.7 percent since 2000 (DOC 2009c, 2009d).

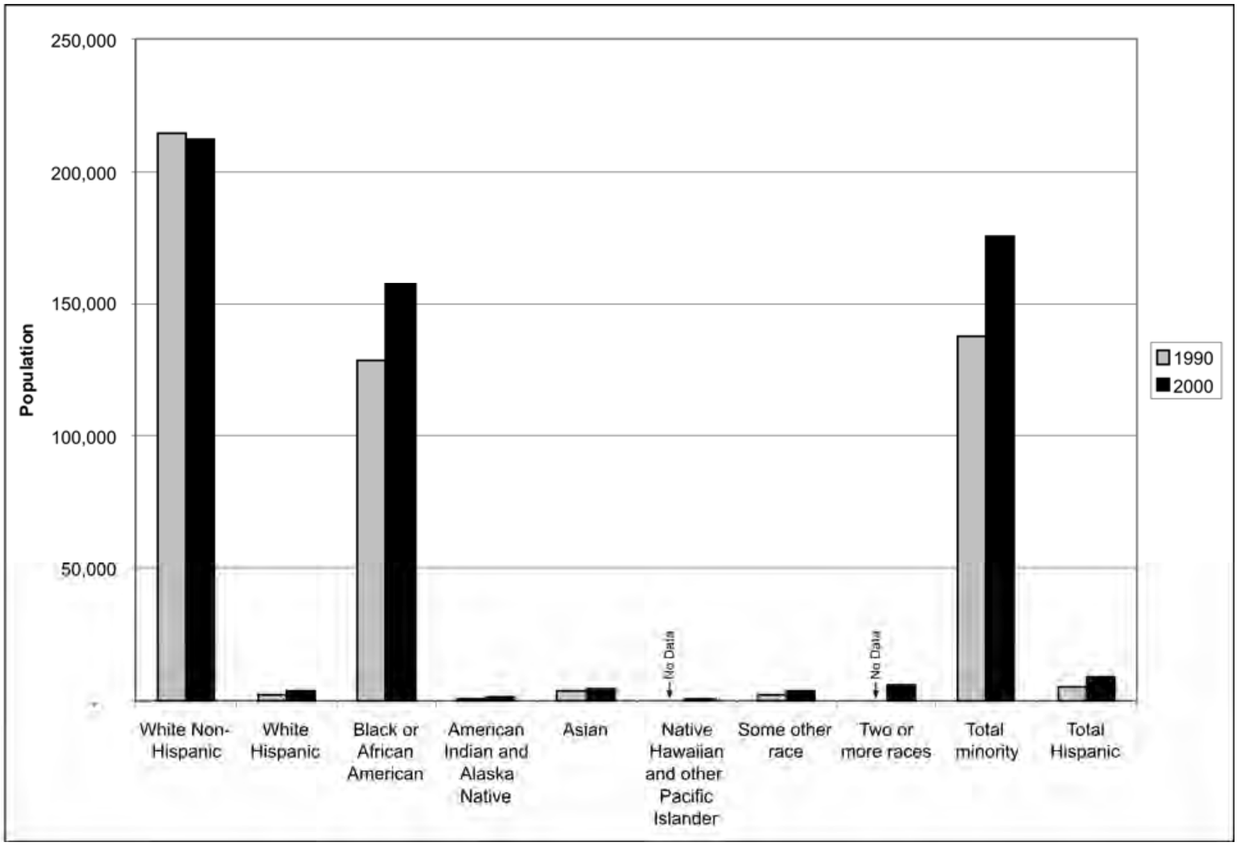


Figure 3–20. Populations Residing in the Four-County Area Surrounding the Savannah River Site in 1990 and 2000

E Area

Approximately 8,178 people lived within 16 kilometers (10 miles) of E Area at SRS in 2000 (DOC 2009d). This area included an estimated 36 percent minority and 17 percent low-income population. By comparison, the four-county area included a 45 percent minority and 18 percent low-income population, and the two-state region of South Carolina and Georgia included a 36 percent minority and 13 percent low-income population. There are 14 census block groups located within the 16-kilometer (10-mile) radius surrounding E Area, 4 of which contained a disproportionately high number of minority individuals; none contained a disproportionately high number of low-income individuals. Figure 3–21 shows the proximity of the identified minority communities to E Area. Figure 3–22 shows the cumulative populations living at a given distance from the site. The total population living within 16 kilometers (10 miles) of E Area is primarily concentrated to the north and northwest toward the outskirts of the Augusta-Richmond Metropolitan Statistical Area. No one resides within approximately 3.2 kilometers (2 miles) of E Area.

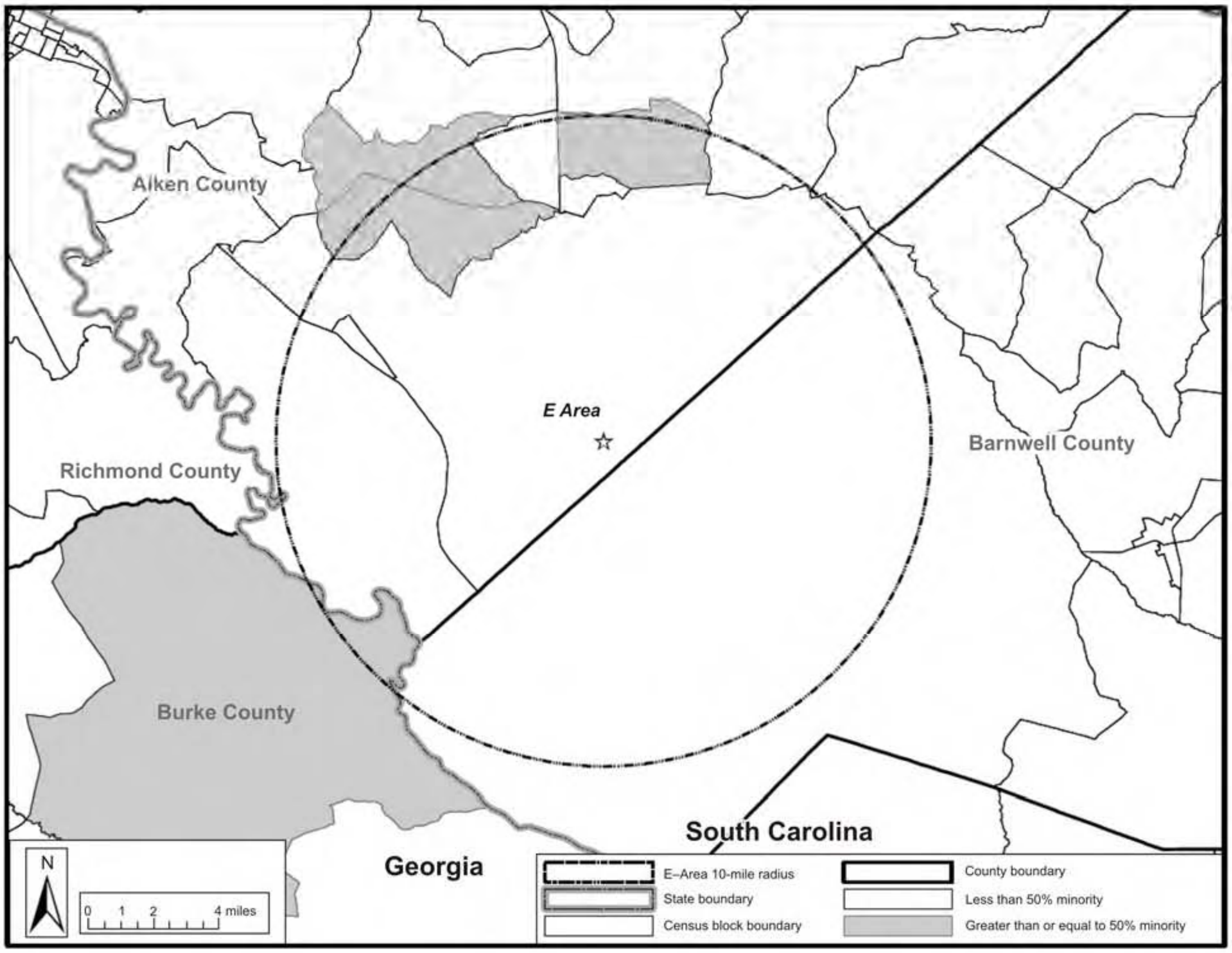


Figure 3–21. Block Groups Containing Minority Populations Surrounding E Area at the Savannah River Site

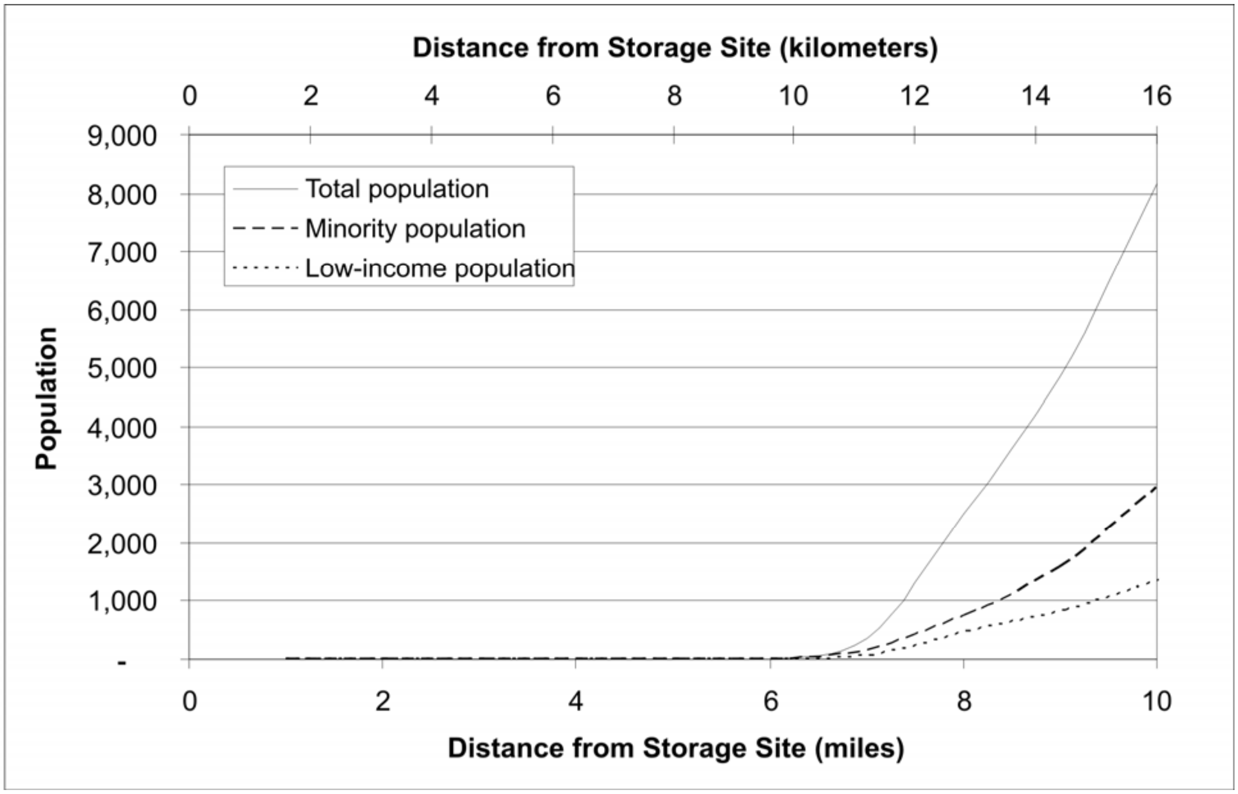


Figure 3–22. Cumulative Populations Residing Within 16 Kilometers (10 Miles) of E Area at the Savannah River Site

POTENTIALLY SUSCEPTIBLE POPULATIONS

Environmental justice concerns were considered in greater detail in areas that have been identified as containing a disproportionately high number of minority or low-income individuals. This section presents information regarding factors that may contribute to disproportional impacts, such as age and access to health care.

Figure 3–23 displays a breakdown of potentially susceptible demographics for the 16-kilometer (10-mile) ROI, the two-state region, and the four-county region. For purposes of this analysis, the demographics of primary concern are children under the age of 18, women ages 18 to 39, and individuals ages 65 and up. The population of children under 18 and women ages 18 to 39 living within the 16-kilometer (10-mile) ROI appear to be consistent with the surrounding four-county and two-state regions. The population of individuals ages 65 and up living within the 16-kilometer (10-mile) ROI is larger than that demographic living in surrounding areas; however, the differences do not appear to be appreciable.

HPSAs are designated by the Health Resources and Services Administration. These data are presented at the greatest level of spatial resolution available for each county within the 16-kilometer (10-mile) ROI. All of Aiken County is designated as a primary medical care and dental HPSA for low-income populations, and one medical facility in the county is designated as a dental and mental health HPSA. All of Barnwell County is designated as a primary health care and dental HPSA. There are no mental health HPSA designations in Barnwell County. One medical facility is designated as a primary medical care HPSA in Burke County, and the entire county is designated as both a dental and mental health HPSA. Several census tracts in Richmond County are designated as primary medical care HPSAs; however, none of these tracts lie within the 16-kilometer (10-mile) ROI. One medical facility in Richmond County is designated as both a dental and mental health HPSA (HRSA 2009b).

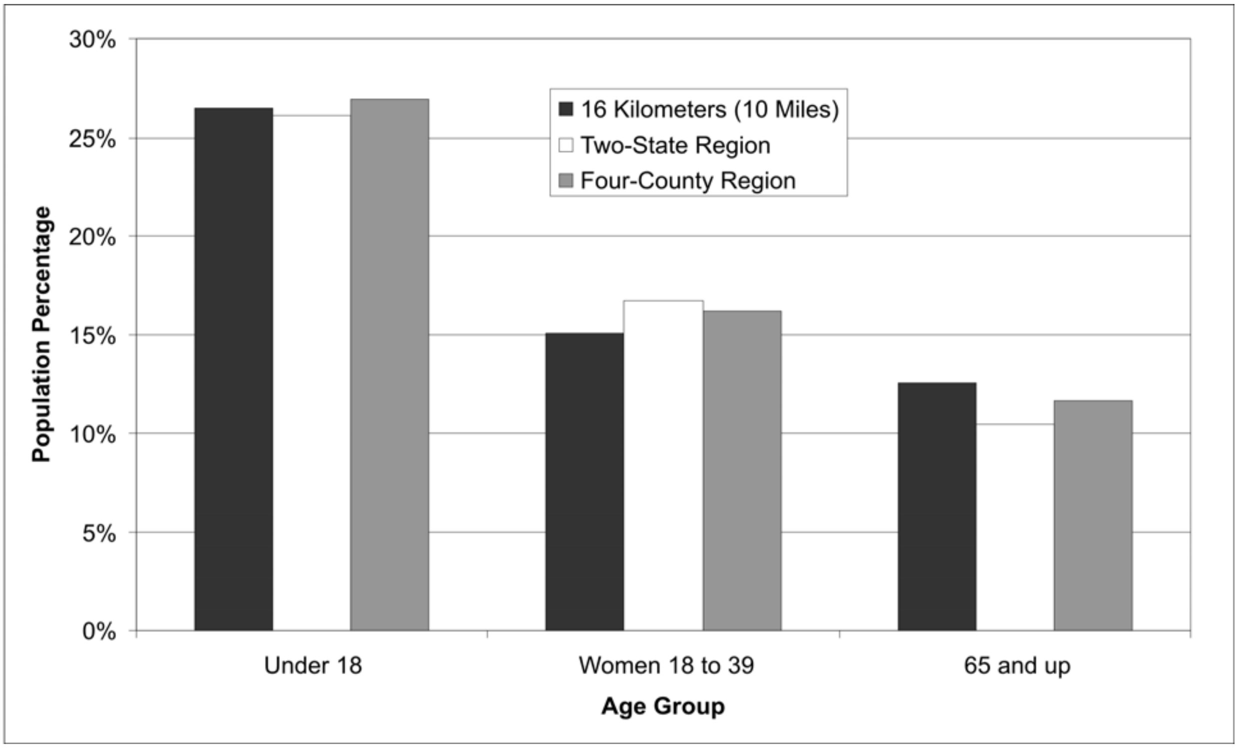


Figure 3–23. Percentage of Age Groups Within the 16-Kilometer (10-Mile) Region of Influence and the Two-State and Four-County Areas Surrounding the Savannah River Site

3.8 WASTE CONTROL SPECIALISTS, SITE

3.8.1 Land Use and Visual Resources

3.8.1.1 Land Use

The privately owned WCS facility complex occupies 541 hectares (1,338 acres) of rural property just east of the Texas–New Mexico state line. A 5,460-hectare (13,500-acre) tract of land also owned by WCS surrounds the developed portion of the site. The WCS property is located primarily in northwestern Andrews County, Texas, and extends to the west into Lea County, New Mexico. The nearest population center is the city of Eunice, New Mexico, located approximately 10 kilometers (6 miles) west of the site. The city of Andrews, Texas, is located approximately 50 kilometers (31 miles) east of the WCS site. WCS currently contains facilities used for the processing, storage, or disposal of hazardous waste, LLW, and MLLW (WCS 2007a:11.1.1-10; 2009a:3).

Industries operating in the vicinity of WCS include gravel and caliche mining, oil and gas production, landfill operations, cattle grazing, and ranching. Louisiana Energy Services has filed an application with the NRC to operate a commercial uranium enrichment facility adjacent to the western boundary of the WCS property. This facility is currently under construction. The Lea County Landfill occupies approximately 16 hectares (40 acres) of adjacent land to the southwest. The majority of the remaining land within the vicinity of the site is used for ranching activities and seasonal livestock grazing. No parkland or other environmentally sensitive areas exist within a 16-kilometer (10-mile) radius of the site (WCS 2007a:2-9, 11-9, 11.1.1-10; 2009a:2).

3.8.1.2 Visual Resources

WCS is located in the High Plains region of the central Great Plains; this region is characterized by grassland, shrubs, and few, scattered trees (WCS 2007a:2-38). The topography of the facilities area generally slopes to the south-southwest (Cook-Joyce and Intera 2007:5-8).

The developed areas of WCS are consistent with BLM's VRM Class III or IV. Class III includes areas in which there have been moderate changes in the landscape that could attract attention, but do not dominate the view of the casual observer. Class IV includes areas in which major modifications to the character of the landscape have occurred. These changes may be dominant features of the view and the major focus of viewer attention (DOI 1986:App. 2). Major visual features at WCS include the buildings, excavated earthen mounds, and access roads. The viewshed in the vicinity of WCS consists mainly of open range interspersed with resource extraction facilities, the Lea County Landfill, and oil well pump jacks. Although it does not possess any dramatic, unique, or rare features, the overall area can be considered to have modest scenic quality that is pleasant to regard for its rural, undeveloped nature (Hicks & Company 2007:78). This viewshed is generally consistent with VRM Class II (where visible changes to the character of the landscape are low and do not attract the attention of the casual observer) and Class III.

3.8.2 Geology, Soils, and Geologic Hazards

3.8.2.1 Geology

WCS is located in west Texas and lies within the southern portion of the High Plains section of the North American Great Plains physiographic province. The site is situated on the southwestern edge of the Southern High Plains. The Southern High Plains is an elevated area of undulating plains with low relief encompassing a large area of west Texas and eastern New Mexico. Across WCS, elevations range from approximately 1,041 meters (3,415 feet) to 1,067 meters (3,500 feet) above mean sea level (Cook-Joyce and Intera 2007:1-1).

Regional geologic structure is dominated by the north-central portion of a prominent Paleozoic structural feature known as the Central Basin Platform of the Permian Basin, which was uplifted during the Mississippian and Pennsylvanian ages. Significant faults are known to exist in the deep subsurface, as interpreted from petroleum exploration activities. The faults are expressed in Paleozoic rocks at depths of a few thousand meters (thousands of feet). The closest Quaternary faults are in the Guadalupe Mountains, about 160 kilometers (100 miles) southwest of WCS, associated with the Basin and Range physiographic province. Faulting of any significance in the vicinity of WCS or the Central Basin Platform is generally considered to be Permian in age or earlier (Cook-Joyce and Intera 2007:4-1–4-3, 4-8, 4-9, 4-17; WCS 2007a:11.1.1-24, 11.1.1-28, 11.1.1-29). Investigations of two reverse faults observed in a sandstone unit in the upper portion of the Triassic red beds of the original RCRA landfill excavation conducted in 2004 concluded that the movement on the faults was no later than early Cretaceous (about 135 million years before present).

WCS is located over a geologic feature referred to as the "red bed ridge," which influences overall site geology. It is a prominent buried ridge developed on the upper surface of the Triassic Dockum Group. The Dockum Group red beds are present beneath the WCS facility site at depths ranging from about 2.4 to 24 meters (8 to 80 feet) (Cook-Joyce and Intera 2007:2). The Dockum Group consists of a series of fluvial and lacustrine mudstone, siltstone, sandstone, and silty dolomite deposits, which reach up to approximately 430 meters (1,400 feet) thick in the area of the Central Basin Platform. The buried ridge persisted as a drainage divide throughout the late Cenozoic era and continues to generally divide surface topographic drainage between the Colorado and Pecos Rivers (Cook-Joyce and Intera 2007:2, 2-2; WCS 2007a:11.1.1-26).

The Cooper Canyon Formation of the Dockum Group is the uppermost bedrock unit present beneath the site and is composed of red bed claystones and sandstones/siltstones. There are several sandstone/siltstone layers identified below the top of the Cooper Canyon Formation, which extend for various distances laterally in the subsurface. There are three distinct formations immediately above the Cooper Canyon Formation. These are (1) the Ogallala Formation (northeast of the buried ridge), (2) the Cretaceous Antlers Formation (over the crest of the buried ridge), and (3) the Gatuna Formation (southwest of the buried ridge). These formations are laterally contiguous because the buried ridge was a surface drainage divide throughout the late Cenozoic era, with Tertiary to Quaternary fluvial material (fluvial sediments of the Ogallala and Gatuna) deposited on either side of the ridge, and the Cretaceous Antlers Formation likely acting as an erosion-resistant cap over the crest of the ridge. These three formations are informally called the OAG unit at the site (WCS 2007a:11.1.1-25–26, Figure 2.5.2).

Another important component of the site-specific geology is the “caprock caliche,” a hard, erosion-resistant, pedogenic calcrete that formed on all pre-Quaternary deposits prior to deposition of the overlying Blackwater Draw Formation. This informal unit is present at the top of the underlying Ogallala, Antlers, and Gatuna Formations throughout the WCS area. It is frequently considered part of and is thus mapped as the Ogallala Formation. The caprock caliche in the vicinity of WCS is hard, laminated, and pisolitic, with chert pebbles. It is exposed at the surface in some areas; it is typically 1.5 to 3 meters (5 to 10 feet) thick but it can be as thick as 6 meters (20 feet) or more. In thick areas, nodules and layers of opal have formed as replacement mineralization. Where exposed at the surface, the caprock caliche is weathered and broken into rubble. The caprock caliche is distinguished from caliches in overlying sediments by its hard, laminated form, compared with the lighter, softer, sandier and less dense younger caliches (Cook-Joyce and Intera 2007:2-7; WCS 2007a:11.1.1-26).

Beneath the south-southwestern part of WCS, the Gatuna Formation consists of 0.6 to 4.6 meters (2 to 15 feet) of coarse, red, cross-bedded, and gravelly sand. The underlying Antlers Formation occurs as a buried erosional remnant along the crest of the red bed ridge underlying the WCS site. The Antlers ranges in thickness from 0 meters in the southwest corner to about 6 meters (20 feet) in the area of the proposed landfill disposal site to about 12.2 meters (40 feet) in the northwest corner of the facilities area (Cook-Joyce and Intera 2007:2-5, 2-7).

Surface deposits across WCS generally consist of Holocene age sands overlying the sediments of the Quaternary Blackwater Draw Formation. The Blackwater Draw forms an extensive cover over virtually all of the Southern High Plains and consists of windblown sands, silts, and clays derived from the alluvial sediments in the Pecos River valley to the west. Thickness of the Blackwater Draw sediments and overlying sands ranges from 0 to 17 meters (0 to 55 feet) across the site. Several soil horizons have developed in the Blackwater Draw, with varying degrees of caliche (cemented calcium carbonate) development (see Section 3.8.2.2) (Cook-Joyce and Intera 2007:2-9, 2-10, 2-12).

Geologic resources in the immediate vicinity of WCS include coarse aggregate (gravel), sand, and possibly fine aggregate. Commercial mineral and fossil fuel operations beyond the site include gravel and caliche mining, oil and gas production. As mentioned earlier, a sand and gravel operation is located approximately 0.8 kilometers (0.5 miles) west of the WCS property. The operation includes crushing of caliche, as well as screening and crushing of sands and gravels. Caliche is widely available over the entire Southern Plains Region, and there is no economic incentive for caliche mining in the immediate vicinity of WCS. Subsurface petroleum product exploration and production have been conducted in the area of the Central Basin Platform for over 75 years. Most of the oil wells in the vicinity of the site have been abandoned or are in the process of secondary or tertiary recovery. The absence of oil wells on the proposed disposal site supports the absence of favorable conditions for oil production. A single, minimally producing oil well exists several hundred meters (yards) southwest of the proposed landfill disposal site and is the nearest well to the existing facilities. The well stopped producing in April 2002. The well was restarted in December 2004, with a 2005 total production of 390 barrels through August 2005. Several exploration boreholes that did not produce were drilled on the Flying W Ranch in the vicinity of the proposed disposal site. These dry wells provide evidence that significant oil and gas reserves are unlikely beneath the site (WCS 2007a:11.1.1-10–11).

3.8.2.2 Soils

The surface soils at WCS consist primarily of highly moisture-deficient eolian sands, underlain by a well-developed caliche and sand and gravel (WCS 2007a:11.1.1-44). A general soil map of Andrews County prepared by the NRCS shows WCS mapped as the Blakeney-Conger association. The Blakeney-Conger soils are fine sandy loams, loams, and clay loams that range in thickness from 0 to 46 centimeters (0 to 18 inches), underlain by strongly cemented rounded caliche or strongly cemented caliche plates. A representative profile of Blakeney-Conger soils comprises a surface layer of about 15 centimeters (6 inches) of grayish-brown loam underlain by about a 30 centimeters (12 inches) of friable pale-brown clay loam. Underlying the clay loam is a layer of white, laminar caliche plates about 56 centimeters (22 inches) thick. Below the caliche plates, to a depth of about 190 centimeters (75 inches), is weakly cemented caliche. Although the caliche below a depth of about 46 centimeters (18 inches) is described by the NRCS as part of the profile of soils of the Blakeney-Conger Series, it also represents the gradation into the underlying caprock caliche, which has developed on the OAG unit sands and gravels (Cook-Joyce and Intera 2007:2-10, 2-11).

More-recent and -detailed soil unit mapping by the NRCS identifies natural soils across the southern portion of the WCS site as Ratliff soils, which are gently undulating. Ratliff soils are loams at the surface, grading to clay loams to a depth of about 200 centimeters (80 inches). Their parent material comprises calcareous, loamy eolian deposits from the Blackwater Draw Formation. The soils do not generally present any limitations for site development. A semi-circular area of approximately 16 hectares (40 acres) of the middle portion of the site, bordering the current facility complex, is mapped as Faskin and Douro soils, which are also gently undulating. These soils are a fine sandy loam at the surface and sandy clay loams to a depth of 200 centimeters (80 inches). Likewise, they have no identified site development limitations. Blakeney and Conger soils, which are, again, gently undulating, are mapped across the northern portion of the Central Facilities Area. In profile, they consist of fine sandy loam from 0 to 46 centimeters (0 to 18 inches) belowground surface; cemented material from 46 to 81 centimeters (18 to 32 inches); and gravelly loam from 81 to 173 centimeters (32 to 68 inches). This unit has some limitations for development due to the depth to cemented material. This profile generally matches the description of the older association. None of the soils at WCS are prime or other important farmland soils, although some soil units mapped to the west of the site are considered farmland of statewide importance (NRCS 2009e).

3.8.2.3 Geologic Hazards

WCS lies in a region with crustal properties that indicate minimum risk due to faulting and seismicity. The Central Basin Platform is an area of moderate, low-intensity seismic activity based on historical seismicity. The largest earthquake in the vicinity of WCS, referred to as the "Rattlesnake Canyon earthquake," had a magnitude of 5 and occurred in 1992. Estimates of the epicenter of this event range from 11 to 31 kilometers (7 to 19 miles) southwest of the site, indicating an epicenter in association with movement on the West Platform fault zone. The depth was estimated at 12 kilometers (7.4 miles), well below oil field production in that area (Cook-Joyce and Intera 2007:4-20, 4-21, 4-22). The event produced shaking of MMI V at its epicenter (USGS 2009m). Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects.

Within a radius of 100 kilometers (62 miles) of WCS, a total of 9 earthquakes (larger than magnitude 2.5) have been recorded since 1973. This includes the Rattlesnake Canyon earthquake of January 1992, which remains the closest earthquake epicenter of record (USGS 2009g).

As previously cited in Section 3.2.2.3, the latest probabilistic PGA data from the USGS are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For the WCS site, the calculated PGA is approximately 0.12 *g* (USGS 2009d). In addition, a site-specific probabilistic seismic analysis was conducted to support WCS's application for near-surface LLW disposal at the site. The probabilistic analysis concluded that the largest contributor to the seismic hazard at WCS is the background seismicity of the Southern Great Plains seismic source zone. The results indicated a peak acceleration of approximately 0.05 *g* for the same probability of exceedance (i.e., 2,500-year return period) (Cook-Joyce and Intera 2007:4-23, 4-24; WCS 2007a:11.1.1-32).

No subsidence features related to salt dissolution have been identified within the facilities area or the immediate vicinity of WCS. The nearest active subsidence features to WCS are the San Simon Swale, the San Simon Sink, the Wink Sinks, and a sink northwest of Jal, New Mexico. These sinks all lie above the Permian Capitan Reef. The closest features, the San Simon Swale and the San Simon Sink, are located approximately 32 kilometers (20 miles) west-southwest of WCS in Lea County, New Mexico. These surface subsidence features are believed to be caused by the collapse of solution cavities formed above the Capitan Reef aquifer in the Permian Salado Formation that have migrated upward over time in response to successive roof failures. WCS is located near or within the interior dissolution zone. Based on apparent Permian salt removal on oil field geophysical logs, there are indications that Whalen and Shafter Lakes may be subsidence features. These lakes are located approximately 24 kilometers (15 miles) and 40 kilometers (25 miles) southeast and east of WCS, respectively. There is also a depression located approximately 4 kilometers (2.5 miles) east of the facilities area that contains perennial water. Oil field geophysical logs, including this depression, were reviewed in the WCS area, and no evidence of salt dissolution was apparent (Cook-Joyce and Intera 2007:4-29–4-32, Figure 4-27; WCS 2007a:11.1.1-32).

3.8.3 Water Resources

3.8.3.1 Surface Water

There are no perennial streams on or in the immediate vicinity of WCS. The principal surface-water drainage feature on the site consists of a draw that crosses the southern portion of the site. This draw, referred to as the "ranch house drainage," crosses the WCS property about 0.4 kilometers (0.25 miles) southeast of the WCS facility complex and flows from east to west (Haas 2006:Fig II.F.4). Most of the surface water caught by ranch house drainage is lost to infiltration in the sand dunes, which encroach on the drainage in the southwest part of the facilities area. The ranch house drainage crosses under the access road to the southwest of the proposed site through six 74- by 46-centimeter (29- by 18-inch) culverts. These culverts are installed below grade and a ditch excavated in the eolian cover sands upgradient and downgradient from the road. The ditch upgradient locally erodes on the ditch sides and washes into the culverts. The drainage crosses under Texas State Highway 176 through two 109- by 69-centimenter (43- by 27-inch) culverts. After crossing the highway, the drainage continues southwest and ultimately drains into Monument Draw in New Mexico (WCS 2007a:11.1.1-24). Monument Draw is a southward-draining ephemeral draw about 4.8 kilometers (3 miles) west of the WCS site boundary. The draw does not have through-going surface-water drainage, and due to encroachment of alluvial and eolian deposits, loses surface expression after it enters Winkler County, Texas (Cook-Joyce and Intera 2007:1-1).

Small surface depressions and a few established playa basins are present within a 10-kilometer (6.2-mile) radius of WCS. The largest of the surface depressions within the area is a playa with a drainage area of approximately 1.6 square kilometers (1 square mile). The center of this playa is located approximately 2.4 kilometers (1.5 miles) north-northeast of the WCS facility complex. The WCS facility complex is not located within the drainage basin of this playa. However, drainage from a large area of the northern portion of the WCS site area does drain toward this playa. Remnant deposits of a filled and now partially sand-covered playa or salt lake basin are found about 6 kilometers (3.7 miles) east of WCS. Surface drainage from the area north and east of the WCS site flows eastward into this basin (Cook-Joyce and Intera 2007:1-1, 1-2, Figure 2; Haas 2006:Figure II.F.1; WCS 2007a:11.1.1-24).

Other features outside the WCS site include Baker Spring to the west and small depressions (playas) or solution pans (localized dissolution of the caprock caliche at or near ground surface) between Baker Spring and the facility. Baker Spring is a historic spring that discharged from the Gatuna Formation in Lea County, New Mexico, about 610 meters (2,000 feet) west of the facility. Groundwater discharge has not been directly observed at Baker Spring, although ephemeral groundwater discharge likely occurs following significant precipitation. Baker Spring is also the site of a former gravel and caliche quarry. Two surface draws discharge to the Baker Spring area, and, following extended periods of precipitation (such as the year 2004, the second wettest year on record), surface-water and ephemeral groundwater discharge accumulate in a quarried depression in the red beds below the spring. The Baker Spring area retains surface water for sustained periods following significant rainfall events. Scratch Spring is located approximately 4.8 kilometers (3 miles) east of WCS. This former spring is located on the northwestern edge of the partially covered playa or salt lake basin that drains the areas north and east of the site. The spring is believed to have been dry since at least 1923 (Cook-Joyce and Intera 2007:1-1, 1-2, Figure 2; WCS 2007a:11.1.1-24).

The only other features are three manmade stock ponds located near the eastern boundary of WCS and a stock pond located southeast of the facility boundary. The stock ponds can retain surface water for several months following significant rainfall events (WCS 2007a:11.1.1-23–24).

A hydraulic study was performed to delineate the 100- and 500-year floodplains for the ranch house drainage south of WCS. The findings show that the floodplains do not encroach on the facility complex or proposed disposal areas (Haas 2006:Fig II.F.4; WCS 2007a:11.1.1-24).

3.8.3.2 Groundwater

Groundwater occurs in two principal aquifer systems in the vicinity of WCS, the High Plains Aquifer and the Dockum Aquifer. The High Plains Aquifer in the vicinity of WCS occurs in the sediments of the OAG unit (see Section 3.8.2.1). The term “Ogallala Aquifer” is frequently used interchangeably with “High Plains Aquifer,” since regionally the Ogallala Formation is the primary component of the High Plains Aquifer. On WCS, the formations that comprise the High Plains Aquifer are saturated to the north of the facilities area. This is because the dry line, the southern limit of saturated conditions in the High Plains Aquifer, is located just on the northern border of the current WCS facilities and designated landfill areas (WCS 2007a:11.1.1-35, Figure 2.5.7).

The Dockum Aquifer in the vicinity of WCS consists of two water-bearing sandstone formations in the Dockum Group: the Santa Rosa Formation at the base of the Dockum, between about 347 and 427 meters (1,140 and 1,400 feet) below ground surface and the Trujillo Formation, between about 183 and 213 meters (600 to 700 feet) below ground surface. Both yield water with less than 3,000 milligrams per liter total dissolved solids. Based on carbon-14 ages of groundwater in the lower Dockum Aquifer, most of the recharge to the sandstones in the aquifer is considered to have occurred during the Pleistocene epoch, some 15,000 to 35,000 years before present. The upper portion of the Dockum Group (the Cooper Canyon Formation) serves as an aquitard in the region. This is supported by the fact that the hydraulic head of the lower Dockum Aquifer is significantly lower than that of the overlying High Plains Aquifer throughout much of the Southern High Plains. This relative head difference, approximately 60 to 90 meters (200 to 300 feet) in western Andrews County, and age dating indicates that the lower Dockum aquifer is receiving very little recharge from cross-formational flow (WCS 2007a:11.1.1-35).

Unsaturated conditions generally exist within the OAG unit along the crest and to the south-southwest of the red bed ridge, which trends from northwest to southeast through the area of the proposed waste disposal facilities. Thus, the OAG unit is dry at the WCS landfills, on the crest of the red bed ridge. The OAG unit has some saturation to the north and east of the WCS landfills and is dry to the south and west. To the north and east of the facilities across the northern half of WCS, the depth to the water table is on the order of 24 meters (80 feet) at the base of the OAG unit. Recharge to the OAG unit occurs in the vicinity of playas that collect and hold precipitation for some period. During relatively wet conditions, such as from late 2003 until early 2005, the dry line likely migrated southward as infiltration from the largest playa in the vicinity reaches the OAG unit and mounds. During dry or drought conditions, the dry line will likely migrate northward, retreating down the northward slope of the buried ridge (Cook-Joyce and Intera 2007:6-7, 6-8; WCS 2007a:11.1.1-35–37, Figure 2.5.3, Figure 2.5.7).

Groundwater has been encountered under confined conditions in the 24-meter (80-foot) sandstone and 38-meter (125-foot) sandstone zones of the Cooper Canyon Formation near the eastern boundary of WCS. Elsewhere within the site area, including beneath the footprints of the site, the 24-meter (80-foot) zone and the 38-meter (125-foot) zone are unsaturated. Groundwater conditions in the 55-meter (180-foot) zone transition from confined to unconfined to dry from north to south beneath WCS. The 69-meter (225-foot) zone is saturated with groundwater under confined conditions throughout WCS. The 69-meter (225-foot) zone is considered the uppermost saturated zone, but with very low permeability. It is the zone in which monitoring is conducted for the existing landfill. Groundwater flow in the OAG unit on the north side of the site is northward along a relatively broad north-sloping paleochannel on the paleosurface of the red beds. Groundwater flow in the saturated OAG unit east of the site is to the east-southeast. Groundwater flow velocity in the OAG unit is no more than 0.06 meters (0.2 feet) per day (Cook-Joyce and Intera 2007:6-7–6-98; WCS 2007a:11.1.1-35–37, Figure 2.5.7).

Groundwater provides a backup water supply for WCS. The non-potable water supply well for the site is the central well, which obtains water from sandstone sections of the lower Dockum Group Santa Rosa Formation at a depth of about 347 to 427 meters (1,140 to 1,400 feet) below ground surface. A backup well, the southeast well, obtains water from the Dockum Group Trujillo Formation sandstone at a depth of about 183 to 213 meters (600 to 700 feet) below ground surface (Cook-Joyce and Intera 2007:6-5). Water use is further discussed in Section 3.8.7.4.

The closest aquifer designated by EPA as a sole-source aquifer is the Edwards Aquifer located in San Antonio, Texas, area. The WCS site is not considered to be a component of a recharge area of any potential sole-source aquifer (WCS 2007a:11.1.1-43).

3.8.4 Meteorology, Air Quality, and Noise

3.8.4.1 Meteorology and Air Quality

The climate at WCS is semiarid and is characterized by warm dry summers. The average annual rainfall is 36 centimeters (14 inches) (WCS 2008a:App. 13.A:7). Maximum rainfall occurs between May and October. Damaging hailstorms rarely occur in Andrews County (NCDC 2009f). The average annual snowfall in Andrews, Texas, is 8.6 centimeters (3.4 inches) (WCS 2007a:App 2.3.1:2.3.1-6).

Severe weather events in the area include flash floods; high winds; dust storms; tornadoes; hail; and occasional snow, ice, and fog. During a 42-year period of record, Andrews County reported 21 tornadoes. The average annual windspeed is 2 to 5 meters per second (5 to 12 miles per hour). The prevailing winds are from the south (WCS 2008a:App. 13.A:7-10). The maximum windspeed at Midland, Texas (highest one minute average), is 26 meters per second (58 miles per hour) (NOAA 2009b:70). The Midland National Weather Service Station is about 98 kilometers (61 miles) southeast of the facility.

The average annual temperature at Andrews, Texas, is 17.6 °C (63.7 °F). Temperatures range from a monthly average minimum temperature of –1 °C (30 °F) in January to a monthly average maximum of about 35 °C (95 °F) in July (WCS 2007a:App. 2.3.1:2.3.1-8). Additional information on meteorology is provided in Section 4.1 of the WCS Renewal License Application (WCS 2008a:4-1–4-6).

WCS is in an area of Andrews County, Texas, that is designated better than national standards for sulfur dioxide and better than national standards or unclassifiable for nitrogen dioxide. The area is unclassifiable/attainment regarding attainment of the standard for carbon monoxide and ozone. EPA has not assigned an attainment status designation for lead; the area is unclassifiable for PM_{10} and $PM_{2.5}$ (40 CFR 81.344). Nearby areas of Lea County, New Mexico, are similarly designated for the criteria pollutants (40 CFR 81.332).

The nearest PSD Class I area is Carlsbad Caverns, New Mexico, about 129 kilometers (80 miles) to the west. WCS and its vicinity are classified as a Class II area. No PSD permits are required for any emission source at WCS.

Storage and processing operations at the facility result in some emissions of radiological particulate matter and tritium. The primary sources of criteria pollutants at WCS are stabilization activities, unloading, liquid waste bulking, landfill operation, waste solidification, and silos and stockpiles (TCEQ 2009). WCS has an operating permit that covers these sources as required under the Federal Clean Air Act and companion State of Texas regulations (WCS 2008a:Ch. 3:Table 3.5).

There are ambient air monitors for nitrogen dioxide, ozone, PM_{10} and $PM_{2.5}$ in Lea County, New Mexico. Monitored concentrations in the region are well below ambient standards.

3.8.4.2 Noise

Major noise emission sources within WCS include various equipment and machines—HVAC equipment, material-handling equipment, and vehicles. No environmental noise studies have been conducted at the site. There are few noise-sensitive receptors near the facility since it is not located near populated areas, and nearby land uses include a quarry, farming operations, and radioactive waste storage operations. Noise levels from the plant are expected to be compatible with nearby land uses. The closest residence is approximately 5.6 kilometers (3.5 miles) from the facility (WCS 2008a:App. 4.A:103, App. 13.A, Section 3:3).

The State of Texas and Andrews County have not established community noise standards, which specify acceptable noise levels applicable to the facility. Sound level measurements have not been recorded near the site; however, it is expected that the acoustic environment near the site boundary ranges from that typical of rural to industrial locations. Traffic is the primary source of noise at the site boundary and near roads used to access the site. The traffic generated by activities at the site includes employee vehicles and trucks used for shipping. Roads that provide access to the site include Texas State Highway 176/New Mexico State Road 176 and other roads. There is occasional railroad activity on the spur between the Texas–New Mexico Railroad near Eunice that provides access to the site (WCS 2008a).

3.8.5 Ecological Resources

3.8.5.1 Terrestrial Resources

The facilities area of WCS consists of 541 hectares (1,338 acres) of low desert grassland populated with scattered trees and shrubs. The site's vegetation is classified mainly as mixed, shortgrass, and, in limited quantities, tallgrass prairie. Shrubs and grasses such as mesquite and buffalo grass dominate the majority of the landscape. In areas of overgrazing soapweed and snakeweed are common. Many areas on site exhibit some degree of disturbance from human activities. Portions of the site have been developed to include oil well pads, pipelines, and access roads. In bare soil areas resulting from disturbance, species such as mesquite, soapweed, and Russian thistle are common (WCS 2007a:5-7).

Common mammals found on WCS include coyote, black-tailed jackrabbit, gopher, and rodents such as Ord's kangaroo rat and the silky pocket mouse. Common bird species found on site include the American kestrel, barn swallow, and the scaled quail. Reptile species present include the whiptail lizard, southern prairie lizard, sand dune lizard, and western hognose snake. No evidence of amphibians was found in the ephemeral pools located in the north and south of the site (WCS 2007a:5-7). Habitat and species composition in the immediate vicinity of the proposed mercury storage facility is typical of the surrounding landscape.

3.8.5.2 Wetlands

Wetland resources are limited to ephemeral pools located in the extreme northern and southern portions of WCS, and at the Baker Spring outcrop. These limited wetland resources provide habitat for amphibians such as the Texas toad and spadefoot toad (WCS 2007a:2.9.1-55). No wetlands exist in the vicinity of the proposed mercury storage facility.

3.8.5.3 Aquatic Resources

No permanent aquatic resources exist on WCS and, as such, aquatic resources are limited. Although not observed to date, surface pools and roadside ditches may provide breeding habitat for the Texas and spadefoot toads following periods of rain (WCS 2007a:2.9.1-55).

3.8.5.4 Threatened and Endangered Species

Nine federally and/or state-listed threatened, endangered, and candidate species have been identified as occurring or possibly occurring on WCS. While suitable habitat does not exist for the peregrine falcon, American swallow-tailed kite, southwestern willow flycatcher, and whooping crane, these species may pass through the site during migration. Marginal habitat for the lesser prairie chicken does exist, but no occurrences have been reported (WCS 2007a:2.9.1-60). Table 3–20 lists all sensitive species occurring or potentially occurring on site.

Table 3–20. Federally and State-Listed Species Potentially Occurring at the Waste Control Specialists Site

Common Name	Scientific Name	Federal Status	State Status
American peregrine falcon	*Falco peregrinus*		Endangered
American swallow-tailed kite	*Elanoides forficatus*		Threatened
Bald eagle	*Haliaeetus leucocephalus*		Threatened
Lesser prairie chicken	*Tympanuchus pallidicinctus*	Candidate	
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered
Whooping crane	*Grus americana*	Endangered	Endangered
Black-tailed prairie dog	*Cynomys ludovicianus*	Candidate	
Texas horned lizard	*Phrynosoma cornutum*		Threatened
Sand dune lizard	*Sceloperus arenicolus*	Candidate	

Source: WCS 2007a:2.9.1-60.

3.8.6 Cultural and Paleontological Resources

3.8.6.1 Prehistoric and Historic Resources

A 1994 survey (Galvin Eling Associates 1994) of WCS involved a thorough pedestrian survey that identified no cultural resources. The assessment found an absence of archaeological and cultural resources and found no evidence of prehistoric or significant historic occupation or exploitation of the area. This is due in large part to a lack of essential resources that would provide an enticement for occupation. The study found no site that was currently listed or nominated for listing in the NRHP. The potential to find buried deposits in upland soils is low.

A determination of "No Effect" was issued by the SHPO in 1994. A June 2004 letter of acceptance of the "No Effect" determination was received from the Texas Historical Commission to confirm this status (WCS 2009a).

3.8.6.2 American Indian Resources

There have been no American Indian resources identified on WCS.

3.8.6.3 Paleontological Resources

There have been no paleontological resources identified on WCS.

3.8.7 Site Infrastructure

In addition to the description provided below, a summary of WCS's sitewide infrastructure characteristics is presented in Table 3–21.

Table 3–21. Waste Control Specialists Infrastructure Characteristics

Resource	Current Site Usage	Site Capacity
Transportation (kilometers)		
Roads	Not Available	Not Available
Railroads	9.6	9.6
Electricity		
Energy consumption (megawatt-hours per year)	3,488[a]	Not Available
Fuel		
Natural gas (cubic meters per year)	(b)	(b)
Fuel oil (liters per year)	(b)	(b)
Diesel fuel (liters per year)	86,276	(c)
Gasoline (liters per year)	108,496	(c)
Propane (liters per year)	16,159	(c)
Water (liters per year)	24,721,000	49,740,311[d]

a Estimate based on usage from January through May 2009.

b Fuel resource not used on site.

c Limited only by the ability to transport resource to the site.

d Annual capacity of the central well located east of the storage buildings (see Section 3.8.7.4).

Note: Unless noted all values based on 2008 usages. To convert kilometers to miles, multiply by 0.6214; cubic meters to cubic feet, by 35.315; and liters to gallons, by 0.26417.

Source: Hicks & Company 2008:105; Reavis 2009a, 2009b; WCS 2009a.

3.8.7.1 Ground Transportation

WCS is located approximately 50 kilometers (31 miles) west of Andrews, Texas, and 122 meters (400 feet) east of the Texas–New Mexico state line. It is 10 kilometers (6 miles) east of the city of

Eunice, New Mexico. Road access to the site is via State Highway 176, located 1.6 kilometers (1 mile) south of the site. Site roads are limited in extent and provide access to onsite facilities such as the Mixed Waste and Treatment Facility (WCS 2009a:3, Figure 5-2).

A railroad spur is located on site and a railroad staging area is located within 114 meters (375 feet) of the Container Storage and Bin Storage Facilities (WCS 2009a). The rail access gate is located on the western side of the facility. The onsite railroad spur has a 110-railcar capacity, and the rail line that connects to the plant from the west connects from the cities of Eunice and Hobbs, New Mexico, near the Texas–New Mexico state line. WCS owns 10 kilometers (6 miles) of rail connection from the west near Eunice to the Union Pacific line in Monahans, Texas (Hicks & Company 2008:105).

3.8.7.2 Electricity

Sitewide electricity is purchased from Oncor. There are no substations on the site; transformers support individual buildings or equipment (Reavis 2009b). Annual electricity consumption is estimated at 3,488 megawatt-hours per year. Electrical capacity information, the maximum ability to draw power from the utility, is not available (Reavis 2009a, 2009b).

3.8.7.3 Fuel

Fuel use at WCS consists of propane (for heating), diesel fuel, and gasoline (Beach 2009; WCS 2009a). Fuel is delivered by truck and refilled as needed. The facility has the following diesel storage tanks: a 30,270-liter (8,000-gallon) tank, a 1,890-liter (500-gallon) portable tank, a 1,060-liter (280-gallon) tank, and a 380-liter (100-gallon) tank. Other fuel tanks include an 18,920-liter (5,000-gallon) gasoline tank and an 18,920-liter (5,000-gallon) and 3,785-liter (1,000-gallon) propane tank (Reavis 2009b).

3.8.7.4 Water

The primary source of potable water for WCS is via pipeline from Eunice, New Mexico. WCS uses water from its central well for fire water and dust suppression. The central well is located east of the Container Storage and Bin Storage Facilities and is completed in the Santa Rosa sandstone; a backup well, the southeast well, obtains water from the Trujillo Formation. Production from the central well is at a rate of 95–114 liters (25–30 gallons) or 50–60 million liters (13–16 million gallons) per year. Sewage flows directly into 10 aboveground 28,000-liter (7,500-gallon) tanks, where the sewage is sampled for radionuclides before shipment by tanker truck to a publicly owned treatment work in Andrews, Texas. Sewage holding tanks are added as new personnel facilities are added. Wastewater, primarily landfill leachate, is treated in the wastewater treatment unit (Reavis 2009b).

Estimated annual water use was about 24.7 million liters (6.5 million gallons) in 2008. Total sanitary wastewater generated is estimated to be 1 million liters (270 thousand gallons) per year. An estimated 290,000 liters (76,000 gallons) of process wastewater is treated annually in an onsite wastewater treatment unit (Reavis 2009a, 2009b).

3.8.8 Waste Management

WCS operates a 541-hectare (1,338-acre) waste disposal facility capable of managing the following waste forms: TRU waste, mixed TRU waste, LLW, MLLW, hazardous waste, and nonhazardous waste. The WCS property is licensed by the Texas Commission on Environmental Quality for the following waste management facilities (WCS 2007a, 2009a):

- An RCRA storage, processing, and disposal facility (RCRA Subtitle C landfill)
- A TSCA treatment, storage, and disposal facility

- A radioactive waste treatment, storage, and near-surface disposal facility for LLW (Federal and Texas compact material only)
- An NRC-exempt facility to treat and store special nuclear material
- A nuclear byproduct material receipt and disposal facility (as defined in Title 30 of the *Texas Administrative Code*, Section 336.1105)

WCS operations are supported by multiple facilities, including various radiological and RCRA/TSCA treatment/processing facilities, multiple storage buildings with a capacity to store 50,970 cubic meters (66,664 cubic yards) of material, an RCRA/TSCA landfill with a capacity of 4.1 million cubic meters (5.4 million cubic yards), a LLW/MLLW/TRU shallow landfill, and a site water treatment plant (WCS 2007a, 2009a).

3.8.8.1 Waste Generation and Management

Table 3–22 summarizes recent waste management activities for waste received at WCS. Although WCS is permitted to manage multiple radioactive waste streams, no Federal LLW or byproduct waste has been received for disposal. WCS received 19,995 cubic meters (26,150 cubic yards) of LLW in 3,776 canisters from the DOE Fernald former uranium processing facility for storage in 2005. The Fernald canisters will ultimately be disposed of in the newly permitted byproduct WCS landfill (WCS 2009a).

Table 3–22. Waste Received and Managed at Waste Control Specialists Site, 2006–2008

Waste Type	2006	2007	2008
	(metric tons)		
RCRA/TSCA hazardous	14	203	132
TCEQ Class 1	29,017	5,388	3,098
TCEQ Class 2	0	1	1
Railroad Commission of Texas designated	1	7	0
Municipal	0	92	146

Note: Waste received is treated and stabilized, as required, and disposed of in an RCRA-permitted landfill. Waste amounts do not include secondary waste generated during treatment or waste generated from active site remediation efforts. Low-level radioactive waste (byproduct waste) was received prior to 2006 for storage only. To convert metric tons to tons, multiply by 1.1023.

Key: RCRA=Resource Conservation and Recovery Act; TCEQ=Texas Commission on Environmental Quality; TSCA=Toxic Substances Control Act.

Source: WCS 2009a.

To date, the WCS-permitted RCRA/TSCA landfill has received 324,281 cubic meters (424,127 cubic yards) of material for disposal (approximately 7.8 percent of the landfill capacity) (WCS 2009a). The site wastewater treatment plant primarily treats leachate from the RCRA/TSCA landfill and collected stormwater. In 2008, the wastewater plant treated 288,638 liters (76,250 gallons) of leachate and stormwater.

Nonhazardous wastes generated at WCS includes construction and maintenance waste (e.g., wood, concrete, metal objects, soil, and roofing materials), office waste, lunchroom waste, and janitorial waste. Nonhazardous waste generated is collected by a commercial waste–hauling contractor and disposed of at the Lea County Landfill in New Mexico. Sanitary wastewater generated at WCS is collected in large aboveground storage tanks and disposed of off site using a commercial sanitary waste contractor.

3.8.8.2 Waste Minimization

WCS has an active Waste Minimization and Pollution Prevention Program to reduce the total amount of waste generated and disposed of at WCS. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal (WCS 2009a).

3.8.9 Occupational and Public Health and Safety

3.8.9.1 Normal Operations

WCS contains facilities for storage of radioactive and toxic wastes and land disposal facilities for hazardous and toxic wastes (WCS 2008b:8-9). Soil and groundwater conditions are described in Sections 3.8.2.2 and 3.8.3.2.

3.8.9.2 Facility Accidents

WCS has had no spills, fires, explosions, leaks, or other such incidents that have resulted in offsite impacts. Spills and leaks from waste containers and equipment have occurred in the operational area of the site with only localized spread of released material (WCS 2009b). Various hypothetical accidents have been evaluated by WCS, including fires, explosions, material releases, equipment or vehicle accidents, and natural events (WCS 2008b:11-13).

WCS has an established *Consolidated Emergency Response Plan* to maintain adequate preparedness for fire and hazardous materials releases (WCS 2008b:22). The site has a full emergency response organization that includes capabilities for radiological, hazardous materials, fire, and medical incidents. Onsite equipment includes a fully equipped mobile response trailer and fire truck. Emergency personnel include State of Texas certified emergency medical technicians and two fully trained and qualified firefighters. Additionally, offsite first responders participate in annual drills (WCS 2009b).

3.8.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to the site and employee traffic. These include death or injury from accidental release of nonradioactive and radioactive materials, effects of air pollutants and low levels of radiation emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of nonradioactive or radioactive materials. Risks related to nonradioactive transportation to WCS and to normal radioactive transportation of LLW to WCS were evaluated in the *Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste.* The total annual average population dose would be about 133 person-rem for shipment of LLW from utilities, assuming drum shipments use commercial routing and cask shipments use population-constrained routing. For shipments from major non-utility commercial LLW generators, the total average annual population dose would be 17 person-rem from an average of 7.26 equivalent full shipments annually. For shipments from major DOE LLW generators, the total average annual population dose would be 57 person-rem from an average of 4,436 equivalent full shipments annually (for an average of 0.013 person-rem per shipment) (WCS 2007a:11.7-19–24). Risks related to radiological transportation were estimated, using the currently recommended dose conversion factor, to be about 0.1 latent cancer fatalities per year in the total affected population.

Based on a daily trip rate of approximately 347 trips per working day in the vicinity of WCS, an accident rate of 1.123×10^{-6} per mile, and an average distance of 56 kilometers (35 miles) (the distance from WCS to Andrews) per trip, it was estimated that the WCS-generated traffic near WCS would result in about 123 additional accidents over the 35-year anticipated operating life of the WCS facility (WCS 2007a:11.7-32).

3.8.10 Socioeconomics

WCS is located approximately 50 kilometers (31 miles) west of Andrews, Texas, near the Texas–New Mexico state line. As of 2009, WCS employed approximately 150 persons. Approximately 90 percent of the people employed at WCS reside in two counties: Andrews in Texas and Lea in New Mexico (WCS 2009b). Therefore, these two counties are identified as the ROI in this socioeconomics analysis.

3.8.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of the two-county ROI increased by 30 percent to 36,626. By July 2009, the unemployment rate of the ROI was 8.0 percent, slightly lower than the unemployment rate across the two-state region of Texas and New Mexico (8.2 percent) (BLS 2009).

3.8.10.2 Demographic and Housing Characteristics

In 2008, the estimated population of the two-county ROI was 72,800. From 2000 to 2008, the ROI population grew by 6.3 percent, compared with 16.1 percent growth throughout the two-state region of Texas and New Mexico (DOC 2009b). In 2000, the percentage of the ROI population under the age of 18 was 30 percent; women ages 18 to 39 composed 14 percent (DOC 2009d). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. There were 29,624 housing units in the ROI in 2007, an increase of 2.8 percent from 2000 (DOC 2008). In 2000, 62.4 percent of housing units in the ROI were owner occupied, 22 percent were renter occupied, and 16 percent were vacant (DOC 2009d).

3.8.10.3 Local Transportation

The primary route into WCS is Texas State Highway 176, which serves as a major east-west route connecting to New Mexico State Road 176 to the west and the city of Andrews, Texas, to the east. U.S. Route 385 and Ranch Road 181 are the main north-south routes in Andrews County. Both of these routes connect to Texas State Highway 176 east of WCS. The average daily traffic volume on the segment of Texas State Highway 176 west of the site to the state line was 2,700 vehicles per day in 2007 (TXDOT 2009). In 2004, the segment of New Mexico State Road 176 from the state line west toward New Mexico State Road 209 and the outskirts of Eunice had an average daily traffic volume of 2,250 vehicles per day (NMDOT 2009). The average daily traffic on Texas State Highway 176 was 3,000 vehicles per day to the east of the site approaching Ranch Road 181, and 2,700 vehicles per day from Ranch Road 181 approaching the city of Andrews, where it intersects U.S. Route 385. The average daily traffic volume on Ranch Road 181 was 650 vehicles per day north of Texas State Highway 176 and 1,150 south of 176 (TXDOT 2009). A rail line services WCS from the west that connects to the Texas–New Mexico Railroad approximately 10 kilometers (6 miles) west of the site near Eunice, New Mexico. This line connects to the Union Pacific line in Monohans, Texas (WCS 2007b:10). The closest commercial airport to WCS is the Lea County Regional Airport located in the city of Hobbs, New Mexico. This airport is operated by Lea County along with two general aviation facilities located adjacent to the cities of Jal and Lovington. There are two other general aviation airports in the region: the Andrews County Airport, owned and operated by Andrews County, and Gaines County Airport, owned and operated by Gaines County. The airport formerly operating in Eunice was closed in 2007 (NMDOT 2009).

3.8.11 Environmental Justice

The 16-kilometer (10-mile) radius the storage location at WCS encompasses parts of three counties: Andrews and Gaines in Texas and Lea in New Mexico. Figure 3–24 shows populations residing in the three-county area, as reported in the 1990 and 2000 censuses (DOC 2009d, 2009e). In this figure, lightly shaded bars show populations in 1990, while the darker bars show those in 2000. In the decade between

1990 and 2000, the total population of Andrews, Gaines, and Lea Counties decreased by approximately 1.5 percent to 82,982, while the minority population increased by approximately 24 percent to 36,880, and the low-income population decreased by approximately 11 percent to 16,553. Demographic data from the 2000 census show that the White Hispanic population accounts for approximately 35 percent of the total minority population, while those people self-identified as "some other race" (meaning those who provided write-in entries such as Mexican, Puerto Rican, or Cuban) residing in the three-county area accounted for approximately 47 percent of the total minority population. Persons who declared that they are of Hispanic or Latino origin are included in the "total Hispanic" population shown in Figure 3–24, regardless of race. They composed approximately 88 percent of the total minority population residing in Andrews, Gaines, and Lea Counties in 2000.

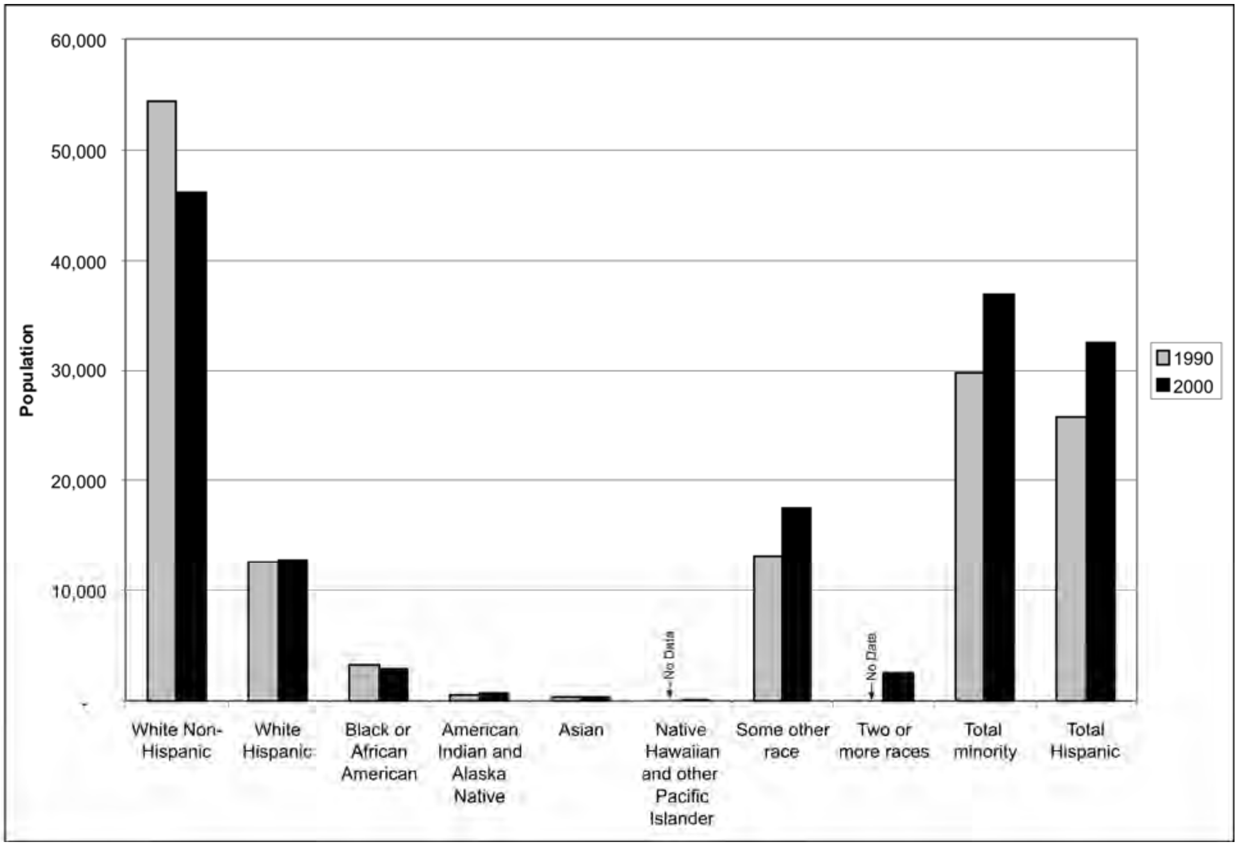


Figure 3–24. Populations Residing in the Three-County Area Surrounding Waste Control Specialists Site in 1990 and 2000

Data for Andrews, Gaines, and Lea Counties are unavailable from the *2007 ACS 1-Year Estimates* due to the population threshold of 65,000 necessary for inclusion. Data for Andrews and Gaines Counties are unavailable from the *2005–2007 ACS 3-Year Estimates* due to a population threshold of 20,000 people. However, the 3-year estimates do report data for Lea County. According to the *2005–2007 ACS 3-Year Estimates*, the total population of Lea County increased by approximately 3 percent to 56,998, and the low-income population decreased by approximately 17 percent to 9,405 since 2000. Detailed demographic data of race and Hispanic origin for Lea County from the *2005–2007 ACS 3-Year Estimates* are unavailable due to an insufficient number of sample cases.

Approximately 2,900 people lived within 16 kilometers (10 miles) of WCS in 2000 (DOC 2009d). This area included an estimated 40 percent minority and 17 percent low-income population. By comparison, the three-county area included a 44 percent minority and 20 percent low-income population and the two-state region of Texas and New Mexico included a 48 percent minority and 16 percent low-income population. There are eight census block groups located within the 16-kilometer (10-mile) radius surrounding WCS, one of which contained a disproportionately high number of minority individuals; none contained a disproportionately high number of low-income individuals. Figure 3–25 shows the proximity of the identified minority community to WCS. Figure 3–26 shows the cumulative populations living at a given distance from WCS. The population living within 16 kilometers (10 miles) of WCS is mostly concentrated to the west in the city of Eunice.

Approximately 20 people lived within approximately 3.2 kilometers (2 miles) of WCS in 2000 (DOC 2009d). This area included an estimated 27 percent minority and 6 percent low-income population. There are two census block groups located within this ROI; of this total, none contained a disproportionately high number of minority or low-income individuals.

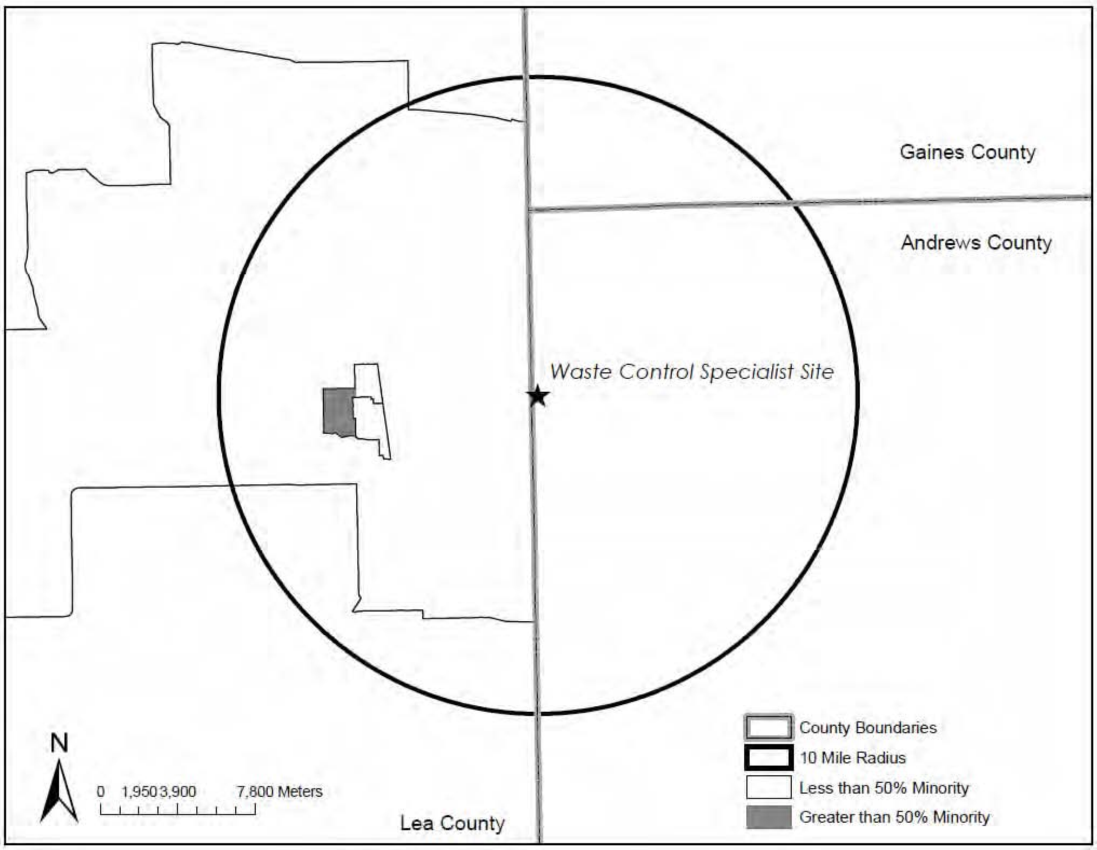


Figure 3–25. Block Group Containing Minority Populations Surrounding Waste Control Specialists Site

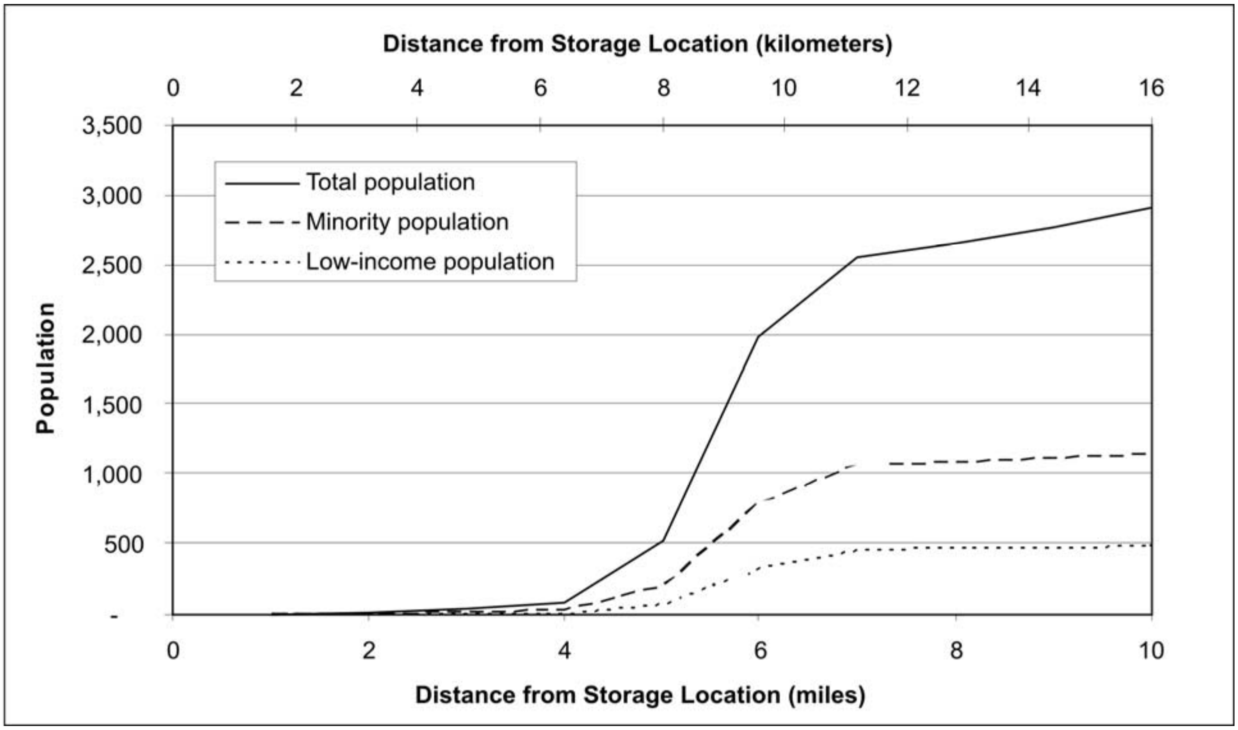


Figure 3–26. Cumulative Populations Residing Within 16 Kilometers (10 Miles) of Waste Control Specialists Site

POTENTIALLY SUSCEPTIBLE POPULATIONS

Environmental justice concerns were considered in greater detail in areas that have been identified as containing a disproportionately high number of minority or low-income individuals. This section presents information regarding factors that may contribute to disproportional impacts, such as age and access to health care.

Figure 3–27 displays a breakdown of potentially susceptible demographics for the 16-kilometer (10-mile) ROI, the 3.2-kilometer (2-mile) ROI, the two-state region, and the three-county region. For purposes of this analysis, the demographics of primary concern are children under the age of 18, women ages 18 to 39, and individuals ages 65 and up. The populations of children under 18 living within the 16-kilometer (10-mile) and 3.2-kilometer (2-mile) ROIs slightly exceed that living in the two-state region. The populations of women ages 18 to 39 living in the two ROIs appear to be consistent with the surrounding three-county and two-state regions, and the populations of individuals ages 65 and up living in the two ROIs slightly exceed that of the surrounding areas. None of the differences appear to be appreciable.

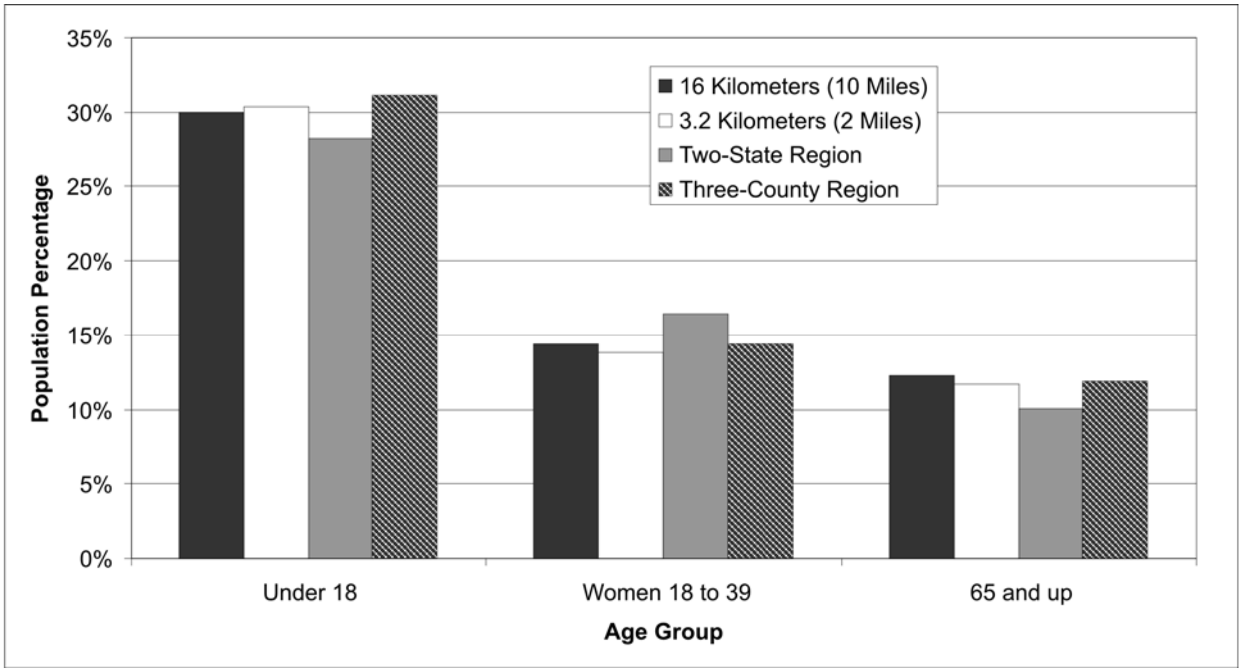


Figure 3–27. Percentage of Age Groups Within the 16-Kilometer (10-Mile) and 3.2-Kilometer (2-Mile) Regions of Influence and the Two-State and Three-County Areas Surrounding Waste Control Specialists Site

HPSAs are designated by the Health Resources and Services Administration. These data are presented at the greatest level of spatial resolution available for each county within the 16-kilometer (10-mile) ROI. Andrews County is designated as a primary medical care HPSA for low-income populations; the entire county is designated as a mental health HPSA. There are no dental HPSA designations in Andrews County. All of Gaines and Lea Counties are designated as primary medical care, dental, and mental health HPSAs (HRSA 2009b).

3.9 Y–12 NATIONAL SECURITY COMPLEX

3.9.1 Land and Visual Resources

3.9.1.1 Land Use

Y–12 is an industrial site that has been in operation since World War II. It is one of the three principal industrial sites within the 14,164-hectare (35,000-acre) Oak Ridge Reservation (ORR). Y–12 is situated in Bear Creek Valley at the eastern boundary of ORR. It is bounded by Pine Ridge to the north and Chestnut Ridge to the south. The main area of Y–12 is classified as industrial and encompasses approximately 324 hectares (800 acres) of numerous support, manufacturing, and storage facilities located in central and west-central portions of the site. The eastern portion of Y–12 is occupied by Lake Reality and the former New Hope Pond (now closed), maintenance facilities, office space, and training facilities. The far western portion of the site consists primarily of waste management facilities and construction contractor support areas (DLA 2004:3-68; DOE 2001c:4-12; 2008e:4-383; 2009g:4-5).

Lands bordering ORR and Y–12 are predominantly rural and are used primarily for residences, small farms, forest land, and pasture land. The residential section of the city of Oak Ridge forms the northern boundary of ORR (DOE 2009g:4-2).

3.9.1.2 Visual Resources

The landscape at ORR is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The viewshed around the site consists mainly of rural land. Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric conditions (DOE 2009g:4-7).

The developed areas of ORR, including Y–12, are consistent with BLM's VRM Class IV. Class IV includes areas in which major modifications to the character of the landscape have occurred. These changes may be dominant features of the view and the major focus of viewer attention (DOI 1986:App. 2). At Y–12, most structures are of a low profile and reach heights of three stories or less.

3.9.2 Geology, Soils, and Geologic Hazards

3.9.2.1 Geology

ORR lies in the southwestern portion of the Valley and Ridge Physiographic Province of east-central Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys. Y–12 is located in Bear Creek Valley between Pine and Chestnut Ridges (DOE 2009g:4-13, 4-14). Most of Y–12 lies at an elevation of approximately 305 meters (1,000 feet) above mean sea level (DLA 2004:3-59).

Unconsolidated materials across the valley and the Upper East Fork Poplar Creek watershed, which drains most of Y–12, include Holocene (recent) alluvium (streamlaid deposits), colluvium (material transported downslope), manmade fill, fine-grained residuum from the weathering of the underlying bedrock, saprolite (a transitional mixture of fine-grained residuum and bedrock remains), and weathered bedrock. The overall thickness of these materials in the Y–12 area is typically less than 12 meters (40 feet). In the undeveloped areas of the site, the saprolite retains primary textural features of the unweathered bedrock, including fractures (DOE 2009g:4-17).

Bedrock comprising the Cambrian age Conasauga Group underlies the valley. The upper part of the group is mainly limestone, while the lower units consist mostly of shale. Karst features, including large fractures, cavities, and conduits, are typically found at depths greater than approximately 300 meters (980 feet) (DOE 2009g:4-13, 4-14).

3.9.2.2 Soils

Developed portions of Bear Creek Valley are designated as urban land in the county soil survey. Due to extensive cut-and-fill grading during construction of Y–12, very few areas have natural soil horizons. Alluvium, colluvium, manmade fill, fine-drained residuum from the weathering of the underling bedrock, saprolite, and weathered bedrock mainly compose the surficial materials across Y–12 (DOE 2009g:4-19).

3.9.2.3 Geologic Hazards

There is no evidence of active faults in the Valley and Ridge Physiographic Province or within the sedimentary rocks comprising the Appalachian Basin structural feature, where ORR is located. The nearest active faults are approximately 480 kilometers (298 miles) northwest of ORR in the New Madrid (Reelfoot rift) fault zone (see Section 3.6.2.3). Historical earthquakes occurring in the Valley and Ridge of Tennessee are not attributable to fault structures in underlying sedimentary rocks, but rather occur at depth in basement rock (DLA 2004:3-59).

The closest large earthquake in eastern Tennessee occurred on November 30, 1973, in Maryville, Tennessee. It had a local magnitude of 4.6 with an epicenter located about 34 kilometers (21 miles) southeast of Y–12. This earthquake produced an MMI of V to VI at ORR (DLA 2004:3-60;

USGS 2009n). Since the 1973 Maryville earthquake, 61 earthquakes have been recorded within 100 kilometers (62 miles) of Y–12, generally ranging in magnitude from 2.6 to 4.2 (USGS 2009n). Appendix B, Table B–4, summarizes and compares the parameters cited in this *Mercury Storage EIS* to describe earthquakes and their effects.

As previously described in Section 3.2.2.3, the latest probabilistic PGA data from the USGS are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual probability (chance) of occurrence of about 1 in 2,500. For Y–12, the calculated PGA is approximately 0.22 *g* (USGS 2009d).

3.9.3 Water Resources

3.9.3.1 Surface Water

Upper East Fork Poplar Creek drains the majority of the industrial facilities within Y–12 and has been radically altered from its natural state by the construction of facilities at the site. The western portion of the creek flows underground through pipes, and the remaining portion flows in a modified and straightened channel lined with riprap and concrete. To maintain a minimum flow equivalent to 26 million liters (7 million gallons) per day and to improve downstream water quality, raw water from the Clinch River has been added to the western portion of the open channel. This flow augmentation was stipulated under the Y–12 1995 NPDES permit. Drainage from Y–12 enters both Bear Creek and East Fork Poplar Creek. These streams ultimately converge and enter Poplar Creek approximately 13 kilometers (8 miles) east of the site. Poplar Creek then flows into the Clinch River about 19 kilometers (12 miles) southeast of Y–12 (DLA 2004:3-62; DOE 2008f:4-52).

The Clinch River is the only surface-water body on or near ORR classified for domestic water supply use. Classifications for all streams in Tennessee are for fish and aquatic life, recreation, irrigation, livestock watering, and wildlife. In addition, the Clinch River and a short segment of Poplar Creek from its confluence with the Clinch River are classified for industrial water supply use. From its mouth to mile 15, East Fork Poplar Creek, is posted with public health warnings from the State of Tennessee against fish consumption and water contact due to bacterial contamination, mercury, and PCB contamination (TDEC 2008).

Approximately 65 outfalls from Y–12 are subject to compliance monitoring under its NPDES permit (TN0002968). Under the permit, DOE must also maintain a stormwater pollution prevention plan to minimize the discharge of pollutants in stormwater runoff, and results of stormwater monitoring are provided in the annual stormwater report, which is submitted to the Tennessee Division of Water Pollution Control. Sanitary wastewater from Y–12 is discharged to the City of Oak Ridge publicly owned treatment works under Industrial and Commercial Users Wastewater Permit Number 1-91 (DOE 2008f:4-45, 4-46, 4-50–4-53).

Ambient surface-water quality in Upper East Fork Poplar Creek has been affected primarily by Y–12 legacy operations from the late 1940s to the early 1980s. Contaminants include mercury, PCBs, and uranium isotopes, which have also been found at detectable concentrations in stream sediments. Surface-water surveillance monitoring continues to be conducted as a best management practice (DOE 2008f:4.53).

The Tennessee Valley Authority has conducted floodplain studies along Bear Creek, Clinch River, and East Fork Poplar Creek. Some easternmost portions of Y–12 lie within the 100- and 500-year floodplains of East Fork Poplar Creek. However, the current mercury storage location is located outside of the 500-year floodplain (DOE 2009g:4-47, 4-49).

3.9.3.2 Groundwater

Y–12 is divided into three hydrogeologic regimes, which are mainly delineated by surface-water drainage patterns, topography, and groundwater flow characteristics. These regimes include the Bear Creek hydrogeologic regime; the Upper East Fork Poplar Creek hydrogeologic regime, in which the majority of the Y–12 complex is located; and the Chestnut Ridge hydrogeologic regime. Most of the Bear Creek and Upper East Fork Poplar Creek regimes are underlain by geologic formations that are part of the ORR aquitard. Collectively, the units composing the aquitard have low permeability and low transmissivity; water is not easily transmitted through these formations (DOE 2009g:4-32, 4-33).

In general, nearsurface (shallow) groundwater flow follows topography at Y–12. Shallow groundwater flow in the Bear Creek regime and the Upper East Fork Poplar Creek regime is divergent from a topographic and groundwater divide located near the western end of Y–12 that defines the boundary between the two regimes. In addition, flow converges on the primary surface streams (Bear Creek and Upper East Fork Poplar Creek) from Pine Ridge and Chestnut Ridge. In Bear Creek Valley, groundwater in the intermediate and deep intervals moves predominantly through fractures in ORR aquitards, converging on and then moving through fractures and solution conduits in the Maynardville Limestone. Karst development in the Maynardville Limestone has a significant impact on groundwater flow paths in the shallow and intermediate intervals. In general, groundwater flow parallels the valley and geologic strike (DOE 2009g:4-33, 4-34).

In Bear Creek Valley, the depth to groundwater is generally about 6 to 9 meters (20 to 30 feet) (DLA 2004:3-64). Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at Y–12. Industrial and drinking water supplies are taken primarily from surfacewater sources; however, single-family wells are common in adjacent rural areas not served by the public water supply system. Most of the residential wells in the immediate vicinity of Y–12 are south of the Clinch River (DOE 2009h:4-36). Aquifers would be considered Class II (current or potential sources of drinking water or other beneficial use).

Groundwater monitoring at Y–12 has shown that the groundwater quality has been affected by nitrate, VOCs, metals, and radionuclides, with nitrate and VOCs being the most widespread contaminants. Some radionuclides are also present, particularly in the Bear Creek hydrogeologic regime and the western portion of the Upper East Fork Poplar Creek regime (DLA 2004:3-64; DOE 2008f:4-63–4-65, 4-67). Groundwater monitoring conducted in 2007 continues to show that concentrations of nine different metals (barium, beryllium, cadmium, chromium, lead, mercury, nickel, thallium, and uranium) exceeded MCLs in groundwater wells and in surface-water locations downgradient of the S-2 Site, the S-3 Site, and the Salvage Yard source areas, and throughout Y–12. Some metals, such as mercury and uranium, are being transported through the surface-water and groundwater systems and have been observed in concentrations above standards some distance from source areas (DOE 2008f:4-65–4-69). Groundwater contamination at the site is associated with past industrial and waste disposal activities and is not associated with the current storage of DOE elemental mercury.

3.9.4 Meteorology, Air Quality, and Noise

3.9.4.1 Meteorology and Air Quality

The mean annual temperature for the ORR area is 14.2 °C (57.6 °F). Local winters consist of migratory cyclones that produce significant precipitation events every 3 to 5 days. The coldest month is usually January, with an average temperature of about 2.6 °C (36.7 °F) and low temperatures that occasionally drop as low as –31 °C (–23.8 °F). Summers are characterized by warm, humid conditions. July is typically the hottest month of the year with an average temperature of about 25.2 °C (77.4 °F) and high temperatures that occasionally exceed 38 °C (100 °F) (DOE 2008f:4-389).

The annual average precipitation is 140 centimeters (55 inches), which includes about 24 centimeters (9.6 inches) of snowfall. Precipitation in the region is greatest in the winter months, December through February. Precipitation in the spring exceeds the summer rainfall, but the summer rainfall may be locally heavy because of thunderstorm activity. The driest periods generally occur during the fall months when high-pressure systems are most frequent (DOE 2008f:4-389–4-390).

Severe weather events in the area include flash floods, high winds, hail, and occasional snow and ice. During a 60-year period of record, Anderson County reported three tornadoes (NCDC 2009g). The maximum windspeed, based on the highest 1-minute average, is 29 meters per second (64 miles per hour) (NOAA 2009b:69).

ORR is located in Anderson and Roane Counties in the Eastern Tennessee–Southwestern Virginia Air Quality Control Region No. 207, and Y–12 is completely within Anderson County. EPA has designated Anderson County as a nonattainment area for the 8-hour ozone standard, as part of the larger Knoxville 8-hour ozone nonattainment area that encompasses several counties. Anderson County is also designated nonattainment for $PM_{2.5}$. For all other criteria pollutants for which EPA has made attainment designations, the ORR area is designated as attainment with the NAAQS (40 CFR 81.343).

Airborne discharges from ORR facilities, both radioactive and nonradioactive, are subject to regulation by EPA, the Tennessee Department of Environment and Conservation Division of Air Pollution Control, and DOE orders. The primary source of criteria air pollutants at Y–12 is the steam plant, where coal and natural gas are burned. In fact, more than 90 percent of the Y–12 air pollutant emissions to the atmosphere are attributed to the operation of the steam plant. Actual emissions from the steam plant are well below allowable emissions (DOE 2008c:4-390).

Concentrations of regulated pollutants observed at locations near ORR are presented in the annual environmental report (DOE 2008c:4-40–4-45). Monitoring results indicate that the ORR operations have an insignificant effect on local air quality (DOE 2008f:4-390).

The nearest PSD Class I area is Great Smoky Mountains National Park, about 51 kilometers (32 miles) to the southeast. Y–12 and its vicinity are classified as a PSD Class II area (DOE 2001c:4-56).

The release of radiological contaminants, primarily uranium, into the atmosphere at Y–12 occurs as a result of plant production, maintenance, and waste management activities. Atmospheric emissions of radionuclides from DOE facilities are limited by EPA regulations found under the National Emission Standards for Hazardous Air Pollutants regulations (40 CFR 61.90–61.97), which have been delegated to the Tennessee Department of Environment and Conservation for implementation. All three ORR facilities are operated in accordance with the Tennessee regulatory dose limits for hazardous air pollutants for radionuclides and have met all emission and test procedures (DOE 2008c:4-390). Details on the annual radionuclide compliance modeling and other National Emission Standards for Hazardous Air Pollutants that cover asbestos and specific source categories on ORR are reported in the *Oak Ridge Reservation Annual Site Environmental Report for 2007* (DOE 2008f:7-1–7-6).

3.9.4.2 Noise

Major noise sources within Y–12 include various industrial facilities and equipment and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, vehicles). Most Y–12 industrial facilities are at a sufficient distance from the site boundary so that noise levels at the boundary from these sources are not distinguishable from background noise levels. The acoustic environment along the Y–12 boundary, in rural areas, and at nearby residences away from traffic noise, is typical of a rural location with a day-night average sound level in the range of 35 to 50 dBA. Areas near the site within the city of Oak Ridge are typical of a suburban area, with a day-night average sound level in the range of 53 to 62 dBA. Traffic is the primary source of noise at the Y–12 boundary and at residences located near roads. During peak hours, the Y–12 worker traffic is a major contributor to traffic noise levels in the area (DOE 2008c:4-392). The nearest residences are about 0.5 kilometers (0.3 miles) north of Bear Creek Road and are separated from Y–12 by a ridge.

3.9.5 Ecological Resources

3.9.5.1 Terrestrial Resources

ORR consists of approximately 14,164 hectares (35,000 acres) of eastern deciduous and mixed hardwood forest. Forested land within the site is composed largely of oak-hickory stands with lesser quantities of pine-hardwood and pine. Large sections of land have been designated as protected natural areas, including a 1,416-hectare (3,500-acre) parcel on the western side of the site (DLA 2004:3-64; DOE 2008c:4-398).

Within ORR, 39 species of mammals, 260 species of birds, and 59 species of reptiles and amphibians have been recorded. Common mammals include the opossum, raccoon, and red fox. Common resident bird species include the summer tanager and yellow-throated vireo, while migratory species include the scarlet tanager and Philadelphia vireo. Reptiles represented at ORR include the common garter snake, southern ring-necked snake, and copperhead. Amphibians include the bullfrog, southern leopard frog, and spring peeper (DLA 2004:3-64; DOE 2008c:4-398).

Y–12 consists of 328 hectares (811 acres) of mowed grass, concrete, gravel, asphalt, and industrial structures. Thus, the site lacks unique habitats and contains little diversity in flora and fauna. Plant species encountered within Y–12 are typical of a disturbed and developed landscape. Such species include grasses, common plantain, and dandelion. Animal species within the vicinity of the proposed mercury storage facility at Y–12 are limited to those tolerant of human activities and are likely to include house sparrow, pigeon, and raccoon (DLA 2004:3-64; DOE 2008c:4-398).

3.9.5.2 Wetlands

Approximately 243 hectares (600 acres) of wetlands have been identified at ORR. Most of these are classified as forested palustrine, scrub-shrub, and emergent wetlands. There is an emergent wetland (0.18 hectares [0.45 acres]) at the eastern end of Y–12 at a seep by a small tributary of East Fork Poplar Creek. The wetland receives effluent from an NPDES outfall (DLA 2004:3-65; DOE 2008c:4-399).

3.9.5.3 Aquatic Resources

The Clinch River is the main aquatic resource found within ORR. The Clinch River supports a diverse fishery, including largemouth bass, channel catfish, and carp. Although sport fishing is not allowed within ORR, it is permitted downstream of the Melton Hill Dam. Within Y–12, aquatic resources are limited to drainage basins, retention ponds, and other manmade structures. The closest natural water feature to the proposed mercury storage facility is Bear Creek, which flows along the southern boundary of Y–12 (DLA 2004:3-65; DOE 2008c:4-399).

3.9.5.4 Threatened and Endangered Species

ORR is home to several federally and state-protected plant and animal species. Two federally listed vertebrate species are known to occur at ORR: the endangered gray bat and the threatened spotfin chub. State-listed mammals include the endangered peregrine falcon. No federally listed vascular plants occur on site, although several state-listed species, including the endangered pink lady's-slipper, tall larkspur, and fen orchid, have been recorded. Table 3–23 lists all sensitive species potentially occurring at ORR (DLA 2004:3-65-66; DOE 2008c:4-400-402).

Within Y–12, no protected species are known or expected to occur (DLA 2004:3-66).

Table 3–23. Federally and State-Listed Species Potentially Occurring at the Oak Ridge Reservation

Common Name	Scientific Name	Federal Status	State Status
Plants			
Spreading false-foxglove	*Aureolaria patula*		Threatened
Appalachian bugbane	*Curiesmicifuga rubifolia*		Threatened
Pink lady's-slipper	*Cypripedium acaule*		Endangered
Tall larkspur	*Delphinium exaltatum*		Endangered
Northern bushhoneysuckle	*Diervilla lonicera*		Threatened
Mountain witch-alder	*Fothergilla major*		Threatened
Butternut	*Juglans cinerea*		Threatened
Canada lily	*Lilium canadense*		Threatened
Michigan lily	*Lilium michiganense*		Threatened
Fen orchid	*Liparis loeselii*		Endangered
Tuberculed rein-orchid	*Platanthera flava var. herbiola*		Threatened
Shining ladies-tresses	*Spiranthes lucida*		Threatened
Animals			
Spotfin chub	*Cyprinella monacha*	Threatened	Threatened
Peregrine falcon	*Falco peregrinus*		Endangered
Gray bat	*Myotis grisescens*	Endangered	Endangered

Source: DOE 2008c:Table 4.9.7-1.

3.9.6 Cultural and Paleontological Resources

About 90 percent of ORR has been surveyed on a reconnaissance level for prehistoric and historic archaeological resources, but less than 5 percent has been intensely surveyed. There have been several archaeological surveys conducted at Y–12 in the past (DOE 2008c:4-403).

3.9.6.1 Prehistoric Resources

Human occupation and the use of the East Tennessee Valley between the Cumberland Mountains and the southern Appalachians are believed to date back to the Late Pleistocene epoch, at least 14,000 years ago. Archaeologists have traditionally believed that these Paleo-Indian bands subsisted primarily by hunting the large game of that era and collecting wild plant foods (DOE 2008c:4-402, 4-403).

During the Mississippian periods (900 A.D. to historic times), larger-scale permanent communities developed in the ORR region, first along the alluvial terraces, and later on the second river terraces in the rich bottomlands suitable for intensive agriculture. These communities included multiple structures, storage pits, hearths, mounds, stockades, plazas, and semi-subterranean earth lodges.

Forty-four prehistoric sites have been recorded within the boundaries of ORR. Y–12 contains only one known archaeological site (40AN68), which is located on a flat rise overlooking East Fork Poplar Creek. This site is not eligible for inclusion in the NRHP (DOE 2008c:4-403).

3.9.6.2 Historic Resources

While no cultural resources at Y–12 are listed in the NRHP, the site has 76 existing historic properties. The Tennessee SHPO has concurred with this determination. The district and its contributing properties are eligible under Criterion A for historical associations with the Manhattan Project, development as a nuclear weapons component plant within the post–World War II scientific movement, and early nuclear activities. The historic district is also eligible under Criterion C for the engineering merits of many of the properties and their contributions to science.

There are at least 32 cemeteries located within the boundaries of the ORR, 7 of which are located on the Y–12. These cemeteries are associated with the European-American use of the area prior to World War II and are likely to have religious or cultural importance to descendants and the local community. All are currently maintained and protected. No other traditional, ethnic, or religious resources have been identified on the Y–12 (DOE 2008c:4-404).

3.9.6.3 American Indian Resources

Ancestors of the Eastern Band of the Cherokee Indians and the Cherokee Nation of Oklahoma may be culturally affiliated with the prehistoric use of ORR area. The Overhill Cherokee occupied the surrounding area by the late 1700s. Their subsistence was based on hunting, gathering, and horticulture. Residences had both summer and winter structures. Most of the Cherokee people were relocated to the Oklahoma Territory in 1838 (DOE 1996c:4-31).

Procedures for consulting with the Cherokee regarding traditional cultural places are in place. No American Indian traditional use areas or religious sites are known to be present on Y–12. Also, no artifacts of American Indian religious significance are known to exist or to have been removed from Y–12 (DOE 2008c:4-404).

3.9.6.4 Paleontological Resources

The area is underlain by bedrock formations dominated by calcareous siltstones, limestones, sandstones, siliceous shales, and siliceous dolostones. The majority of geologic units with surface exposures contain paleontological materials. All of these paleontological materials consist of common invertebrate remains, which are unlikely to be unique compared with those available throughout the east Tennessee region.

3.9.7 Site Infrastructure

3.9.7.1 Ground Transportation

Y–12 is located on ORR in Anderson County, Tennessee, approximately 29 kilometers (18 miles) west of the city of Knoxville. Y–12 contains 105 kilometers (65 miles) of roads ranging from well-maintained, paved roads to remote, seldom-used roads that provide occasional access. Primary roads serving Y–12 include Tennessee State Routes 58, 62, 95, and 170 and Bear Creek Road. In addition, Y–12 is located within 80 kilometers (50 miles) of three interstate highways: Interstates 40, 75, and 81. Rail transport to the site is from a 6.4-kilometer (4-mile) rail spur from the CSX main line, east of Oak Ridge (DOE 2009g). DOE maintains an additional 4.8 kilometers (3 miles) of rail at Y–12 (DLA 2004:3:69).

3.9.7.2 Electricity

Electric power is supplied to ORR by the Tennessee Valley Authority and is distributed to Y–12 via three 161-kilovolt overhead radial feeders. There are eleven 13.8-kilovolt distribution systems that range in size from 10 to 50 megavolt-amperes that distribute power to substations located at facilities throughout Y–12. In total, these distribution systems include approximately 48 kilometers (30 miles) of overhead lines, 16 kilometers (10 miles) of underground cable, and 740 pole- and pad-mounted transformers (DOE 2009g:4-8).

At Y–12, the average monthly power usage is less than 10 to 40 megawatts. The available capacity, approximately 430 megawatts, greatly exceeds current demands due to the fact that the original uses of the site required a large, robust electrical system to support the uranium enrichment mission. The change in mission from uranium enrichment to weapons manufacturing and subsequent evolution to the current mission has greatly reduced electrical requirements (DOE 2009g:4-9).

Y–12 has a significant emergency and standby power generator system. The emergency power system provides backup power to critical safety-related loads, such as the emergency egress lighting systems and the fire alarm system, as well as non-critical loads, such as security systems and mission-related process systems. The combined capacity of the emergency and standby power generator system is 2.6 megawatts (DOE 2009g:4-9).

The annual consumption at the site as a whole is 350,000 megawatt-hours; electrical capacity is 3,770,000 megawatt-hours (DOE 2009g).

3.9.7.3 Fuel

Both natural gas and coal are used as fuels for heating and operations at Y–12. Sigcorp Energy Services supplies natural gas to Y–12. Natural gas, which is used for furnaces, the Y–12 steam plant, and laboratories, is supplied via a pipeline from the East Tennessee Natural Gas Company at “C” Station located south of Bethel Valley Road near the eastern end of Y–12. It is distributed via pipelines of varying size throughout Y–12. Each boiler of the Y–12 steam plant is capable of firing on either pulverized coal or natural gas and includes two coal pulverizers and four burners. Coal for the steam plant is purchased regionally, delivered by truck, and stored in a bermed area near the plant (DOE 2009g:4-9, 4-10). Current site usage is 64,000 metric tons (70,550 tons) per year, while that of natural gas is 2.7 million cubic meters (97 million cubic feet) per year.

3.9.7.4 Water

Raw water for ORR is obtained from the Clinch River south of the eastern end of Y–12 and pumped to the water treatment plant located on the ridge northeast of Y–12. Ownership and operation of the treated water system was transferred from DOE to the City of Oak Ridge in April 2000. The water treatment plant can deliver water to two water storage reservoirs at a potential rate of

90.8 million liters (24 million gallons) per day. Water from the reservoirs is distributed to Y–12, Oak Ridge National Laboratory, and the City of Oak Ridge. Separate underground piping systems provide distribution of raw and treated water within Y–12. The primary use of the raw water is to maintain a minimum flow of 26.5 million liters (7 million gallons) per day in the East Fork Poplar Creek. The treated water system supplies water for fire protection, process operations, sanitary sewage requirements, and boiler feed at the steam plant (DOE 2009g:4-10).

Estimated annual treated water use was 5.9 billion liters (1.6 billion gallons) (DOE 2009g:4-10). Water capacity was 9.7 billion liters (2.6 billion gallons) (DLA 2004:3-68).

3.9.8 Waste Management

Y–12 is part of DOE's ORR, which also includes the East Tennessee Technology Park and Oak Ridge National Laboratory. In general, ORR environmental compliance and waste management activities are the responsibility of site contractors overseen by DOE's Environmental Management Program and other facility-specific government agencies (e.g., U.S. Department of Defense, NNSA). Across ORR, waste management programs, systems, and facilities have managed various forms of HLW, LLW, MLLW, TRU waste, and hazardous and nonhazardous waste streams (DOE 2008e).

As a function of routine onsite activity and ongoing site remediation efforts, Y–12 manages LLW, MLLW, hazardous waste, and nonhazardous waste. Y–12 does not generate HLW or TRU waste. All site wastes are managed in accordance with appropriate treatment, storage, and disposal technologies and in compliance with applicable Federal and state law. Y–12 is identified as an RCRA large-quantity generator. In general, waste management activities at Y–12 are the responsibility of NNSA and are regulated under the Tennessee Solid Waste Management Act (TCA 68-211-801 et seq.) and DOE's Records of Decision associated with the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 2008c).

Several waste treatment and disposal facilities are managed by DOE at Y–12. These facilities include multiple onsite nonhazardous landfills, a recently constructed above-grade CERCLA waste treatment and disposal facility in support of ongoing site remediation activity, and multiple wastewater treatment facilities that predominantly handle mercury-contaminated water discharges and remediation waste streams (DOE 2009h). Site disposal facilities are the responsibility of DOE's Environmental Management Program (DOE 2008c).

3.9.8.1 Hazardous Waste Generation and Management

Y–12 is currently the designated storage location of DOE's NNSA national defense stockpile of mercury. The mercury stockpile, located in a mercury-specific, single-story, slab-on-grade block/masonry building, includes 1,206 metric tons (1,329 tons) of mercury in 35,000 3-liter (0.8-gallon), 34.6-kilogram (76-pound) seamless carbon steel flasks. Mercury-contaminated waste (air monitoring equipment, personal protective equipment, spill rags, etc.) generated from maintaining the mercury stockpile is minimal. Mercury-contaminated waste from the stockpile is generally disposed of off site using licensed waste disposal contractors (DOE 2007e).

Y–12 RCRA-regulated waste is generated through a variety of production and maintenance operations. The major sources of hazardous wastes are plating rinse waters, waste oil, and solvents from machining and cleaning operations; contaminated soil, soil solutions, and soil materials from RCRA closure activities; and waste contaminated with hazardous constituents from construction and demolition activities (DOE 2008c). The majority of the 13 cubic meters (17 cubic yards) of RCRA-regulated waste generated per year is in solid form. Some hazardous waste may be treated on site and then disposed of as nonhazardous waste. The remaining hazardous waste is shipped off site for treatment and disposal at either DOE or commercial facilities (DLA 2004; DOE 2008c).

At Y–12, DOE's Oak Ridge Environmental Management Program oversees large mercury remediation activities as a result of historic mercury use at the site. These remediation efforts include the cleanup of an estimated 907 metric tons (1,000 tons) of released mercury in surrounding soils, sediments, streams, aquifers, and landfills across the site. Various remediation methods and support facilities are utilized at the Y–12 site to clean up mercury, including Big Springs Water Treatment Facility for wastewater treatment and Environmental Management Waste Management Facility for onsite CERCLA waste treatment and disposal (DOE 2009h, 2009i).

3.9.8.2 Waste Minimization

Y–12 has an active Waste Minimization and Pollution Prevention Program to reduce the total amount of waste generated and disposed of at the site. These minimization efforts are in compliance with DOE's ORR Office Pollution Prevention and Waste Minimization Program. This program focuses on eliminating waste by reducing waste sources, by substituting materials, by recycling potential waste materials that cannot be minimized or eliminated, and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. In 1999, Y–12 reported 38 pollution prevention projects, which resulted in a waste reduction of 8,283 cubic meters (10,833 cubic yards) (DOE 2001c).

3.9.9 Occupational and Public Health and Safety

3.9.9.1 Normal Operations

Activities at ORR have the potential to release hazardous chemicals and radionuclides to the environment. These releases could result in exposures of members of the public to low concentrations of chemicals or radionuclides. Monitoring and surveillance are used to show that doses from chemicals and radionuclides are in compliance with regulations. Recent estimates of doses from chemical and radionuclide releases are reported in the *Oak Ridge Reservation Annual Site Environmental Report for 2007*. There are several non-DOE-related sources of radiation exposure near ORR. Based on responses from owners of these sources, the annual dose to a member of the public from the DOE and non-DOE sources was well below any regulatory dose limit (DOE 2008f:7-1–7-20). Radiation doses to the public and to workers have been estimated and compared with the applicable criteria in the *Draft Site-Wide Environmental Impact Statement for the Y–12 National Security Complex* (DOE 2009g).

Reported ambient mercury concentrations at the two monitoring sites continue to be elevated above the reference site background level of 0.006 micrograms per cubic meter, but were well below the American Conference of Governmental Industrial Hygienists' threshold limit value of 25 micrograms per cubic meter and the EPA reference concentration of 0.3 micrograms per cubic meter for chronic-inhalation exposure (DOE 2008f:4-42, 4-43).

Concentrations of mercury in fish tissue collected near Y–12 have historically been elevated in East Fork Poplar Creek compared with concentrations in reference samples and samples taken from other streams near ORR. In 2007, the average mercury concentration in fish tissue from East Fork Poplar Creek was about 0.8 parts per million, which is above the Tennessee precautionary advisory level for mercury of 0.3 parts per million and within the EPA recommended consumption limit of one fish meal per month (greater than 0.47 through 0.94 parts per million for methylmercury) (DOE 2008f:4-58, 5-54, 6-15; EPA 2009i:4-5; TDEC 2007:7). Soil and groundwater conditions are described in Sections 3.9.2.2 and 3.9.3.2, respectively.

3.9.9.2 Facility Accidents

Accidents evaluated for the *Draft Site-Wide Environmental Impact Statement for the Y–12 National Security Complex* included wildfires, earthquakes, explosions, criticality events, fire events involving radioactive materials, and chemical accidents. The evaluation of hazardous chemicals at Y–12 concluded that no chemical impacts would cause adverse impacts beyond the site boundary (DOE 2009g:3-39, D-36–D-52).

DOE has established emergency response plans for Y–12 to maintain adequate response preparedness for fire and hazardous materials releases. Fire and emergency services are coordinated with offsite emergency organizations (DOE 2009g:3-39, D-40).

3.9.9.3 Transportation

There are a number of risks to the public and workers related to transporting materials to the site and employee traffic. These include death and injury from accidental release of nonradioactive and radioactive materials, effects of air pollutants and low levels of radiation emitted during normal (incident-free) transportation, and accidents resulting in death or injury where there is no release of nonradioactive or radioactive materials. Risks related to truck transportation of radioactive material to Y–12 were evaluated in the *Draft Site-Wide Environmental Impact Statement for the Y–12 National Security Complex*. The impacts associated with radiological transportation would be less than 1 latent cancer fatality per year (DOE 2009g:5-7, 5-9, 5-17).

3.9.10 Socioeconomics

Y–12 is located on ORR in eastern Tennessee, approximately 29 kilometers (18 miles) west of the city of Knoxville. Over 90 percent of people employed at Y–12 reside in four counties: Anderson, Knox, Loudon, and Roane (DOE 2008c:4-404). Therefore, these four counties are identified as the ROI in this socioeconomics analysis. Y–12 employs approximately 6,000 persons (DOE 2009i).

3.9.10.1 Regional Economic Characteristics

From 2000 to 2008, the labor force of the ROI increased by approximately 12 percent to 313,806. By July 2009, the unemployment rate of the ROI was 8.7 percent, which was lower than the unemployment rate for Tennessee (11 percent) (BLS 2009).

3.9.10.2 Demographic and Housing Characteristics

In 2008, the estimated population of the four-county ROI was 604,063. From 2000 to 2008, the ROI population grew by 11 percent, compared with 9.2 percent growth throughout the state of Tennessee (DOC 2009b). Young children and pregnant women are considered to be among the most vulnerable populations to mercury poisoning. The percentage of the ROI population under the age of 18 was 22 percent; women ages 18 to 39 composed 15 percent (DOC 2009c). There were 272,204 housing units in the ROI in 2007 (DOC 2008), 64 percent of which were owner occupied, 27 percent were renter occupied, and 8.9 percent were vacant (DOC 2009c).

3.9.10.3 Local Transportation

There are several interstate highways in the region surrounding ORR. The primary east-west route is Interstate 40, which passes the site approximately 14 kilometers (9 miles) south, where it merges with Interstate 75, the primary north-south route. Interstate 75 runs in conjunction with Interstate 40 for approximately 27 kilometers (17 miles), then splits to the west of Knoxville and continues north. Access routes to Y–12 are provided from State Routes 58, 62, 95, and 170 (Bethel Valley Road), and Bear Creek Road. In 2008, the average annual daily traffic along the segment of State Route 170 most accessible to Y–12 was 8,007 vehicles per day. The average annual daily traffic for the segment of State Route 62 from State Route 95 to State Route 170 was 31,959 vehicles per day. State Route 95's annual average daily traffic was 23,986 vehicles per day from the county line to State Route 62, and 6,666 vehicles per day from State Route 95 to Interstate 40 (TTD 2009). There is no public access to Bear Creek Road.

Rail access is provided to Y–12 by a 6.4-kilometer (4-mile) rail spur connecting to the CSX main line east of Oak Ridge (DLA 2004:3-69). There are two airports located in the ROI operated by the Metropolitan Knoxville Airport Authority. The McGee Tyson Airport is located approximately 32 kilometers (20 miles) southeast of Y–12. This facility handles commercial airline traffic, air cargo, military aviation, and general aviation. The Downtown Knoxville Island Airport is a general aviation facility located approximately 35 kilometers (22 miles) east of Y–12 (COK 2009). There are several private airports located throughout the ROI, primarily engaged in agricultural services.

3.9.11 Environmental Justice

The 16-kilometer (10-mile) radius surrounding the storage location at Y–12 encompasses parts of five Tennessee counties: Anderson, Knox, Loudon, Morgan, and Roane. In the decade between 1990 and 2000, the total population of the five-county area increased by approximately 13 percent to 564,115; the minority population increased by approximately 38 percent to 58,573; and the low-income population decreased by approximately 1 percent. Demographic data from the 2000 census show that the Black or African American population accounts for approximately 65 percent of the total minority population. Persons who declared that they are of Hispanic or Latino origin are included in the "total Hispanic" population, regardless of race. They composed approximately 12 percent of the total minority population residing in Anderson, Knox, Loudon, Morgan and Roane Counties in 2000.

Data for Loudon, Morgan, and Roane Counties from the *2007 ACS 1-Year Estimates* are unavailable due to a population threshold of 65,000 people necessary for inclusion. However, the *2005–2007 ACS 3-Year Estimates* reported data for all five counties included in the 16-kilometer (10-mile) radius surrounding Y–12. According to the *2005–2007 ACS 3-Year Estimates*, the total population of the five-county area increased by 8 percent to 606,721, and the low-income population increased by 20 percent to 83,919 since 2000. During this time, the total minority population of Knox County increased by approximately 21 percent to 58,125. Detailed demographic data of race and Hispanic origin from the *2005–2007 ACS 3-Year Estimates* for Anderson, Loudon, Morgan, and Roane Counties are unavailable due to an insufficient number of sample cases.

Approximately 101,939 people lived within 16 kilometers (10 miles) of Y–12 in 2000 (DOC 2009d). This area included an estimated 7.6 percent minority and 7.9 percent low-income population. By comparison, the five-county area included a 10 percent minority and 13 percent low-income population, and the state included a 21 percent minority and 13 percent low-income population. There are 89 census block groups located within the 16-kilometer (10-mile) radius surrounding Y–12. Of this total, one contained a disproportionately high number of minority individuals and one contained a disproportionately high number of low-income individuals. Figure 3–28 shows the proximity of the identified minority and low-income communities to Y–12. The population living within 16 kilometers (10 miles) of Y–12 is more densely concentrated to the southeast toward the outskirts of Knoxville.

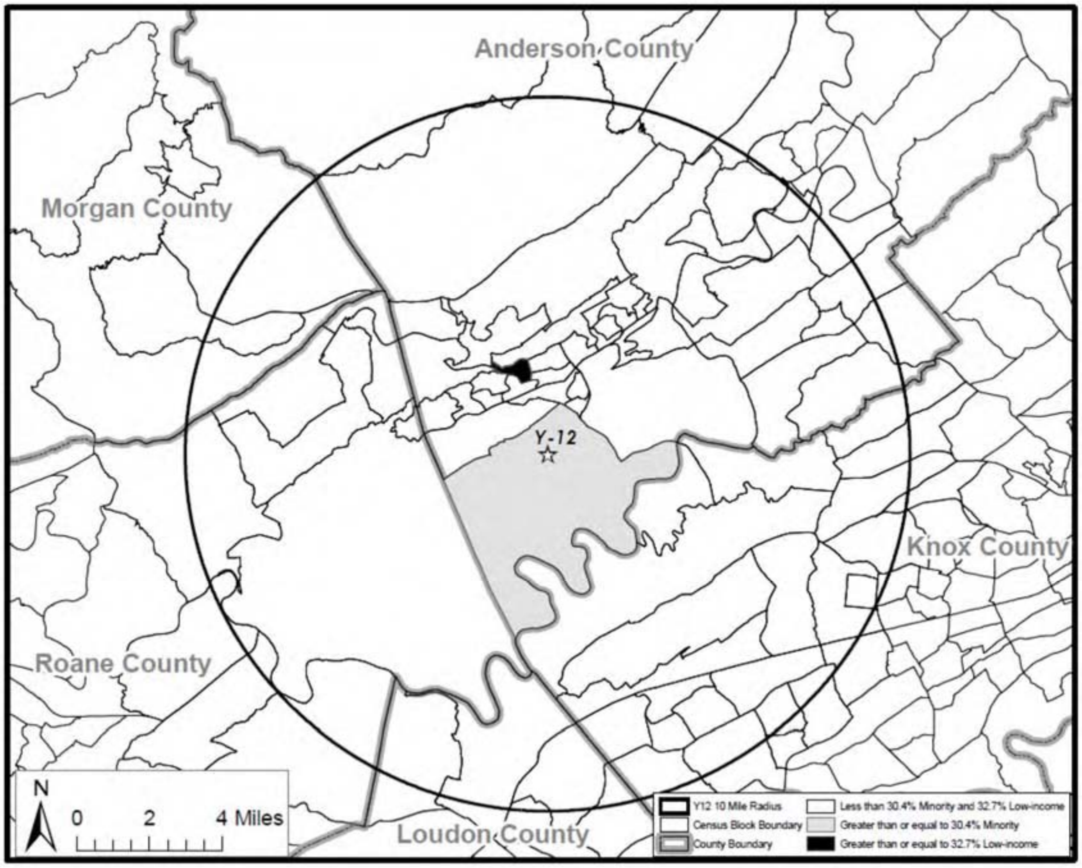


Figure 3–28. Block Group Containing Minority Populations Surrounding Y–12 National Security Complex

Approximately 3,093 people lived within approximately 3.2 kilometers (2 miles) of Y–12 in 2000 (DOC 2009d). This area included an estimated 27 percent minority and 14 percent low-income population. There are nine census block groups located within this ROI; three contained a disproportionately high number of minority individuals and none contained a disproportionately high number of low-income individuals. There are more block groups containing a disproportionately high number of minority individuals within the approximately 3.2-kilometer (2-mile) ROI than in the 16-kilometer (10-mile) ROI. This is due to a lower threshold within the smaller ROI because it only includes parts of Anderson County, while the larger 16-kilometer (10-mile) ROI includes parts of five counties (see Appendix B, Section B.11). Figure 3–29 shows the proximity of the identified minority communities to Y–12.

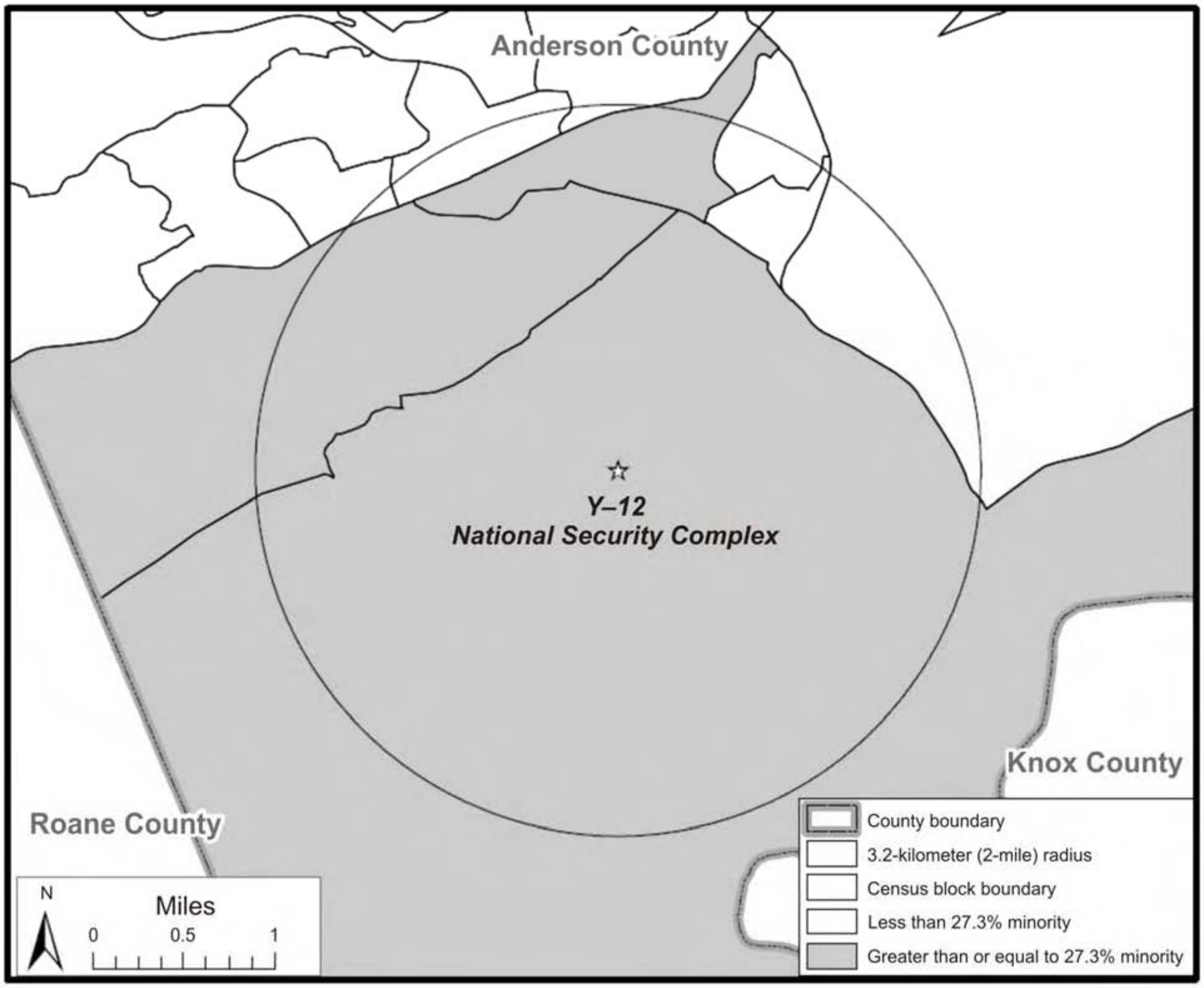


Figure 3–29. Block Groups Containing Minority Populations Surrounding Y–12 National Security Complex

POTENTIALLY SUSCEPTIBLE POPULATIONS

Environmental justice concerns were considered in greater detail in areas that have been identified as containing a disproportionately high number of minority or low-income individuals. This section presents information regarding factors that may contribute to disproportional impacts, such as age and access to health care.

Factors such as age could have the potential to amplify an individual's exposure to environmental contaminants, such as mercury. For purposes of this analysis, the age groups of primary concern are children under the age of 18, women ages 18 to 39, and individuals ages 65 and up. The populations of children under 18 and women ages 18 to 39 living within the 16-kilometer (10-mile) and 3.2-kilometer (2-mile) ROIs appear to be consistent with the surrounding areas. The population of individuals ages 65 and up living in the 3.2-kilometer (2-mile) ROI (20 percent) is noticeably larger than that demographic living in the 16-kilometer (10-mile) ROI (14 percent), the state (12 percent), and the five-county region (14 percent).

Factors such as access to health care could hamper a community's ability to cope with potentially adverse health impacts. HPSAs are designated by the Health Resources and Services Administration. These data are presented at the greatest level of spatial resolution available for each county within the 16-kilometer (10-mile) ROI. There are no primary medical care or mental health HPSA designations in Anderson County; however, the county is designated as a dental HPSA for low-income populations. Several Knox County census tracts have been designated as dental HPSAs, although none lie within the 16-kilometer (10-mile) ROI. There is one medical facility in Knox County designated as a primary medical care HPSA; there are no mental health HPSA designations in the county. There are no HPSA designations in Loudon County. One medical facility in Morgan County is designated as a primary medical care, dental, and mental health HPSA; and the entire county is designated as a primary medical care HPSA. Morgan County is also designated as a dental HPSA for low-income populations. Roane County is designated as a primary medical care and dental HPSA for low-income populations. There are no mental health HPSA designations in Roane County (HRSA 2009b).

3.10 REFERENCES

Adams, M.L., 2006, Idaho Operations Office, Idaho Falls, Idaho, personal communication (letter) to L.A. Sehlke, Battelle Energy Alliance, LLC, Idaho Falls, Idaho, "Use of the 'Big Lost River Flood Hazard Study, Idaho National Laboratory, Idaho, U.S. Bureau of Reclamation 2005' (AS-SSD-INL-06-030)," January 12.

Baur, G., 2009, S.M. Stoller Corporation, Grand Junction, Colorado, personal communication to S. Dixon, Science Applications International Corporation, Germantown, Maryland, "Additional Information on Site Infrastructure," August 5.

BCPD (Benton County Planning Department), 2007, *Benton County Comprehensive Plan*, Chapter 8, "Transportation Element," accessed through http://www.co.benton.wa.us/comp_plan_.htm.

Beach, L., 2009, Waste Control Specialists, LLC, Andrews, Texas, personal communication (email) to S. Dixon, Science Applications International Corporation, Germantown, Maryland, "Request for Additional Information, WCS," August 19.

BLS (U.S. Bureau of Labor Statistics), 2009, *Local Area Unemployment Statistics, 1990–2008 by Selected States and Counties*, accessed through http://www.bls.gov/data/, June 26.

Bulgarino, N., 2008, Ameresco Federal Solutions, personal communication (telephone conversation) with R. Werth, Science Applications International Corporation, Germantown, Maryland, "P-Area Biomass Facility Modeling and $PM_{2.5}$ Concerns in the Aiken/Augusta Area," August 15.

Caudell, M.B., 2000, *Crackerneck Wildlife Management Area and Ecological Reserve, Comprehensive Natural Resource Management Plan*, South Carolina Department of Natural Resources, Columbia, South Carolina, July.

CDNR (Colorado Department of Natural Resources), 2009, *Threatened and Endangered Species List – Colorado Division of Wildlife*, accessed through http://wildlife.state.co.us/WildlifeSpecies/SpeciesOfConcern/ThreatenedEndangeredList/ListOfThreatenedAndEndangeredSpecies.htm, June 22.

CDOT (Colorado Department of Transportation), 2009, *Vehicle Traffic Volumes and Truck Weights on Colorado State Highways*, accessed through http://www.dot.state.co.us/app_DTD_DataAccess/Traffic/index.cfm?fuseaction=TrafficMain&MenuType=Traffic.

CEQ (Council on Environmental Quality), 1997, *Environmental Justice Guidance Under the National Environmental Policy Act*, Executive Office of the President, accessed through http://ceq.eh.doe.gov/nepa/regs/ej/ej.pdf, December 10.

Chatters, J.C., and N.A. Cadoret, 1990, *Archaeological Survey of the 200 East and 200 West Areas, Hanford Site, Washington*, PNL-7264, Pacific Northwest Laboratory, Richland, Washington, March.

Clawson, K.L., G.E. Start, and N.R. Ricks, eds., 1989, *Climatography of the Idaho National Engineering Laboratory*, 2nd ed., DOE/ID-12118, Rev. 00, Idaho Operations Office, Idaho Falls, Idaho, December.

COK (City of Knoxville), 2009, *Airports*, accessed through http://www.ci.knoxville.tn.us/newcomers/airports.asp, August 13.

Cook-Joyce and Intera (Cook-Joyce, Inc., and Intera, Inc.), 2007, *Geology Report*, Rev. 12c, Appendix 2.6.1, Austin, Texas, prepared for Waste Control Specialists, LLC, Austin, Texas, May 1.

CTUIR (Confederated Tribes of the Umatilla Indian Reservation), 2009, Draft Language Submitted by the Confederated Tribes of the Umatilla Indian Reservation, Department of Science and Engineering, Pendleton, Oregon.

Depperschmidt, J.D., 2007, Idaho National Laboratory, Idaho Falls, Idaho, personal communication (email) to M. Burandt, U.S. Department of Energy, Office of River Protection, Richland, Washington, "Fed Ex Address" (regarding response to data request for INL, including 2006 nonradiological criteria pollutant releases), May 22.

Desormeau, J., 2009, U.S. Department of Energy, Office of Legacy Management, Grand Junction, Colorado, personal communication (email) to J. DiMarzio, Science Applications International Corporation, Germantown, Maryland, "Non-hazardous Waste Disposal Information at the Grand Junction Disposal Site," July 16.

DLA (Defense Logistics Agency), 2004, *Final Mercury Management Environmental Impact Statement*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DNSC (Defense National Stockpile Center), 2006, "Defense Stockpile Announces the Selection of the Mercury Consolidation Storage Location," Defense Logistics Agency, Fort Belvoir, Virginia, February 2.

DOC (U.S. Department of Commerce), 2008, *U.S. Census Bureau*, *Table 4: Annual Estimates of Housing Units for Counties of Selected States: April 1, 2000 to July 1, 2008*, accessed through http://www.census.gov/popest/housing/HU-EST2007-4.html, August 21.

DOC (U.S. Department of Commerce), 2009a, *U.S. Census Bureau*, *Local Employment Dynamics, Labor Shed Reports for Selected Regions Generate Using LED OnTheMap Version 3*, accessed through http://lehdmap3.did.census.gov/themap3/, October 8.

DOC (U.S. Department of Commerce), 2009b, *U.S. Census Bureau, Table 1: Annual Estimates of the Resident Population for Counties of Selected States; April 1, 2000 to July 1, 2008*, accessed through http://www.census.gov/popest/counties/CO-EST2008-01.html, March 19.

DOC (U.S. Department of Commerce), 2009c, *U.S. Census Bureau*, *2005–2007 American Community Survey 3-Year Estimates*, accessed through http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS&_submenuId=datasets_2&_lang=en.

DOC (U.S. Department of Commerce), 2009d, *U.S. Census Bureau*, *2000 Decennial Census*, accessed through http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_submenuId=datasets_1&_lang=en.

DOC (U.S. Department of Commerce), 2009e, *U.S. Census Bureau*, *1990 Decennial Census*, accessed through http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_tabId=DEC2&_submenuId=datasets_1&_lang=en&_ts=269449200487.

DOC (U.S. Department of Commerce), 2009f, *U.S. Census Bureau*, *2007 American Community Survey 1-Year Estimates*, accessed through http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS&_submenuId=datasets_2&lang=en.

DOE (U.S. Department of Energy), 1986, *Final Environmental Statement, Remedial Actions at the Former Climax Uranium Company Uranium Mill Site, Grand Junction, Mesa County, Colorado*, DOE/EIS-126-F, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, New Mexico, December.

DOE (U.S. Department of Energy), 1995, *Savannah River Site Waste Management Final Environmental Impact Statement,* DOE/EIS-0217, Savannah River Operations Office, Aiken, South Carolina, July.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, D.C., December.

DOE (U.S. Department of Energy), 1996b, *Programmatic Agreement Among the U.S. Department of Energy Richland Operation Office, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site, Washington*, DOE/RL-96-77, Rev. 0, Richland Operations Office, Richland, Washington, August 21.

DOE (U.S. Department of Energy), 1996c, *Final Programmatic Environmental Impact Statement* for *Stockpile Stewardship and Management*, DOE/EIS-0236, September.

DOE (U.S. Department of Energy), 1997, *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*, DOE-RL-88-20, Rev. 1, Richland Operations Office, Richland, Washington, July.

DOE (U.S. Department of Energy), 1999a, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, DOE/EIS-0222-F, Richland Operations Office, Richland, Washington, September.

DOE (U.S. Department of Energy), 1999b, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Office of Fissile Materials Disposition, Washington, D.C., November.

DOE (U.S. Department of Energy), 1999c, *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement*, DOE/EIS-0290, Idaho Operations Office, Idaho Falls, Idaho, January.

DOE (U.S. Department of Energy), 2000, *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, D.C., December.

DOE (U.S. Department of Energy), 2001a, *Environmental Assessment, Use of Existing Borrow Areas, Hanford Site, Richland, Washington*, DOE/EA-1403, Richland Operations Office, Richland, Washington, October.

DOE (U.S. Department of Energy), 2001b, *Hanford Waste Management Program Strategic Plan*, DOE/RL-2001-15, Rev. 0, Richland Operations Office, Richland, Washington, February.

DOE (U.S. Department of Energy), 2001c, *Final Site-Wide Environmental Impact Statement for the Y–12 National Security Complex*, DOE-EIS-0309, Oak Ridge Y–12 Area Office, Oak Ridge, Tennessee, September.

DOE (U.S. Department of Energy), 2002a, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin,* DOE/RL-2002-39, Rev. 0, Richland Operations Office, Richland, Washington, June.

DOE (U.S. Department of Energy), 2002b, *Central Waste Complex*, Fact Sheet, Richland Operations Office, Richland, Washington, January.

DOE (U.S. Department of Energy), 2002c, *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-0319, National Nuclear Security Administration, Washington, D.C., August.

DOE (U.S. Department of Energy), 2002d, *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement*, DOE/EIS-0287, Idaho Operations Office, Idaho Falls, Idaho, September.

DOE (U.S. Department of Energy), 2002e, *Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement*, DOE/EIS-0303, Savannah River Operations Office, Aiken, South Carolina, May.

DOE (U.S. Department of Energy), 2004a, *Idaho National Engineering and Environmental Laboratory Site Environmental Report, Calendar Year 2003*, DOE/ID-12082(03), Idaho Operations Office, Idaho Falls, Idaho, October.

DOE (U.S. Department of Energy), 2004b, *Environmental Assessment for the Construction, Operation, and Closure of the Burma Road II Borrow Pit at the Savannah River Site*, DOE/EA-1501, Savannah River Operations Office, Aiken, South Carolina, July.

DOE (U.S. Department of Energy), 2005a, *Grand Junction, Colorado, Site Environmental Report for Calendar Year 2004*, Office of Legacy Management, Washington, D.C., August.

DOE (U.S. Department of Energy), 2005b, *Draft Environmental Impact Statement for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems*, DOE/EIS-0373D, Office of Nuclear Energy, Science and Technology, Washington, D.C., June.

DOE (U.S. Department of Energy), 2005c, *2005 Supplement Analysis of the INL Site Portion of the April 1995 "Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs, Final Environmental Impact Statement,"* DOE/EIS-0203F-SA-02, Idaho Operations Office, Idaho Falls, Idaho, June.

DOE (U.S. Department of Energy), 2005d, *Environmental Remediation and the Federal Facility Agreement and Consent Order*, accessed through http://cleanup.inel.gov/remediation, February 23.

DOE (U.S. Department of Energy), 2005e, *Savannah River Site End State Vision*, Office of Environmental Management, accessed through http://sro.srs.gov/srs%20end%stat%20vision.htm., July 26.

DOE (U.S. Department of Energy), 2005f, *Natural Resources Management Plan for the Savannah River Site*, New Ellenton, South Carolina, May.

DOE (U.S. Department of Energy), 2006a, *Calendar Year 2005 Nonradioactive Inventory of Airborne Emissions Report*, DOE/RL-2006-05, Rev. 0, Richland Operations Office and Office of River Protection, Richland, Washington, March.

DOE (U.S. Department of Energy), 2006b, *Idaho National Laboratory Site Environmental Report, Calendar Year 2005*, DOE/ID-12082(05), Idaho Operations Office, Environmental Surveillance, Education and Research Program, Idaho Falls, Idaho, October.

DOE (U.S. Department of Energy), 2006c, *Missouri Hazardous Waste Management Facility Permit Part 1*, Permit No. MO9890010524, Kansas City Plant, Kansas City, Missouri.

DOE (U.S. Department of Energy), 2007a, *Occurrence Reporting and Processing System*, "ORPS Summary Report," accessed through https://orps.hss.doe.gov/Orps/Reports/Summary.asp, Office of Health, Safety and Security, April 30.

DOE (U.S. Department of Energy), 2007b, *Type A Accident Investigation Report: The July 27, 2007, Tank 241-S-102 Waste Spill at the Hanford Tank Farms*, Vol. 1, Office of Health, Safety and Security, Office of Corporate Safety Programs, Washington, D.C., September.

DOE (U.S. Department of Energy), 2007c, *Idaho National Laboratory Site Environmental Report, Calendar Year 2006*; DOE/ID-12082(07), Idaho Operations Office, Environmental Surveillance, Education and Research Program, Idaho Falls, Idaho, September.

DOE (U.S. Department of Energy), 2007d, *Environmental Assessment for the National Pollutant Discharge Elimination System Stormwater Compliance Alternative at the Savannah River Site*, DOE/EA-1563, Savannah River Operations Office, Aiken, South Carolina, June.

DOE (U.S. Department of Energy), 2007e, Power Point Presentation at "*Department of Energy National Nuclear Security Administration Mercury Storage at the Y–12 National Security Complex*", Power Point Presentation at DOE National Nuclear Security Administration (NNSA) Commodity-Grade Mercury Stakeholder Meeting, NNSA Y–12 Site Office, June.

DOE (U.S. Department of Energy), 2008a, *Occurrence Reporting and Processing System*, Office of Health, Safety and Security, Washington, D.C.

DOE (U.S. Department of Energy), 2008b, *Idaho National Laboratory Site Environmental Report, Calendar Year 2007*, DOE/ID-12082(07), Idaho Operations Office, Environmental Surveillance, Education and Research Program, Idaho Falls, Idaho, September.

DOE (U.S. Department of Energy), 2008c, *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*, DOE/EIS-0236-S4, National Nuclear Security Administration, Washington, D.C., October.

DOE (U.S. Department of Energy), 2008d, *Environmental Assessment for Biomass Cogeneration and Heating Facilities at the Savannah River Site*, DOE/EA-1605, Savannah River Operations Office, Aiken, South Carolina, August.

DOE (U.S. Department of Energy), 2008e, *The Oak Ridge Reservation 2006 Annual Site Environmental Report Summary*, DOE/ORO-2234, National Nuclear Security Administration, accessed through http://www.ornl.gov/sci/env_rpt/aser2006/aser_summary.pdf, March.

DOE (U.S. Department of Energy), 2008f, *The Oak Ridge Reservation Annual Site Environmental Report 2007*, DOE/ORO/2261, accessed through http://www.ornl.gov/sci/env_rpt/aser2007.shtm, September.

DOE (U.S. Department of Energy), 2009a, *Grand Junction, Colorado, Processing Site and Disposal Site Fact Sheet*, Office of Legacy Management, Washington, D.C., May 5.

DOE (U.S. Department of Energy), 2009b, *2008 UMTRCA Title 1 Annual Report, Grand Junction Colorado*, Office of Legacy Management, Washington, D.C., January.

DOE (U.S. Department of Energy), 2009c, *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391, Office of River Protection, Richland, Washington, October.

DOE (U.S. Department of Energy), 2009d, *Hanford Site, Hanford Overview*, accessed through http://www.hanford.gov/?page=215, July 12.

DOE (U.S. Department of Energy), 2009e, *Solid Waste Integrated Forecast Technical (SWIFT) Report 2008.0: FY 2008 to FY 2035*, accessed through http://hanford.gov/swift/index.htm, September 29.

DOE (U.S. Department of Energy), 2009f, *Idaho National Laboratory Cultural Resource Management Plan*, DOE/ID-10997, Rev. 3, Idaho Operations Office, accessed through http://www.inl.gov/technical publications/Documents/4192201.pdf, February.

DOE (U.S. Department of Energy), 2009g, *Draft Site-Wide Environmental Impact Statement for the Y–12 National Security Complex*, DOE/EIS-0387, National Nuclear Security Administration, Y–12 Site Office, Oak Ridge, Tennessee, October.

DOE (U.S. Department of Energy), 2009h, *Y–12 National Security Complex Fact Sheet*, accessed through http://www.y12.doe.gov/about/factsheet.php, August 11.

DOE (U.S. Department of Energy), 2009i, *Factsheet – Y–12 National Security Complex and Off-site*, DOE Oak Ridge Office, January.

DOE and DOI (U.S. Department of Energy, Office of Public Affairs, Washington D.C., and U.S. Department of the Interior, Office of Public Affairs, Washington, D.C.), 2008, "DOI Designates B Reactor of DOE's Hanford Site As a National Historic Landmark: DOE to Offer Regular Public Tours in 2009," August 25.

DOE and Ecology (U.S. Department of Energy, Richland Operations Office, Richland Washington, and Washington State Department of Ecology, Olympia, Washington), 1996, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*, DOE/EIS-0189, August.

DOE and Mesa County (U.S. Department of Energy and Mesa County), 1996, Memorandum of Understanding Between the United States Department of Energy and The Mesa County Board of Commissioners, April 24.

DOI (U.S. Department of the Interior), 1986, *Visual Resource Inventory*, BLM Manual Handbook 8410-1, Bureau of Land Management, Washington, D.C., January.

DOI (U.S. Department of the Interior), 2000, *24 Command Fire, Benton County, Washington, June–July 2000, Burned Area Emergency Rehabilitation Plan,* Northern States Burned Area Emergency Rehabilitation Team, Richland, Washington, July 7.

DOI (U.S. Department of the Interior), 2008, *Programmatic Biological Assessment: Gunnison River Basin, Colorado: Operations of the Wayne N. Aspinall Unit; Operations and Depletions of Existing Reclamation Projects; and Operations and Depletions of Non-federal Water Development*, Bureau of Reclamation, Upper Colorado Region, Western Colorado Field Office, December 23.

DOI (U.S. Department of Interior), 2009, "Secretary Salazar Dedicates Dominguez-Escalante National Conservation Area, Emphasizes Economic Benefits of BLM's Ax Format National Landscape Conservation System," Office of the Secretary, accessed through http://www.doi.gov/news/09_News_Releases/081209.html, October 5.

Duncan, J.P., ed., 2007, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNNL-6415, Rev. 18, Pacific Northwest National Laboratory, Richland, Washington, September.

Ecology (Washington State Department of Ecology), 2001, *Hanford Site Air Operating Permit*, Permit No. 00-05-006, Olympia, Washington, June 20.

Ecology (Washington State Department of Ecology), 2003, personal communication (letter) to J.E. Rasmussen, U.S. Department of Energy, Waste Treatment Plant, Olympia, Washington, "Final

Approval of Prevention of Significant Deterioration Application, No. PSD-02-01, Amendment 1," November 12.

Ecology (Washington State Department of Ecology), 2005, *Final Approval of PSD Application, U.S. Department of Energy, Waste Treatment Plant, No. PSD-02-01 Amendment 2*, Olympia, Washington, October 6.

Ecology (Washington State Department of Ecology), 2006, *Hanford Site Air Operating Permit, 2006 Renewal*, Permit No. 00-05-006, Olympia, Washington, December 29.

EPA (U.S. Environmental Protection Agency), 2006, *Mid-Atlantic Integrated Assessment: Mid-Atlantic Highlands Steams Assessment*, Appendix C, "Glossary," Office of Research and Development, accessed through http://www.epa.gov/maia/thml/mah-apc.html, March 3.

EPA (U.S. Environmental Protection Agency), 2007, *EPA AirData, Monitor Values Report – Criteria Air Pollutants, Idaho, Ozone, 2004–2006*, accessed through http://www.epa.gov/air/data/reports.html, February 8.

EPA (U.S. Environmental Protection Agency), 2009a, *Monitor Values Report – Hazardous Air Pollutants, Colorado, Mercury*, accessed through http://www.epa.gov/air/data/reports/html, September 8.

EPA (U.S. Environmental Protection Agency), 2009b, *Monitor Locator Map – Criteria Pollutants, Colorado*, accessed through http://www.epa.gov/air/data/.

EPA (U.S. Environmental Protection Agency), 2009c, *Region 10: The Pacific Northwest, Sole Source Aquifer Program*, accessed through http://yosemite.epa.gov/r10/water.nsf/Sole+Source+Aquifiers/SSA, January 7.

EPA (U.S. Environmental Protection Agency), 2009d, *Monitor Locator Map – Criteria Air Pollutants, Nevada*, accessed through http://www.epa.gov/air/data/.

EPA (U.S. Environmental Protection Agency), 2009e, *Monitor Locator Map – Criteria Air Pollutants, Missouri*, accessed through http://www.epa.gov/air/data/.

EPA (U.S. Environmental Protection Agency), 2009f, *Monitor Values Report – Hazardous Air Pollutants, Missouri, Mercury*, accessed through http://www.epa.gov/air/data/reports.html, October 2.

EPA (U.S. Environmental Protection Agency), 2009g, *Monitor Values Report – Criteria Air Pollutants, Georgia*, accessed through http://www.iaspub.epa.gov/airsdata/.

EPA (U.S. Environmental Protection Agency), 2009h, *Monitor Values Report – Criteria Air Pollutants, South Carolina*, accessed through http://www.iaspub.epa.gov/airsdata/.

EPA (U.S. Environmental Protection Agency), 2009i, *Guidance for Assessing Chemical Contamination Data for Use in Fish Advisories*, Vol. 2, *Risk Assessment and Fish Consumption Limits*, 3rd ed., EPA 823-B-00-008, Office of Science and Technology, Office of Water, Washington, D.C., November.

FAA (Federal Aviation Administration), 2009, *Airport Data (5010) and Contract Information*, accessed through http://www.faa.gov/airports/airports_safety/airportdata_5010/.

Ferns, T.W., 2003a, U.S. Department of Energy, Richland Operations Office, Richland, Washington, personal communication (email) to T. Friend, Science Applications International Corporation, Richland, Washington, "Infrastructure," June 19.

Ferns, T.W., 2003b, U.S. Department of Energy, Richland Operations Office, Richland, Washington, personal communication (email) to P. Dunigan, U.S. Department of Energy, Richland, Washington, "Infrastructure Questions," September 9.

Fluor Hanford (Fluor Hanford, Inc.), 2006, *Fiscal Year (FY) 2006 Fluor Hanford Annual Energy Management Report*, FH-0602654.1, Richland, Washington, November 7.

Foss, J.L., 2009, State Supervisor, Idaho Fish and Wildlife Office, U.S. Fish and Wildlife Service, Boise, Idaho, personal communication (letter) to R.D. Blew, Plant Ecologist, The S.M. Stoller Corporation, Idaho Falls, Idaho, "Semi-Annual Species List Update," June 1.

Fossum E. and Ischay C., 2009, *INL 2007 Reportable Water Baseline*: *Credit for Clean Water Returned to the Aquifer*, Idaho National Laboratory, Idaho Falls, Idaho, February 3.

Galvin Eling Associates, 1994, *Cultural Resource Survey of a Proposed Waste Facility, Andrews County, Texas*, Appendix 2.2.1, "*Archaeological and Cultural Survey of the Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste,*" Austin, Texas, August.

GAP (Government Accountability Project), 2003, *Knowing Endangerment: Worker Exposure to Toxic Vapors at the Hanford Tank Farms*, Nuclear Oversight Campaign, September.

Geiser, D.W., 2009, *Response to Expression of Interest: Facility for the Long-Term Management and Storage Elemental Mercury*, S05346, U.S. Department of Energy, Office of Legacy Management, Washington D.C., April 24.

GJDS (Grand Junction Disposal Site), 2009 *"Mercury Storage EIS" Data Call Response.*

GSA and NNSA (U.S. General Services Administration and National Nuclear Security Administration), 2008, *Environmental Assessment for the Modernization of Facilities and Infrastructure for the Non-nuclear Production Activities Conducted at the Kansas City Plant*, DOE/EA-1592, Kansas City, Missouri, April 21.

Haas, F.H., 2006, *Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste*, Appendix 2.4.1, "Flood Plain Study," Rev. 11a, Prepared for Waste Control Specialists, LLC, Austin, Texas, March 31.

Hartman, M.J., ed., 2000, *Hanford Site Groundwater Monitoring: Setting, Sources, and Methods*, PNNL-13080, Pacific Northwest National Laboratory, Richland, Washington, February.

Hartman, M.J., V.S. Richie, and J.A. Rediker, 2009, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*, DOE/RL-2008-66, U.S. Department of Energy, Richland Operations Office, accessed through http://www.hanford.gov/cp/gpp/library/annualreports.cfm., March.

Hawthorne (Hawthorne Army Depot), 2001, *Hawthorne Army Depot Installation Action Plan*, Hawthorne, Nevada, March.

Hawthorne (Hawthorne Army Depot), 2009, *"Mercury Storage EIS" Data Call Response.*

Hebdon, J., 2003, U.S. Department of Energy, Richland Operations Office, Richland, Washington, personal communication (letter) to M.A. Wilson, State of Washington, Department of Ecology, Kennewick, Washington, "Calendar Year 2002 Nonradioactive Inventory of Airborne Emissions Report," April 7.

Hicks & Company, 2007, *Socioeconomic Impacts of the Waste Control Specialists Proposed Low-Level Radioactive Waste Disposal Facility, Andrews County, Texas,* Proposed Low-Level Radioactive License No. 4100, March 16.

Hicks & Company, 2008, *Socioeconomic Impacts of the Waste Control Specialists Radioactive Material Storage and Processing Facility, Andrews County, Texas*, Renewal of License No. R04971, Appendix A (page 105), July 3.

Holecek, M.L., 2009, *Identifying a Storage Facility for Elemental Mercury*, Response to Request for Expressions of Interest, U.S. Department of Energy, National Nuclear Security Administration, Kansas City Site Office, Kansas City, Missouri, April 24.

Honeywell (Honeywell Federal Manufacturing & Technologies), 2007, *2007 Annual Site Environmental Summary*, Kansas City, Missouri, September.

Honeywell (Honeywell Federal Manufacturing & Technologies), 2008, *FY 2009 Kansas City Plant Ten-Year Site Plan*, Kansas City, Missouri, August.

Hortness, J.E., and J.P. Rousseau, 2003, *Estimating the Magnitude of the 100-Year Peak Flow in the Big Lost River at the Idaho National Engineering and Environmental Laboratory, Idaho*, Water-Resources Investigations Report 02-4299, U.S. Geological Survey, Idaho Falls, Idaho.

HRSA (Health Resources and Services Administration), 2009a, *Shortage Designation: HPSAs, MUAs, and MUPs*, accessed through http://bhpr.hrsa.gov/shortage/index.htm., April 20.

HRSA (Health Resources and Services Administration), 2009b, *Find Shortage Areas: HPSA by State and County*, accessed through http://hpsafind.hrsa.gov/HPSASearch.aspx., November 16.

ICF KH Engineers Hanford, 1995, *Life Cycle Strategy, 100/200 Areas Electrical Transmission and Distribution*, Richland, Washington, June 29.

IFG (Idaho Fish and Game), 2009, *Idaho's Special Status Vertegrates and Invertebrates*, access through http://fishandgame.idaho.gov/cdc/animals/, October 28.

IMNH (Idaho Museum of Natural History), 1991, *Subsurface Archaeological Investigations at New Production Reactor Area E on the Idaho National Engineering Laboratory*, Northern Intermountain Quaternary Institute Archaeological Report No. 91-6, Pocatello, Idaho.

INEEL (Idaho National engineering and Environmental Laboratory) 2000, *Recomputation of the Seismic Hazard at the Idaho National Engineering and Environmental Laboratory*, INEEL/EXT-99-00786, Rev. 1, Idaho Falls, Idaho, February.

INL (Idaho National Laboratory), 2009a, *INL Standardized Safety Analysis Report*, SAR-400, Rev. 2, May 27.

INL (Idaho National Laboratory), 2009b, *INL Seismic Monitoring Program*, accessed through http://www.inl.gov/geosciences/earthquakes.shtml, July 13.

INL (Idaho National Laboratory), 2009c, *Quarterly Energy Conservation Performance Report*, Idaho Operations Office, Idaho Falls, Idaho.

INL (Idaho National Laboratory), 2009d, *"Mercury Storage EIS" Data Call Response.*

ITD (Idaho Transportation Department), 2008, *Rural Traffic Flow Map, State of Idaho, Average Daily Traffic Figures for Districts 5 and 6*, accessed through http://itd.idaho.gov/planning/roadwaydata/RTFMaps/2007/index.html.

Jackson, S.M., and J. Boatwright, 1985, "The Borah Peak, Idaho Earthquake of October 28, 1983–Strong Ground Motion," *Earthquake Spectra*, Vol. 2 (1).

Jacobs (Jacobs Engineering Group, Inc.), 1998, *Interim Long-Term Surveillance Plan for the Cheney Disposal Site Near Grand Junction, Colorado*, DOE/AL/62350-243, Rev. 1, April.

KCP (Kansas City Plant), 2009, *"Mercury Storage EIS" Data Call Response.*

Koslow, K.N., and D.H. Van Haaften, 1986, *Flood Routing Analysis for a Failure of Mackay Dam*, EGG-EP-7184, EG&G Idaho, Inc., Idaho Falls, Idaho, June.

Leonard, P.R., 1993, *Environmental Resource Document for the Idaho National Engineering Laboratory*, Vol. 1, Section 3, "Air Resources," EGG-WMO-10279, EG&G Idaho, Inc., Idaho Falls, Idaho, July.

Livaccari, R. and J. Hodge, 2005, "Laramide and Quaternary-Age Faulting Along the Northern Uncompahgre Plateau, Western Colorado," Geological Society of America Abstracts from the 57th GSA Rocky Mountain Section Meeting, Mesa State College, Grand Junction, Colorado, May 23–25.

Mamatey, A., ed., 2008, *Savannah River Site Environmental Report for 2007*, WSRC-STI-2008-00057, Washington Savannah River Company, LLC, Aiken, South Carolina.

Marceau, T.E., 1998, *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan*, DOE/RL-97-56, Rev. 1, Bechtel Hanford, Inc., accessed through http://www.hanford.gov/doe/historic/docs/rl97-56/rl97-56.htm, January.

MDNR (Missouri Department of Natural Resources), 2001, *Mineral Resources of Missouri, Mineral Industries in Missouri*, accessed through http://www.dnr.mo.gov/geology/adm/publications/map-MinRes.pdf, July 7.

MDNR (Missouri Department of Natural Resources), 2009a, *Classified Waters of Missouri*, accessed through http://www.dnr.mo.gov/env/wpp/wqstandards/wq_classfd_wb.htm, July 16.

MDNR (Missouri Department of Natural Resources), 2009b, *Kansas City Area Air Monitoring Sites, 10/29/09*, accessed through http://www.dnr.mo.gov/env/esp/wqs/bc.htm., October 29.

MODOT (Missouri Department of Transportation), 2008, *2008 District 4 Traffic Volume and Commercial Vehicle Count Map*, accessed through http://www.modot.mo.gov/safety/documents/2008_Traffic_District04.pdf.

NCDC (National Climatic Data Center), 2009a, *Storm Events for Colorado*, accessed through http://www4.ncdc.noaa.gov/oa/ncdc.html.

NCDC (National Climatic Data Center), 2009b, *Storm Events for Washington*, accessed through http://www4.ncdc.noaa.gov/oa/ncdc.html.

NCDC (National Climatic Data Center), 2009c, *Storm Events for Idaho*, accessed through http://www4.ncdc.noaa.gov/oa/ncdc.html.

NCDC (National Climatic Data Center), 2009d, *Storm Events for Missouri*, accessed through http://www4.ncdc.noaa.gov/oa/ncdc.html.

NCDC (National Climatic Data Center), 2009e, *Storm Events for South Carolina*, accessed through http://www4.ncdc.noaa.gov/oa/ncdc.html.

NCDC (National Climatic Data Center), 2009f, *Storm Events for Texas*, accessed through http://www4.ncdc.noaa.gov/oa/ncdc.html.

NCDC (National Climatic Data Center), 2009g, *Storm Events for Tennessee*, accessed through http://www4.ncdc.noaa.gov/oa/ncdc.html.

NDEP (Nevada Division of Environmental Protection), 2009a, *Hawthorne Army Depot Webpage: HWAD Mission*, accessed through http://ndep.nv.gov/hwad/haap03.htm, July.

NDEP (Nevada Division of Environmental Protection), 2009b, *Fact Sheet for Class 3 Hazardous Waste Permit – Modification to Permit Number NevHW0013*, Hawthorne Army Depot Facility, accessed through http://ndep.nv.gov/sec/bwmfshwadpods62202.pdf.

Neitzel, D.A., 2005, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNNL-6415, Rev. 17, Pacific Northwest National Laboratory, Richland, Washington, September.

Nichols, M.D., 1996, U.S. Environmental Protection Agency, Memorandum to Regional Directors, "Areas Affected by PM-10 Natural Events," accessed through http://www.epa.gov/ttn/oarpg/t1/meta/m32461.html, May 30.

NMDOT (New Mexico Department of Transportation), 2009, *New Mexico Traffic Flow Maps of Urban Areas (2004) AADT*, accessed through http://nmshtd.state.nm.us/photo_galleries/TrafficFlowMaps/2004%20Traffic%20Flow%20Maps/County/Traff2004County_LEA.pdf.

NNHP (Nevada Natural Heritage Program), 2009, *Nevada Natural Heritage Program, Animal and Plant At-Risk Tracking List*, accessed through http://heritage.nv.gov/lists/track.pdf, March.

NNSA (National Nuclear Security Administration), 2008a, *Final FY 2009 Kansas City Plant Ten-Year Site Plan*, Kansas City Site Office, August.

NNSA (National Nuclear Security Administration), 2008b, *Pollution Prevention and Reporting System*, Kansas City Plant, Kansas City, Missouri, September.

NOAA (National Oceanic and Atmospheric Administration), 2009a, *2008 Local Climatological Data, Annual Summary with Comparative Data – Grand Junction, Colorado*, National Climatic Data Center, Asheville, North Carolina.

NOAA (National Oceanic and Atmospheric Administration), 2009b, *Comparative Climatic Data for the United States Through 2008,* National Climatic Data Center, Asheville, North Carolina.

NOAA (National Oceanic and Atmospheric Administration), 2009c, *2008 Local Climatological Data, Annual Summary with Comparative Data – Reno, Nevada*, National Climatic Data Center, Asheville, North Carolina.

NOAA (National Oceanic and Atmospheric Administration), 2009d, *2008 Local Climatological Data, Annual Summary with Comparative Data – Kansas City, Missouri*, National Climatic Data Center, Asheville, North Carolina.

NOAA (National Oceanic and Atmospheric Administration), 2009e, *2008 Local Climatological Data, Annual Summary with Comparative Data – Augusta, Georgia,* National Climatic Data Center, Asheville, North Carolina.

Noson, L., A. Qamar, and G. Thorsen, 1988, *Washington State Earthquake Hazards*, Washington Division of Geology and Earth Resources Information Circular 85, accessed through http://www.geophys.washington.edu/SEIS/PNSN/INFO_GENERAL/NQT/.

NPS (National Park Service), 2003, *Final 2001 Air Emissions Inventory: Craters of the Moon National Monument and Preserve, Idaho*, WASO – Air Resource Division, Denver, Colorado, October.

NPS (National Park Service), 2009, *Mandatory Class I Areas*, accessed through http://www.epa.gov /oaqps001/visibility/maps.html.

NRC (U.S. Nuclear Regulatory Commission), 2005, *Environmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina*, NUREG-1767, Office of Nuclear Material Safety and Safeguards, Washington, D.C., January.

NRCS (Natural Resources Conservation Service), 2009a, *Web Soil Survey, Mesa County Area, Colorado (Grand Junction Disposal Site)* (generated for Latitude 38.906122 N, Longitude -108.340906 W), U.S. Department of Agriculture, National Cooperative Soil Survey, accessed through http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx , July 9.

NRCS (Natural Resources Conservation Service), 2009b, *Web Soil Survey, Hawthorne Ammunition Plant, Nevada, Part of Mineral County (Hawthorne Army Depot)* (generated for Latitude 38.555015 N, Longitude - 118.593964 W), U.S. Department of Agriculture, National Cooperative Soil Survey, accessed through http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, September 1.

NRCS (Natural Resources Conservation Service), 2009c, *Web Soil Survey, Soil Map—Jackson County, Missouri (Kansas City Plant)* (generated for Latitude 38.958434 N, Longitude -94.570245 W), U.S. Department of Agriculture, National Cooperative Soil Survey, accessed through http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, July 15.

NRCS (Natural Resources Conservation Service), 2009d, *Web Soil Survey, Soil Map—Savannah River Plant Area (E-Area)* (generated for Latitude 33.266906 N, Longitude -81.664165 W), U.S. Department of Agriculture, National Cooperative Soil Survey, accessed through http://websoilsurvey.nrcs.usda.gov/ app/WebSoilSurvey.aspx, July 20.

NRCS (Natural Resources Conservation Service), 2009e, *Web Soil Survey, Soil Map—Andrews County, Texas (Waste Control Specialists Site)* (generated for Latitude 32.437417 N, Longitude -103.061434 W), U.S. Department of Agriculture, National Cooperative Soil Survey, accessed through http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, July 21.

NVDOT (Nevada Department of Transportation), 2009, *2008 Annual Traffic Report, Annual Average Daily Traffic Count Stations for Mineral County*, accessed through http://www.nevadadot.com/ reports_pubs/traffic_report/2008/, June 10.

O'Rourke, T., 2006, *Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report*, INL/EXT-06-00726, Idaho National Laboratory, Idaho Falls, Idaho, September.

Ostenaa, D.A., and D.R.H. O'Connell, 2005, *Big Lost River Flood Hazard Study Idaho National Laboratory, Idaho, Summary Document*, Report 2005 2, U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center, Seismotectonics and Geophysic Group, Denver, Colorado, November.

Perry, J., 2009, Idaho National Laboratory, Idaho Falls, Idaho, personal communication (email) to J. DiMarzio, Science Applications International Corporation, Germantown, Maryland, "Updated Reference for WM Volumes," November 13.

Poston, T.M., R.W. Hanf, R.L. Dirkes, and L.F. Morasch, eds., 2006, *Hanford Site Environmental Report for Calendar Year 2005 (Including Some Early 2006 Information)*, PNNL-15892, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., R.W. Hanf, J.P. Duncan, and R.L. Dirkes, eds., 2007, *Hanford Site Environmental Report for Calendar Year 2006 (Including Some Early 2007 Information)*, PNNL-16623, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., J.P. Duncan, and R.L. Dirkes, eds., 2008, *Hanford Site Environmental Report for Calendar Year 2007 (Including Some Early 2008 Information)*, PNNL-17603, Pacific Northwest National Laboratory, Richland, Washington, September.

Poston, T.M., J.P. Duncan, and R.L. Dirkes, eds., 2009, *Hanford Site Environmental Report for Calendar Year 2008 (including some early 2009 information)*, PNNL-18427, Pacific Northwest National Laboratory, Richland, Washington, September.

Prendergast-Kennedy, E., 2003, Pacific Northwest National Laboratory, Richland, Washington, personal communication (letter) to C. Johnson, Science Applications International Corporation, Richland, Washington, "Cultural Resources Review of Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single Shell Tanks (Tank Closure) Environmental Impact Statement (EIS), (HCRC #2003 200 044)," August 28.

Reavis, S., 2009a, Waste Control Specialists, LLC, Andrews, Texas, personal communication (email) to S. Dixon, Science Applications International Corporation, Germantown, Maryland, "*Mercury Storage EIS,*" June 16.

Reavis, S., 2009b, Waste Control Specialists, LLC, Andrews, Texas, personal communication (email) to S. Dixon, Science Applications International Corporation, Germantown, Maryland, "Request for Additional Information," August 4.

Reidel, S.P., N.P. Campbell, K.R. Fecht, and K.A. Lindsey, 1993, "Late Cenozoic Structure and Stratigraphy of South-Central Washington," *Regional Geology of Washington State*, Bulletin 80, pp. 159–180, Washington Division of Geology and Earth Resources.

Ringe Pace, B., C. Marler, H. Gilbert, D. Lowrey, and J. Braun, 2005, *Cultural Resource Assessment of the Power Line Road and T-24 at the Idaho National Laboratory*, INL/EXT-05-01033, Idaho National Laboratory, Cultural Resource Management, Idaho Falls, Idaho, December.

Rodgers, D.W., H.T. Ore, R.T. Bobo, N. McQuarrie, and N. Zentner, 2002, "Extension and Subsidence of the Eastern Snake River Plain, Idaho," in *Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province*, Idaho Geological Survey Bulletin 30, pp. 121–155.

Sackschewsky, M.R., 2003a, *Blanket Biological Review for General Maintenance Activities Within Active Burial Grounds, 200 E and 200 W Areas, ECR No. 2002-200-034*, PNNL-14133, Pacific Northwest National Laboratory, Richland, Washington, July.

Sackschewsky, M.R., 2003b, *Biological Review for the "Hanford Solid Waste EIS" – Borrow Area C (600 Area), Stockpile and Conveyance Road Area (600 Area), Environmental Restoration Disposal Facility (ERDF) (600 Area), Central Waste Complex (CWC) Expansion (200 West), 218-W-5 Expansion Area (200 West), New Waste Processing Facility (200 West), Undeveloped Portion of 218-W-4C (200 West), Western Half and Northeastern Corner of 218-W-6 (200 West), Disposal Facility Near Plutonium-Uranium Extraction (PUREX) Facility (200 East), ECR No. 2002-600-012b*, PNNL-14233, Pacific Northwest National Laboratory, Richland, Washington, April.

Sackschewsky, M.R., and J.L. Downs, 2007, *Ecological Data in Support of the "Tank Closure and Waste Management Environmental Impact Statement,"* Part 2, "Results of Spring 2007 Field Surveys," PNNL-16620, Pacific Northwest National Laboratory, Richland, Washington, May.

SCDHEC (South Carolina Department of Health and Environmental Control), 2003, *Part 70, Air Quality Permit*, *U.S. Department of Energy, Washington Savannah River Company, LLC* - Savannah River Site, Permit No. TV-0080-0041, February 19.

SCDHEC (South Carolina Department of Health and Environmental Control), 2006, *Regulation 61-62*, *Air Pollution Control Regulations and Standards*, Standard 2, "Ambient Air Quality Standards," Standard 8, "Toxic Air Pollutants," Air Pollution Control, Columbia, South Carolina.

SCDHEC (South Carolina Department of Health and Environmental Control), 2008, *Air Pollution Control Regulations and Standards,* Document No. 3224, Chapter 61 (amendments), *South Carolina State Register*, Vol. 32, Issue 10, October 24.

SCDHEC (South Carolina Department of Health and Environmental Control), 2009a, *Ambient Air Quality Data Summaries for 2007*, accessed through http://www.scdhec.gov /environment/baq/ambientairdata.aspx.

SCDHEC (South Carolina Department of Health and Environmental Control), 2009b, *Ozone Daily Maxima for 2008*, accessed through http://www.scdhec.gov/environment/baq/ambientairdata.aspx.

SCDNR (South Carolina Department of Natural Resources), 2006, *South Carolina Rare, Threatened, and Endangered Species Inventory: All Species Found in South Carolina*, accessed through https://www.dnr.sc.gov/pls/heritage/county_species.list?pcounty=all, January 17.

SCDOT (South Carolina Department of Transportation), 2009, *2008 Average Annual Daily Traffic Counts for Aiken and Barnwell Counties,* accessed through http://www.dot.state.sc.us/getting/aadt.shtml, March 23.

SCEEPP (South Carolina Earthquake Education and Preparedness Program), 2009, *About South Carolina Earthquakes*, accessed through http://scearthquakes.cofc.edu/SCEQ/aboutSCEQ.html, September 10.

Schinner, J.R., 2003, Science Applications International Corporation, Germantown, Maryland, personal communication (telephone conversation) with D. Stapp, Pacific Northwest National Laboratory, Richland, Washington, "Paleontological Resources of the 200 Areas," June 18.

SOC (Special Operating Consulting, LLC), 2009, *Response to the Department of Energy's (DOE's) Request for Expressions of Interest for the Long-Term Management and Storage of Elemental Mercury*, April 20.

SREL (Savannah River Ecology Laboratory), 2008, *The Savannah River Site National Environmental Research Park,* The University of Georgia, accessed through http://www.uga.edu/srel/ Snapshots/NERP.htm, February 18.

SRNL (Savannah River National Laboratory), 2007, *Air Dispersion Modeling for the SRS Title V Permit Renewal*, SRNL-ATG-2007-00021, Aiken, South Carolina, October 4.

SRNS (Savannah River Nuclear Solutions), 2008, "News from the Savannah River Site, New Highly Efficient, Clean Energy Steam Plant Begins Operations at the Savannah River Site," accessed through http://www.srs.gov/general/news/releases/NR2008_SteamPlant.pdf, October 24.

SRNS (Savannah River Nuclear Solutions), 2009, *Facts About the Savannah River Site*, accessed through http://www.srs.gov/general/news/factsheets/srs.pdf, June.

SRS (Savannah River Site), 2008, *Environmental Data for 2007, Toxic Air Pollutant Emissions (2004–2006)*, accessed through http://www.srs.gov/general/pubs/ERsum/er08.

SRS (Savannah River Site), 2009, *"Mercury Storage EIS" Data Call Response.*

Stoller (Stoller Legacy Management Team), 2009, *Comprehensive Emergency Management System*, LMS/POL/ S04326-3.0

TCEQ (Texas Commission on Environmental Quality), 2009, *Permit Amendment, Permit Number: 72653, Commercial Hazardous Waste Management Facility*, Andrews County, Texas, May 18.

TDEC (Tennessee Department of Environment and Conservation), 2007, *Mercury Levels in Tennessee Fish*, Nashville, Tennessee, May.

TDEC (Tennessee Department of Environment and Conservation), 2008, *Posted Streams, Rivers, and Reservoirs*, accessed through http://www.state.tn.us/environment/water.shtml, August.

TTD (Tennessee Transportation Department), 2009, *2008 Average Annual Daily Traffic Book*, accessed through http://www.tdot.state.tn.us/projectplanning/adt.asp.

TXDOT (Texas Department of Transportation), 2009, *TXDOT Statewide Planning Map, 2007 Average Annual Daily Traffic Counts*, accessed through http://www.txdot.gov/apps/statewide_mapping/ StatewidePlanningMap.html, July 21.

USFWS (U.S. Fish and Wildlife Service), 2008, *Hanford Reach National Monument Final Comprehensive Conservation Plan and Environmental Impact Statement, Adams, Benton, Grant and Franklin Counties, Washington,* Burbank, Washington, August.

USFWS (U.S. Fish and Wildlife Service), 2009a, *USFWS Critical Habitat Mapping System, Crithab Mapper*, accessed through http://crithab.fws.gov/, June 22.

USFWS (U.S. Fish and Wildlife Service), 2009b, *Species by County Report (Mesa, CO)*, accessed through http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=08077, June 1.

USFWS (U.S. Fish and Wildlife Service), 2009c, *Species by County Report (Mineral County, NV)*, accessed through http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips =32021, June 1.

USGS (U.S. Geological Survey), 2009a, *US Earthquake Information by State, Colorado, Earthquake History*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/regional/ states/colorado/history.php, January 30.

USGS (U.S. Geological Survey), 2009b, *US Earthquake Information by State, Colorado, Notable Earthquakes, Largest Earthquake in Colorado*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/regional/states/events/1882_11_08.php, January 30.

USGS (U.S. Geological Survey), 2009c, *Earthquake Search, Circular Area, NEIC: Earthquake Search Results*, Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 38.906122 N, Longitude -108.340 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, July 1.

USGS (U.S. Geological Survey), 2009d, *2008 United States National Seismic Hazard Maps, Interactive Maps*, accessed through http://earthquake.usgs.gov/research/hazmaps/products_data/2008/, July 1.

USGS (U.S. Geological Survey), 2009e, *US Earthquake Information by State, Washington, Notable Earthquakes, Largest Earthquake in Washington*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/regional/states/events/1872_12_15.php, July 1.

USGS (U.S. Geological Survey), 2009f, *Earthquake Search, Circular Area, NEIC: Earthquake Results,* Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 46.551329 N, Longitude -119.578 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, July 1.

USGS (U.S. Geological Survey), 2009g, *Earthquake Search, Circular Area, NEIC: Earthquake Search Results,* Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 38.555015 N, Longitude -118.593 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, July 1.

USGS (U.S. Geological Survey), 2009h, *Earthquake Search, Circular Area, NEIC: Earthquake Search Results,* Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 43.567975 N, Longitude -112.931769 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, July 1.

USGS (U.S. Geological Survey), 2009i, *US Earthquake Information by State, Missouri, Notable Earthquakes, Largest Earthquake in Missouri*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/regional/states/events/1811-1812.php#february_7, July 15.

USGS (U.S. Geological Survey), 2009j, *Earthquake Search, Circular Area, NEIC: Earthquake Search Results,* Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 33.266906 N, Longitude -81.664165 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, July 1.

USGS (U.S. Geological Survey), 2009k, *Water-Data Report 2008, 06893500 Blue River at Kansas City, MO, Lower Missouri Basin, Blue Subbasin*, Missouri Water Resource Center, accessed through http://waterdata.usgs.gov/nwis/nwisman/?site_no=06893500&agency_cd=USGS, July 16.

USGS (U.S. Geological Survey), 2009l, *Earthquake Search, Circular Area, NEIC: Earthquake Search Results,* Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 38.958434 N, Longitude -94.5792 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, July 1.

USGS (U.S. Geological Survey), 2009m, *Earthquake Search, Circular Area, NEIC: Earthquake Search Result*, Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 32.437417 N, Longitude -103.061434 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, July 1.

USGS (U.S. Geological Survey), 2009n, *Earthquake Search, Circular Area, NEIC: Earthquake Search Result*, Search Parameters: USGS/NEIC (PDE) 1973 – Present Data Base, Latitude 35.98577 N, Longitude -84.258916 W, Radius 100 km, Earthquake Hazards Program, National Earthquake Information Center, accessed through http://neic.usgs.gov/neis/epic/epic_circ.html, August 24.

Vaughan, B.E., and W.H. Rickard, 1977, *Hanford National Environmental Research Park (NERP), A Descriptive Summary of the Site and Site Related Research Programs, 1952–1977*, PNL-2299, Pacific Northwest National Laboratory, Richland, Washington, November.

WCS (Waste Control Specialists, LLC), 2007a, *Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste,* Rev. 12a, Andrews, Texas, March 16.

WCS (Waste Control Specialists, LLC), 2007b, *Socioeconomic Impacts of the Waste Control Specialists Proposed Low-Level Radioactive Waste Disposal Facility, Andrews County, Texas*, Dallas, Texas, March 16.

WCS (Waste Control Specialists, LLC), 2008a, *WCS Renewal License Application*, Rev. 0, Andrews, Texas, July 3.

WCS (Waste Control Specialists, LLC), 2008b, *Consolidated Emergency Response Plan*, ERP-100, Rev. 3A, Andrews, Texas, March 4.

WCS (Waste Control Specialists, LLC), 2009a, Response to DOE Solicitation No: DE-SOL-0000415, *Expression of Interest, Long-Term Management and Storage of Elemental Mercury*, Dallas, Texas, April 16.

WCS (Waste Control Specialists, LLC), 2009b, *"Mercury Storage EIS" Data Call Response.*

WDFW (Washington Department of Fish and Wildlife), 2009, *Priority Habitats and Species,* accessed through http://wdfw.wa.gov/hab/phslist.htm, August 16.

Wenzel, D.R., H.K. Peterson, and R.L. Dickson, 1993, *INEL Historical Dose Evaluation – Reconstruction of Operational Airborne Releases of Radioactivity to the Environment*, Idaho Falls, Idaho.

WHPP (Worker Health Protection Program), 2008, *The Worker Health Protection Program: About WHPP*, accessed through http://www.worker-health.org/aboutwhpp.html.

Wilkison, D.H., D.J. Armstrong, R.E. Brown, B.C. Poulton, J.D. Cahill, and S. D. Zaugg, 2005, *Water-Quality and Biologic Data for the Blue River Basin, Kansas City Metropolitan Area, Missouri and Kansas, October 2000 to October 2004*, U.S. Geological Survey, Data Series 127, accessed through http://pubs.usgs.gov/ds/2005/127/.

Wiser, T., 2008, Idaho National Laboratory, Idaho Falls, Idaho, personal communication (email) to T. Binder, Science Applications International Corporation, Germantown, Maryland, "INL Employee Residence Distribution," March 5.

Wisness, S.H., 2000, U.S. Department of Energy, Richland Operations Office, Richland, Washington, personal communication (letter) to S. Otterson, Washington State Department of Ecology, Olympia, Washington, "*Calendar Year 1999 Nonradioactive Inventory of Airborne Emissions Report,*" 00-OSS-301, April 17.

WRCC (Western Region Climate Center), 2009a, *Western Region Climate Summaries, Colorado, Grand Junction,* accessed through http//www.wrcc.dri.edu/CLIMATEDATA.html.

WRCC (Western Region Climate Center), 2009b, *Hawthorne, Nevada, Period of Record Monthly Climate Summary,* accessed through http://www.wrcc.dri.edu.

WSDOT (Washington State Department of Transportation), 2008, *Annual Traffic Report*, accessed through http://www.wsdot.wa.gov/mapsdata/tdo/annualtrafficreport.htm.

WSRC (Westinghouse Savannah River Company, LLC), 1993, *Savannah River Site Environmental Report for 1992,* WSRC-TR-93-075, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company, LLC), 1994, *Savannah River Site Environmental Report for 1993,* WSRC-TR-94-075, Aiken, South Carolina.

WSRC (Washington Savannah River Company, LLC), 2006a, *Savannah River Site Environmental Report for 2005,* WSRC-TR-2006-00007, Aiken, South Carolina.

WSRC (Washington Savannah River Company, LLC), 2006b, *SRS Ecology Environmental Information Document*, WSRC-TR-2005-00201, Aiken, South Carolina.

WSRC (Washington Savannah River Company, LLC), 2006c, *Facts About the Savannah River Site: Effluent Treatment Project*, accessed through http://www.srs.gov/general/news/factsheets/etp/pdf, February.

WSRC (Washington Savannah River Company, LLC), 2007a, *Savannah River Site Annual Meteorology Report for 2006 (u),* WSRC-TR-2007-00118, Aiken, South Carolina, April.

WSRC (Washington Savannah River Company, LLC), 2007b, *Savannah River Site Environmental Report for 2006,* WSRC-TR-2007-00008, Aiken, South Carolina.

WSRC (Washington Savannah River Company, LLC), 2007c, *Facts About the Savannah River Site: SRS Ship to WIPP and Transuranic Waste Program,* accessed through http://www.srs.gov/general/news/factsheets/truw/pdf, December.

WSRC (Washington Savannah River Company, LLC), 2007d, *Facts About the Savannah River Site: Liquid Nuclear Waste Processing Facilities*, accessed through http://www.srs.gov/general/news/factsheet/lnwpf.pdf.

WSRC (Washington Savannah River Company, LLC), 2007e, *Facts About the Savannah River Site: Saltstone Facility,* accessed through http://www.srs.gov/general/news/factsheets/salt/pdf, December.

WSRC (Washington Savannah River Company, LLC), 2008, *E-Area Low-Level Waste Facility DOE 435.1 Performance Assessment,* WSRC-STI-2007-00306, Rev. 0., July.

Code of Federal Regulations

10 CFR 40.27, U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites."

10 CFR 100, U.S. Nuclear Regulatory Commission, "Reactor Site Criteria."

14 CFR 150, Federal Aviation Administration, U.S. Department of Transportation, "Airport Noise Compatibility Planning."

33 CFR 328.3, U.S. Army Corps of Engineers, "Definition of Waters of the United States."

40 CFR 50, U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR 61.90 – 61.97, U.S. Environmental Protection Agency, "National Emission Standards for Hazardous Air Pollutants," Subpart H, "Natural Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities."

40 CFR 70, U.S. Environmental Protection Agency, "State Operating Permit Programs."

40 CFR 81.306, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Colorado."

40 CFR 81.311, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Georgia."

40 CFR 81.313, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Idaho."

40 CFR 81.326, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Missouri."

40 CFR 81.329, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Nevada."

40 CFR 81.332, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: New Mexico."

40 CFR 81.341, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: South Carolina."

40 CFR 81.343, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Tennessee."

40 CFR 81.344, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Texas."

40 CFR 81.348, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Washington."

40 CFR 81.434, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart D, "Identification of Mandatory Class I Federal Areas Where Visibility Is an Important Value: Washington."

40 CFR 141, U.S. Environmental Protection Agency, "National Primary Drinking Water Regulations."

40 CFR 143, U.S. Environmental Protection Agency, "National Secondary Drinking Water Regulations."

40 CFR 192.11(e), U.S. Environmental Protection Agency, "Definitions."

<u>Colorado Code of Regulations</u>

5 CCR 1002-31, Colorado Department of Public Health and Environment, Water Quality Control Commission, "The Basic Standards and Methodologies for Surface Water," May 31, 2008.

5 CCR 1002-35, Colorado Department of Public Health and Environment, Water Quality Control Commission, "Classifications and Numeric Standards for Gunnison And Lower Dolores River Basins," July 1, 2007.

5 CCR 1002-41, Colorado Department of Public Health and Environment, Water Quality Control Commission, "Basic Standard for Groundwater," May 31, 2008.

<u>Colorado Revised Statutes</u>

CRS 25-12-103, "Maximum Permissible Noise Levels."

Executive Orders

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, February 11, 1994.

Federal Register

65 FR 37253, Executive Office of the President, 2000, "Proclamation 7319 of June 9, 2000, Establishment of the Hanford Reach National Monument," June 13.

71 FR 61144, U.S. Environmental Protection Agency, 2006, Final Rule, "National Ambient Air Quality Standards for Particulate Matter," October 17.

Idaho Administrative Code

IDAPA 58.01.01.577, Idaho Department of Environmental Quality, "Ambient Air Quality Standards for Specific Air Pollutants," Boise, Idaho, May 1, 1994.

IDAPA 58.01.02, Idaho Department of Environmental Quality, "Water Quality Standards," Boise, Idaho, 2009.

IDAPA 58.01.11, Idaho Department of Environmental Quality, "Ground Water Quality Rule," Boise, Idaho, 2009.

IDAPA 58.01.17, Idaho Department of Environmental Quality, "Rules for the Reclamation and Reuse of Municipal and Industrial Wastewater," Boise, Idaho, 2009.

Kansas City Code of Ordinances

KCC Chapter 46, "Noise Control," Article IV, "Sound Levels by Receiving District."

Missouri Code of State Regulations

10 CSR 20-7.031, Clean Water Commission, Department of Natural Resources, "Water Quality Standards," May 31, 2009.

Nevada Administrative Code

NAC 445A.124, State Environmental Commission, "Class A Waters: Description; Beneficial Uses; Quality Standards," April 23, 2004.

NAC 445A.1693, State Environmental Commission, "Beneficial Uses For Walker Lake," January 18, 2002.

South Carolina Code of Regulations

SCR 61-69, South Carolina Department of Health and Environmental Control, "Classified Waters," June 23, 2006.

Tennessee Code Annotated

TCA 68-211-801 et seq., Solid Waste Management Act of 1991.

United States Code

15 U.S.C. 2601 et seq., Toxic Substances Control Act.

16 U.S.C. 470 et seq., National Historic Preservation Act.

16 U.S.C. 470aa et seq., Archaeological Resources Protection Act of 1979.

16 U.S.C. 1271 et seq., Wild and Scenic Rivers Act.

16 U.S.C. 1531 et seq., Endangered Species Act of 1973.

42 U.S.C. 6901 et seq., Resource Conservation and Recovery Act of 1976.

42 U.S.C. 7401 et seq., Clean Air Act of 1970.

42 U.S.C. 7901 et seq., Uranium Mill Tailings Radiation Control Act of 1978.

42 U.S.C. 9601 et seq., Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

U.S. Department of Energy Orders

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, Change 2, January 7, 1993.

U.S. Public Laws

P.L. 100-605, Hanford Reach Study Act.

P.L. 104-333, Omnibus Parks and Public Lands Management Act of 1996.

Washington Administrative Code

WAC 173-60, Washington State Department of Ecology, "Maximum Environmental Noise Levels," Olympia, Washington, December 2000.

WAC 173-201A, Washington State Department of Ecology, "Water Quality Standards for Surface Waters of the State of Washington," Olympia, Washington, November 20, 2006.

WAC 173-303, Washington State Department of Ecology, "Dangerous Waste Regulations," Olympia, Washington, November 2004.

WAC 173-401, Washington State Department of Ecology, "Operating Permit Regulation," Olympia, Washington, September 2002.

WAC 173-460, Washington State Department of Ecology, "Controls for New Sources of Toxic Air Pollutants," Olympia, Washington, July 1998.

WAC 173-470, Washington State Department of Ecology, "Ambient Air Quality Standards for Particulate Matter," Olympia, Washington, January 1989.

WAC 173-474, Washington State Department of Ecology, "Ambient Air Quality Standards for Sulfur Oxides," Olympia, Washington, September 1987.

WAC 173-475, Washington State Department of Ecology, "Ambient Air Quality Standards for Carbon Monoxide, Ozone, and Nitrogen Dioxide," Olympia, Washington, February 1980.

WAC 173-481, Washington State Department of Ecology, "Ambient Air Quality and Environmental Standards for Fluorides," Olympia, Washington, August 2005.

WAC 173-490, Washington State Department of Ecology, "Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOC)," Olympia, Washington, February 1998.

CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

Chapter 4 presents the potential impacts on the human environment of implementing reasonable alternatives for the long-term management and storage of elemental mercury. Seven candidate sites for mercury storage are evaluated. A No Action Alternative is also evaluated, which includes the impacts of continued storage of elemental mercury in the absence of a facility designated by the U.S. Department of Energy. Each of the alternatives is discussed separately in Sections 4.2 through 4.9, beginning with the No Action Alternative. Activities and impacts associated with closure of mercury storage facilities are presented in Section 4.10. Cumulative impacts, mitigation measures, and resource commitments are presented in Sections 4.11, 4.12, and 4.13, respectively.

4.1 INTRODUCTION

This chapter describes the potential environmental and human health impacts associated with implementation of each of the alternatives considered in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement (Mercury Storage EIS)*. As presented in Chapter 1, the U.S. Department of Energy's (DOE's) proposed action is to select a suitable location for the long-term management and storage of elemental mercury generated in the United States. The seven candidate sites evaluated as alternatives for long-term mercury[1] storage comprise the following: Grand Junction Disposal Site (GJDS), Hanford Site (Hanford), Hawthorne Army Depot, Idaho National Laboratory (INL), Kansas City Plant (KCP), Savannah River Site (SRS), and Waste Control Specialists, LLC (WCS), site.

Detailed descriptions of each alternative are provided in Chapter 2, Section 2.4. DOE has identified the WCS site as the Preferred Alternative, as described in Chapter 2, Section 2.5. A summary comparison of the projected environmental effects among alternatives is presented in Chapter 2, Section 2.7. Site-specific information for each of the environmental disciplines and resource areas considered is presented in Chapter 3; this information provides the basis for this environmental consequences analysis. Specifically, the environmental impacts analyses performed consider all disciplines where the potential exists for effects on the natural and human environment, including consideration of resource conditions that could affect the implementation of alternatives, as follows:

- Land use and visual resources
- Geology, soils, and geologic hazards
- Water resources
- Meteorology, air quality, and noise
- Ecological resources
- Cultural and paleontological resources
- Site infrastructure
- Waste management
- Occupational and public health and safety
- Ecological risk
- Socioeconomics
- Environmental justice

These disciplines were analyzed in a manner commensurate with the importance of the issue or the relative expected level of impact under a specific alternative—the sliding-scale assessment approach (DOE 2004:1, 2).

[1] Unless indicated otherwise, elemental mercury is referred to hereafter simply as "mercury" in this environmental impact statement.

Although the Mercury Export Ban Act of 2008 (P.L. 110-414) contemplates indefinite storage, DOE has used a 40-year period of analysis in this *Mercury Storage EIS* for the purposes of evaluating potential environmental impacts associated with long-term storage. This 40-year timeframe corresponds to the planning projection for receipt into storage of up to 10,000 metric tons (11,000 tons) of elemental mercury, as described in Chapter 2, Section 2.1. It also reflects the expected operational design life of the proposed building or buildings for long-term storage of elemental mercury. A 40-year period of analysis is consistent with the timeframe used in previous analyses by the Defense Logistics Agency (DLA 2004a:1-1) and the U.S. Environmental Protection Agency (EPA) (EPA 1997). These are estimates with a degree of uncertainty; therefore, it is possible that more or less than 10,000 metric tons (11,000 tons) of mercury could eventually require storage for a period longer or shorter than 40 years. There currently is no approved method of treating high-purity elemental mercury for disposal. It is not known when such a treatment method might become available. The new mercury storage facility could be constructed in a modular fashion to accommodate storage of mercury on an as-needed basis (see Chapter 2, Sections 2.2.1 and 2.3.1). The ability to build the storage facility in a modular fashion would also ensure that the facility is sized correctly for the amount of mercury that would eventually require storage. As a conservative assumption, the impacts analyses presented in this chapter evaluate the construction and operation of a new mercury storage facility with 13,950 square meters (150,000 square feet) of storage space, which is necessary to accommodate the projected volume of elemental mercury over the 40-year period of analysis. Additional National Environmental Policy Act (NEPA) analysis would be required to expand the facility(ies) to accept more than 10,000 metric tons (11,000 tons) of mercury or extend its operations beyond the 40-year period of analysis. Closure of the storage facility would occur at the end of storage activities, as discussed in Section 4.10.

The results of the environmental impacts analysis performed for the alternatives evaluated in this *Mercury Storage EIS* were calculated using appropriate computer models and by applying projected facility construction and operations parameters, as appropriate. Appendix B describes the general impact assessment methods employed for each discipline and presents the region of influence (ROI) for each resource area evaluated. Appendix C presents data that were used to support the analysis of impacts from construction and operations of a mercury storage facility or facilities at each of the alternative locations analyzed in this environmental impact statement (EIS). Finally, detailed descriptions of the methods for the evaluation of human health and ecological risk from normal operations, facility accidents, and transportation are presented in Appendix D.

4.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, DOE would not designate and operate a facility for the long-term management and storage of elemental mercury generated within the United States, as further described in Chapter 2, Section 2.4.1. Elemental mercury would continue to be generated from other sources, including chlor-alkali facilities, the gold-mining industry, and waste reclamation and recycling facilities. As identified in Chapter 1, Table 1–1, the vast majority of mercury covered by this EIS would be generated by reclamation and recycling facilities and the gold-mining industry. Under the No Action Alternative, this mercury would have to be stored indefinitely at multiple, privately owned (i.e., non-DOE) facilities. It could be argued that the biggest impact of the No Action Alternative would be widely dispersed storage. The potential benefit of Federal action would be long-term storage and maintenance of this material as opposed to continued, dispersed storage by multiple private entities. Excess elemental mercury in storage that could not be sold would be stored in accordance with law. Non-DOE storage facilities may be constructed and some non-DOE storage sites may need to modify their storage capacity by constructing additional storage space. Such storage would not necessarily occur at the sites identified as potential sources of excess mercury. This storage service might be provided by a commercial waste management company(ies). In brief, such facilities vary in location, size, geographic distribution, natural and human environments, and in the nature of their operations. Therefore, the potential for and nature of environmental impacts from implementing the No Action Alternative at such sites would be highly speculative.

The approximately 1,200 metric tons (1,330 tons) of DOE mercury currently stored in some 35,000 3-liter (3-L) (34.6-kilogram [76-pound]) flasks at the Y–12 National Security Complex (Y–12) would continue to be managed and stored in this location. No new construction would be required.

In the following sections, therefore, the potential impacts on most resource areas at non-DOE storage facilities are discussed qualitatively, while continued mercury storage at DOE's Y–12 is discussed semi-quantitatively.

4.2.1 Land Use and Visual Resources

No impacts on land use and visual resources are expected at most non-DOE storage sites and at Y–12 as no new construction or substantial facility modifications would be required. Land use would not change at most non-DOE sites, and land use at Y–12 would remain predominantly industrial. As indicated in Section 4.2, non-DOE storage facilities may be constructed, and some non-DOE storage sites may need to modify their storage capacity, resulting in land disturbance and related visual impacts. Construction of RCRA-compliant hazardous waste treatment, storage, and disposal (TSD) facilities (40 CFR 264) could trigger additional land use and zoning requirements at existing sites, depending on what would be allowable under local land use plans and zoning ordinances. As discussed in Section 4.2, any analysis of impacts on land use and visual resources at non-DOE storage sites would be highly speculative at this time.

4.2.2 Geology, Soils, and Geologic Hazards

Continued mercury storage at Y–12 would have no impact on geologic or soil resources as there would be no new construction. The potential for geologic conditions to affect existing facilities at Y–12 is low (see Chapter 3, Section 3.9.2.3). However, earthquakes have historically produced ground motion effects equivalent to Modified Mercalli Intensity (MMI) VI at the site, and the maximum predicted earthquake for Y–12 could produce intensities of up to MMI VII (see Appendix B, Table B–4). The predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.22 *g* (force of acceleration relative to that of Earth's gravity). While ground motion in this range could cause considerable damage to ordinary structures, damage to properly designed and constructed facilities is not expected. DOE applies the seismic engineering provisions from the latest building codes as the minimum standard for the design, construction, and upgrade of its facilities.

For non-DOE sites, it is assumed that such storage facilities would be compliant with modern building codes that specify criteria for seismic design in accordance with the assessed hazard for the affected locality. At some locations, construction of new storage space, such as a typical single-story warehouse structure on a concrete foundation, would have negligible-to-minor incremental impacts on geology and soils and geologic resource demands. Mercury storage space constructed to be compliant with RCRA permit requirements, as discussed in Section 4.2.1, or existing, commercial RCRA-permitted facilities, where excess elemental mercury could be sent, would have to meet applicable location, design, construction, and performance standards under Title 40 of the *Code of Federal Regulations* (CFR), Part 264, to safeguard the stored material from release, including threats from natural hazards such as earthquakes.

An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.2.9.2.

4.2.3 Water Resources

No impacts on water resources are expected at Y–12 as there would be no new construction. As discussed in Section 4.2, any analysis of impacts on water resources at non-DOE storage sites would be highly speculative at this time. At some non-DOE sites, new facility construction that might be undertaken would expose soils and sediments to possible erosion by heavy rainfall or by wind and could convey other pollutants in stormwater runoff. Nevertheless, appropriate soil erosion and sediment control measures and spill prevention and waste management practices would serve to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts. It is assumed that all construction would be conducted in accordance with applicable state- or EPA-issued National Pollutant Discharge Elimination System (NPDES) general permits for stormwater discharges associated with construction activities.

Routine mercury storage at new or existing non-DOE storage facilities and ongoing mercury storage at Y–12 would have no impact on surface water or groundwater. Potential impacts on water resources would be limited to the potential for spills and other unforeseen releases that might occur during mercury storage and/or during shipment, such as for transport to an RCRA-permitted storage facility. DOE assumes that non-DOE storage facility operators would adhere to their established procedures and safeguards for proper management and handling of elemental mercury, facility maintenance, and spill prevention and response. Mercury flasks would continue to be stored at Y–12 in wooden box pallets within the existing warehouse, which has epoxy-sealed and curbed concrete floors. Appropriate best management practices for material storage and handling, including inspections of mercury storage locations and mercury vapor monitoring, would continue. All activities would be conducted in accordance with applicable DOE policies and procedures that address spill prevention, response, and cleanup. DOE maintains a stormwater pollution prevention plan for Y–12 to minimize the discharge of pollutants in stormwater runoff (see Chapter 3, Section 3.9.3.1).

4.2.4 Meteorology, Air Quality, and Noise

4.2.4.1 Meteorology

Meteorological events such as heavy snow, tornadoes, high winds, and lightning can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events vary with the locations of existing mercury storage facilities (see Section 4.2.9.3). It is assumed that new and existing non-DOE storage facilities and sources of elemental mercury would be compliant with modern building codes that specify criteria for structural loading in accordance with the assessed meteorological hazards. Mercury storage space constructed to be compliant with RCRA permit requirements, as discussed in Section 4.2, or existing, commercial RCRA-permitted facilities, where excess elemental mercury could be sent from non-DOE storage facilities, would meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31, and applicable state RCRA requirements to prevent the release of stored materials. With regard to DOE storage facilities, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) also explicitly require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards. This includes hurricanes and tornadoes, high winds, excessive snow or ice, etc. The Order also stipulates natural phenomena hazards mitigation for DOE facilities. East-central Tennessee has a temperate climate, and the region is not prone to hurricanes, frequent tornadoes, or heavy snows. Regardless, continued use of the existing Y–12 warehouse for storage of elemental mercury would be subject to periodic review to minimize the risk from meteorological phenomena.

4.2.4.2 Air Quality

Impacts on air quality are anticipated to be negligible from ongoing activities related to storage of elemental mercury. No construction of additional storage space is expected to be required at Y–12. However, new construction or construction of additional storage space at some non-DOE storage sites would result in short-term increases in emissions of criteria and toxic air pollutants from construction equipment. Also, additional short-term air quality impacts would result from truck or rail shipments of elemental mercury from non-DOE storage facilities such as for storage in an RCRA-permitted storage facility. The existing primary sources of criteria air pollutants at any existing storage sites could include heating systems, boilers, and material-handling equipment such as forklifts.

4.2.4.3 Noise

Most activities related to storage, such as inspections, would be performed inside the new or existing storage facilities and would result in negligible or no noise impacts on nearby noise-sensitive areas. Regular maintenance of the storage facilities is expected to continue and is not expected to result in any offsite noise impacts. At non-DOE storage facilities, activities associated with readying elemental mercury for shipment, such as for transport to an RCRA-permitted storage facility, could result in short-term increases in offsite noise, including noise associated with increased truck traffic. No increase in truck traffic is expected at Y–12.

4.2.5 Ecological Resources

As indicated in Section 4.2, some non-DOE storage sites may require new construction or may need to expand and/or modify their storage capacity; construction activities would result in land disturbance, with the potential to disturb terrestrial resources and other ecological resources, and related visual impacts. As discussed in Section 4.2, any analysis of impacts on ecological resources at non-DOE storage sites would be highly speculative at this time. Under the No Action Alternative, no existing facilities at Y–12 would be modified, nor would any new mercury storage facilities be constructed at Y–12, and no incremental impacts on ecological resources would occur.

4.2.6 Cultural and Paleontological Resources

As discussed in Section 4.2, any analysis of impacts on cultural and paleontological resources at non-DOE storage sites would be highly speculative at this time. At Y–12, there are 76 existing historic properties that, along with an associated historic district, are eligible for listing in the National Register of Historic Places (NRHP) (see Chapter 3, Section 3.9.6.2). There would be no impact on these properties at Y–12 from continued mercury storage.

4.2.7 Site Infrastructure

Depending on the need for new construction or for non-DOE storage sites to modify their mercury storage capacity, as discussed in Section 4.2, additional increases in utility resource consumption could occur. However, utility demands for warehouse operations, including lighting and ventilation, are not particularly resource intensive. Under the No Action Alternative, there would be no change in utility infrastructure demands associated with continued storage of elemental mercury at Y–12. Operation of the storage warehouse is expected to continue to require up to about 0.2 megawatt-hours of electricity and 988 liters (261 gallons) of water annually (DLA 2004a:4-28).

4.2.8 Waste Management

Mercury storage operations at non-DOE storage sites and at Y–12 under the No Action Alternative would generate small volumes of mercury-contaminated waste. The waste would primarily consist of cleaning rags used during facility maintenance activities, personal protective equipment (PPE), and materials used during spill response activities. Existing site waste management practices are assumed to continue at all non-DOE sites, with mercury-contaminated wastes shipped off site by a commercial waste management company for proper disposal. As discussed in Section 4.2, any analysis of impacts on waste management at non-DOE storage sites would be highly speculative at this time.

It is estimated that 109 55-gallon (208-liter) drums of mercury-contaminated waste would be generated based on a 40-year period of analysis of continued mercury storage at Y–12. This volume (equivalent to

3 55-gallon drums annually) is significantly less than the total amount of routine hazardous waste generated each year at Y–12 (see Chapter 3, Section 3.9.8). Hazardous waste generated during routine Y–12 operations is shipped off site for treatment and disposal at either DOE or licensed commercial facilities.

4.2.9 Occupational and Public Health and Safety

The No Action Alternative is described in the introductory paragraphs of Section 4.2. The analysis of risks associated with the No Action Alternative can be divided into two parts:

- Risks associated with the operation of non-DOE storage facilities. These risks are very hard to describe quantitatively because to do so would be highly speculative based on the available data.

- Risks associated with the storage of mercury at Y–12. These risks can be analyzed and characterized to the same level of detail as those for the candidate storage facilities under the action alternatives.

Before discussing the human health risks associated with specific alternatives, it is convenient to describe assumptions, data, and methods of analysis that are common to all alternatives. This is done in Section 4.2.9.1. Section 4.2.9.2 then discusses normal operations risks under the No Action Alternative, followed by facility accident risks (see Section 4.2.9.3), transportation risks (see Section 4.2.9.4), and intentional destructive acts (see Section 4.2.9.5). In addition, there are a few site-specific considerations that are discussed in the appropriate sections on occupational and public health and safety.

4.2.9.1 Considerations Common to All Alternatives

Appendix D of this *Mercury Storage EIS* contains a detailed description of the analyses that were performed to assess the human health risks to workers and members of the public. Many of the analytical considerations and many of the results are the same under each alternative. Therefore, the reader is frequently referred to Appendix D to avoid excessive repetition.

4.2.9.1.1 Toxic Effects of Mercury

This study considers three forms of mercury:[2] (a) elemental mercury, which is the form in which mercury would be stored and transported; (b) inorganic/divalent mercury,[3] which is the form into which elemental mercury can be converted if it is involved in a fire;[4] and (c) methylmercury, which can potentially be formed if elemental mercury or inorganic mercury becomes mixed with soil or sediment.[5] EPA (1997a–c), in its *Mercury Study Report to Congress*, provides exhaustive descriptions of the potential effects of these forms of mercury on humans. Appendix D, Sections D.3.1 through D.3.3, provide a summary of that information; a condensed version is presented briefly below.

[2] The consequences of exposure to mercury depend on the form of mercury. See Appendix D, Section D.1.1.2, for a discussion. For a more-detailed primer on the forms of mercury, see GreenFacts (2009).

[3] Mercury can exist in three oxidation states (EPA 1997d:2-2): elemental (Hg^0), mercurous, (Hg_2^{2+}) and mercuric (Hg^{2+}). Mercurous compounds are unstable in the environment. In this EIS, Hg^{2+} is referred to interchangeably as "inorganic" or "divalent" mercury; both terms are shorthand for inorganic mercury compounds. See Appendix D, Section D.1.1.2, for further discussion.

[4] The potential formation of divalent mercury in a fire is extremely important for the assessment of risk in this EIS. Elemental mercury (i.e., the form in which the mercury would be stored) has a very small dry deposition velocity and is only slightly affected by precipitation scavenging (i.e., washout by rain or snow). However, divalent mercury has a significant dry deposition velocity and is quite effectively removed by precipitation. Therefore, the only scenarios in this EIS that lead to deposition on the ground from a vapor cloud are the fire scenarios. See Appendix D, Section D.7.3.3, for further discussion.

[5] Methylmercury is used as a surrogate for organomercuric compounds, as is the case in EPA's *Mercury Study Report to Congress* (EPA 1997a). See Appendix D, Section D.1.1.2, for further discussion.

The principal route of exposure to elemental mercury is by inhalation. Once absorbed through the lungs, it is readily distributed throughout the body and causes a range of adverse neurological effects at low exposure levels, such as (a) tremors; (b) emotional liability; (c) insomnia; (d) muscle weakness, twitching, and atrophy; (e) headaches; and (f) impairment of cognitive function. Elemental mercury may also result in adverse renal effects and pulmonary dysfunction.

In contrast to elemental mercury, ingestion of inorganic mercury salts with subsequent absorption through the gastrointestinal tract is an important route of exposure. Adverse effects of exposure to inorganic mercury include kidney disease, peripheral and motor neurotoxicity, and renal impairment.

Methylmercury is a highly toxic substance that is readily absorbed through the gastrointestinal tract. As is well known, the principal concern is ingestion of methylmercury in fish. Once in the body, it readily passes into the adult and fetal brain, where it accumulates and is subsequently converted to inorganic mercury. Consequently, the nervous system is considered to be the critical target organ system for methylmercury toxicity. The nervous system of developing organisms is considered of special concern.

Human Receptors

The purpose of the human health analysis in this EIS is to assess the risk of exposure of various human receptors to levels of mercury in its various forms that could cause health effects, as described in the foregoing paragraphs. Three human receptors are considered:

- Involved workers – those inside the storage building or working on unloading mercury trucks or railcars
- Noninvolved workers – those nearby but still on site
- Members of the public

Assessment of Risk

Risk under any specific accident scenario is generally expressed as a function of two numbers: the predicted frequency of occurrence of the scenario and the predicted severity of the consequences. For the purposes of this analysis, the matrix shown in Figure 4–1 was used to assess the magnitude of the risk.

The derivation of the frequencies (*f*) of the scenarios that were considered for this risk assessment is provided in Appendix D, Section D.1.1.1. The predicted frequencies are then assigned to one of four bands:

- Frequency Level (FL)-IV (high) – more than or equal to once in 100 years ($f \geq 10^{-2}$ per year)
- FL-III (moderate) – less than once in 100 years to once in 10,000 years (10^{-2} per year $> f \geq 10^{-4}$ per year)
- FL-II (low) – less than once in 10,000 years to once in 1 million years (10^{-4} per year $> f \geq 10^{-6}$ per year)
- FL-I (negligible) – less than once in 1 million years ($f < 10^{-6}$ per year)

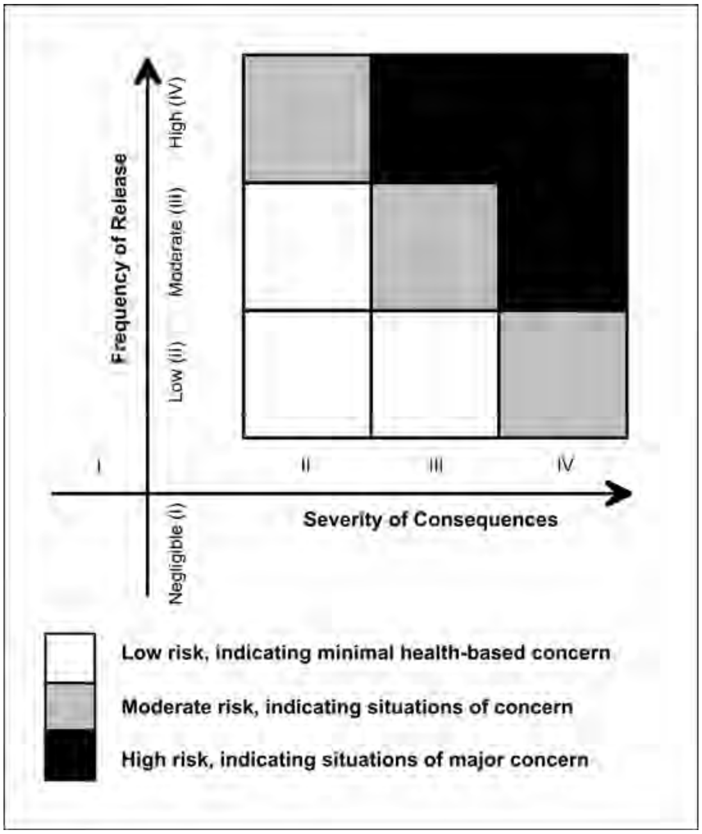


Figure 4–1. Risk (Frequency and Consequence) Ranking Matrix

The form of the risk matrix and the definition of the FLs are consistent with guidance provided by DOE (DOE Standard 3009-94) in its *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*.

The definition of Severity Levels (SLs) I through IV for human receptors is described in detail in Appendix D, Section D.1.1. It is necessary to assign these levels for several cases: (a) acute-inhalation exposures to the public, (b) acute-inhalation exposures to workers, (c) chronic-inhalation exposures to the public and workers, and (d) exposures to mercury deposited on the ground. How these SLs are assigned is discussed in Section D.1.1.2. The assignment of SLs for acute inhalation (i.e., inhalation of elemental mercury or inorganic mercury) is discussed in detail in Sections D.1.1.2.1 and D.1.1.2.3. The SLs are related to EPA's Acute Exposure Guideline Levels (AEGLs), as summarized in Table 4–1.

Table 4–1. Definition of Consequence Severity Bands for Acute Inhalation of Elemental Mercury and Inorganic Mercury – Public Receptors[a]

Acute-Inhalation Consequence Severity Level	Corresponding Airborne Concentrations of Elemental Mercury	Expected Health Effects
Inhalation Severity Level IV	≥ AEGL-3	Potential for lethality as concentration increases above AEGL-3
Inhalation Severity Level III	< AEGL-3 and ≥ AEGL-2	Potential for severe, sublethal, irreversible health effects
Inhalation Severity Level II	< AEGL-2 and ≥ 0.1×AEGL-2[b]	Potential for reversible health effects
Inhalation Severity Level I	< 0.1×AEGL-2[b]	Potential for minor irritation, equated with negligible-to-very-low consequences

[a] Exposure period up to 8 hours.

[b] Ideally, this should be tied to some multiple or fraction of AEGL-1. However, AEGL-1 has not been defined for elemental mercury.

Key: 2=greater than or equal to; L=less than; AEGL=Acute Exposure Guideline Level.

As described below, there are three AEGLs. They represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. It is believed that the recommended exposure levels protect the general population, including infants and children and other individuals who may be susceptible. However, although the AEGL values represent threshold levels for the general public, it is recognized that individuals, subject to unique or idiosyncratic responses, could experience the effects described at concentrations below the corresponding AEGL. The three AEGLs have been defined as follows:

AEGL-1 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL-2 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Airborne concentrations below AEGL-1 represent exposure levels that can produce mild and progressively increasing but transient and nondisabling odor, taste, and sensory irritation or certain asymptomatic, nonsensory effects.

EPA's proposed AEGLs for elemental mercury are shown in Table 4–2.

Table 4–2. Proposed EPA Values for Mercury Vapor AEGLs

Exposure	10 minutes	30 minutes	60 minutes	4 hours	8 hours
Guideline					
AEGL-1[a]	NR	NR	NR	NR	NR
AEGL-2	3.1 mg/m^3	2.1 mg/m^3	1.7 mg/m^3	0.67 mg/m^3	0.33 mg/m^3
AEGL-3	16 mg/m^3	11 mg/m^3	8.9 mg/m^3	2.2 mg/m^3	2.2 mg/m^3

[a] Table 4–1 uses 0.1 × AEGL-2 as a surrogate for AEGL-1. The reasons for doing so are described in Appendix D, Section D.1.1.2.1.

Note: Reported values are in milligrams per cubic meter, NOT parts per million. AEGLs for durations of exposure other than those explicitly listed in this table are obtained by linear interpolation.

Key: AEGL=Acute Exposure Guideline Level; EPA=U.S. Environmental Protection Agency; mg/m^3=milligrams per cubic meter; NR=not recommended (due to insufficient data).

Source: EPA 2009a.

Note that AEGL-1 has not been defined: the reasons for using 0.1 × AEGL-2 as a threshold below which health effects caused by exposure to elemental mercury are expected to be negligible or very low are given in Appendix D, Section D.1.1.2.1, which also explains why the same AEGLs as in Table 4–2 and the same SLs as in Table 4–1 also apply to inorganic mercury. AEGLs for methylmercury are not used in this study because the accident scenarios considered are such that they only lead to inhalation of elemental mercury or inorganic mercury. Methylmercury can only be formed after deposition of the inorganic mercury on the ground and mixing in soil or sediment.

One important consideration is that the AEGLs are intended for one-time exposures only. Therefore, it is necessary to consider the possibility that these levels would not be protective if the same individual were exposed twice. Appendix D, Section D.4.6, shows that, even with conservative assumptions, the acute-inhalation risks from exposure to two accidental spills of mercury over the period of 40 years assumed for this analysis would be negligible under most accident scenarios and at most low.

For workers, the National Institute for Occupational Safety and Health has published a benchmark for acute exposures that are immediately dangerous to life or health (IDLH) (CDC 2009). For mercury, this is 10 milligrams per cubic meter (see Appendix D, Table D–21). The IDLH represents the maximum concentration of a substance in air from which healthy workers can escape without loss of life or irreversible health effects under conditions of a maximum 30-minute exposure time.

In principle, it would be possible to develop an SL scheme, tied to the IDLH, similar to that in Table 4–1. Unfortunately, there are no IDLH equivalents of the three AEGLs. However, the IDLH approximately equals AEGL-3 for a 30-minute exposure (11 milligrams per cubic meter; see Table 4–2). It therefore seems reasonable to adopt the same acute-inhalation SLs for workers as for members of the public. One could make a case that this is conservative because workers are generally expected to be healthy while the AEGLs are crafted to include susceptible members of the public. Therefore, Table 4–1 applies to workers as well as to the public.

For chronic-inhalation exposures to humans, EPA has published a reference concentration (RfC) of 0.0003 milligrams per cubic meter (EPA 2009e). The consequences of exposures below this level are negligible, so, in terms of the SLs in Figure 4–1, the RfC marks the boundary between SL-I and -II. The analysis performed for this EIS shows that all chronic-inhalation exposure scenarios lead to predicted airborne exposures to both the noninvolved worker and the general public in the SL-I range. Therefore, there is no need to define thresholds for SL-III and -IV.

For chronic-inhalation exposures to humans inside the building, it is assumed that, during normal operations, involved workers would never be exposed to airborne concentrations of mercury vapor above the American Conference of Governmental Industrial Hygienists' (ACGIH's) time-weighted average/threshold limit value (TWA/TLV) of 0.025 milligrams per cubic meter of mercury vapor (OSHA 2002). Referring to Figure 4–1, this defines the threshold between SL-I and -II. The analysis performed for this EIS shows that involved worker exposures would always be below this threshold, assuming a combination of ventilation, inspection, monitoring, and use of PPE, as recommended by the *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury (Interim Guidance)* (DOE 2009c). Therefore, there is no need to define the thresholds for SL-III and -IV.

Appendix D, Section D.1.1.2.6, discusses a value for the level of deposited mercury that can be used to define the boundary between SL-I and -II based on an extensively studied real-life case, that of the remediation of East Fork Poplar Creek in Oak Ridge, Tennessee, and its floodplain (ATSDR 2009a, 2009b; ORNL 2009). Mercury was discharged into the creek from 1950 to 1963 as a result of separations of lithium isotopes at Y–12 in support of the hydrogen bomb project. Note that this discharge was <u>not</u> a result of elemental mercury storage at Y–12. The Agency for Toxic Substances and Disease Registry made a finding, based on mercuric chloride, that a cleanup level of 180 milligrams of mercury per kilogram of soil is protective of public health. This is based on a "worst-case" scenario involving young children who live close to East Fork Poplar Creek and play in the East Fork Poplar Creek floodplain. This scenario is considered the worst case because it involves the most sensitive population (young children) exposed to the most highly absorbable forms of inorganic mercury (mercuric chloride and elemental mercury). The most probable route of exposure to inorganic mercury would be swallowing dust and dirt.

Based on the foregoing case, it is judged that the boundary between SL-I (negligible-to-very-low consequences) and -II (onset of adverse consequences due to ingestion of inorganic mercury) is 180 milligrams per kilogram of inorganic mercury. Beyond that, no guidance has been found as to what level would cause irreversible health effects or fatalities. However, the analysis performed for this EIS shows that there are no scenarios in which mercury would be deposited (either by dry or wet deposition) at levels above 180 milligrams per kilogram, so there is no need to define the thresholds for SL-III and -IV.

4.2.9.1.2 Factors Strongly Influencing the Risks Associated with the Proposed Action

There are a number of reasons for expecting the risks associated with the transport and storage of elemental mercury to be low; these are described below.

Elemental mercury has been stored and transported safely for many years. There is a long history of mercury storage at sites holding the Defense National Stockpile Center (DNSC) inventory. Currently, 4,436 metric tons (4,890 tons) are held at three depots: New Haven, Indiana; Somerville, New Jersey; and Warren, Ohio. Formerly, 699 metric tons (770 tons) of this inventory was held at Y–12, but this portion was moved to Warren in early 2005 (Munger 2005).

In the course of preparation of the Defense Logistics Agency *Final Mercury Management Environmental Impact Statement* (DLA 2004a, 2004b), information was gathered from site visits, phone calls, and various documents. The inspection reports for the mercury storage areas were reviewed for information about past releases of mercury. No mercury has reportedly escaped from any of the warehouses, and there is no known member of the public that has been affected at any of the existing storage locations. Decades of experience in maintaining the stockpile of mercury indicate that spills of mercury resulting in environmental contamination have not occurred, and that that normal (accident-free) operating conditions should be maintained at the storage facilities. The storage facilities are built to ensure containment of the mercury under most conditions. Spilled mercury is not known to overrun the spill trays (that can hold the contents of several flasks) or containment berms or penetrate the concrete floors and reach any surface-water or groundwater sources before cleanup.

In addition, Oak Ridge National Laboratory examined 3-L flasks removed from the DNSC inventory (DOE 2009c). It is known that mercury does not react with steel containers at ambient temperatures; this was confirmed by metallurgical analysis of 3-L flasks from the DNSC inventory. Thus, containers in static storage in a well-maintained facility should have a long lifetime.

The vapor pressure of mercury at typical ambient temperatures is very low. As noted in Appendix D, Section D.7.1.3, the assumed temperature of any spillage of elemental mercury is 20 degrees Celsius (°C) (68 degrees Fahrenheit [°F] or 293 Kelvin). At that temperature, its saturated vapor density is only 14 milligrams per cubic meter.[6] This is equivalent to a release of pure elemental mercury vapor that has already been diluted by five orders of magnitude (i.e., mixed with five times its mass of air). Hence, a relatively small amount of additional dilution is required to bring the concentration down to the benchmarks such as the 30-minute AEGL-3 of 11 milligrams per cubic meter or the 60-minute AEGL-2 of 1.7 milligrams per cubic meter. It is for this reason that the human health risks predicted under all scenarios involving the evaporation of a spill of elemental mercury are in the negligible-to-low range at all sites.

For releases of elemental mercury vapor, the dry deposition velocity and the scavenging rate[7] are essentially zero. It is only during fire scenarios that elemental mercury is converted into forms that have non-zero dry deposition velocities or scavenging rates (see Appendix D, Section D.7.3.3). Therefore, for spills of elemental mercury with no accompanying fires, there is no need to be concerned about any pathways that result from deposition onto the ground or into water bodies from airborne plumes.

[6] Even at a conservatively high temperature of 40 °C (104 °F or 313 Kelvin), the saturated vapor pressure is only 65.9 milligrams per cubic meter, still approximately five orders of magnitude more dilute than a pure release of elemental mercury vapor.

[7] The scavenging rate is a measure of how rapidly rainfall can remove mercury from a plume. It is defined and discussed in Appendix D, Section D.7.3.3.

For releases of elemental mercury vapor leaking from the storage building or accidentally released nearby, there is substantial dilution in the building wake.[8] Any new construction and any existing buildings that are candidate storage facilities are sufficiently large that mixing in the turbulent building wake would dilute the elemental mercury concentrations to levels well below 0.1 × AEGL-2 (see Appendix D, Section D.8.2.1).

For fires accompanied by a spill of mercury, substantial plume rise is always predicted. This means that there is considerable initial dilution as the plume rises. Therefore, predicted close-in airborne concentrations and deposited levels of mercury under the plume are very low, and the peaks occur at various distances downwind that depend on the specific weather conditions, by which time considerable dilution in addition to that caused by plume rise dilution has already taken place.

4.2.9.1.3 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites and to the No Action Alternative. As noted above, consequences to the involved worker are predicted to be negligible (SL-I) because involved workers would never be exposed to airborne concentrations of mercury vapor above the ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. Therefore, the risks to involved workers would be negligible.

Appendix D, Section D.4.1.1, reports on mercury vapor concentrations observed over several months in 2001 and 2002 in mercury storage warehouses at the Defense Logistics Agency's Somerville Depot (Shim, Hsieh, and Watts 2002). The only occasions on which concentrations above 0.025 milligrams per cubic meter were encountered occurred during overpacking of flasks in drums, which is not expected during the 40-year period of analysis. In addition, the measurements showed that many of the higher observed levels arose from residual contamination of the floor, which would not be the case in a new storage facility. In addition, once the mercury had been overpacked and placed in a warehouse that had not previously been used for storage, the average mercury vapor concentration[9] taken over various periods from 2 days to a week was 0.00012 milligrams per cubic meter, with a peak of 0.00032 milligrams per cubic meter.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.2.3, shows that the predicted long-term average concentration in the building wake for any of the seven candidate storage sites and Y–12 is not more than 8.0×10^{-5} milligrams per cubic meter. This is well below EPA's chronic-inhalation-exposure RfC of 3.0×10^{-4} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and members of the public would be negligible.

Appendix D, Section D.4.1.2, reviews observed concentrations near Defense Logistics Agency mercury storage warehouses (Shim, Hsieh, and Watts 2002) and confirms that these observations are consistent with the prediction that long-term exposure to elemental mercury vapor during normal operations is well below EPA's RfC of 3.0×10^{-4} milligrams per cubic meter.

[8] The building wake is a volume of highly turbulent air immediately downwind of the building. Any release of mercury vapor from or adjacent to the building would be thoroughly mixed into this wake and extensively diluted before traveling downwind. Appendix D, Section D.7.2.1, describes how to calculate concentrations in the wake.

[9] The sampling times for the concentrations were either 30 seconds (Lumex monitor) or a few minutes (Tekran monitor), so the concentrations discussed above show that the 8-hour TWA was not exceeded.

4.2.9.1.4 Facility Accidents

Appendix D, Section D.2.4, contains detailed considerations of the likelihood of occurrence of candidate facility (onsite) accident scenarios initiated by failures of engineered systems or human errors. Section D.2.5 describes candidate external events and their likelihood of occurrence. Table 4–3 summarizes the results of this analysis. These results are the same for all potential storage sites and do not provide a means of discriminating between them. They are slightly different under the No Action Alternative, which is discussed further below.

Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible (FL-I) frequency from Table 4–3. These accident scenarios are the same for all candidate storage sites and are slightly different under the No Action Alternative.

As described above, the saturated vapor density of mercury at the assumed release temperature of 20 °C (68 °F) is about 14 milligrams per cubic meter. This is only a little above the 30-minute IDLH of 10 milligrams per cubic meter or the 30-minute AEGL-3 of 11 milligrams per cubic meter. In practice, if there is a spill while a worker is present, that worker would leave the building rapidly, in much less than the half-an-hour for which he or she could potentially be exposed to the IDLH and still be able to escape. Therefore, the involved worker would be exposed to a toxic load much less than that accumulated in a half-hour's exposure to 10 to 11 milligrams per cubic meter. As previously discussed, if the exposure lies between AEGL-3 and AEGL-2, it is considered to be in the SL-III range. If the worker moves rapidly, the equivalent toxic load could conceivably be less than AEGL-2 (SL-II) or even 0.1 × AEGL-2 (SL-I).

Per Table 4–3, the frequencies of all of the scenarios in Table 4–4 are low (FL-II) or moderate (FL-III). Combining this with a consequence in the SL-I to -II range gives a risk in the negligible-to-low range for the involved worker in the storage building at all sites.

Table 4–3. Generic Summary of Candidate Onsite Accident Scenarios and Their Likelihood of Occurrence

Hazard	Activity	Postulated Scenario	Frequency of Release[a]	Evaluated Further	Comments[a]
Kinetic	Onsite material handling	Single flask is dropped during handling, resulting in breach.	Moderate (FL-III)	Yes	Consolidation of partially filled pallets could lead to a relatively large number of handling events per year.
Kinetic	Onsite material handling	Single pallet is dropped during transfer to storage racks, resulting in breach.	Moderate (FL-III)	Yes	Assumes pallet dropped from 3.7 meters (12 feet) and all 49 flasks breached. Conservatively assumed that could occur outside the building as well as inside.
Kinetic	Onsite material handling	Triple-pallet collapse.	Moderate (FL-III)	Yes	Requires failure of storage rack. Could only occur inside building.
Kinetic	Onsite material handling	Single 1-MT container drop.	Moderate (FL-III)	Yes	Could occur inside or outside building. Assumes container dropped from a height of less than 1.5 meters (5 feet).
Fire	Onsite storage	Building fire involving multiple flasks or 1-MT containers.	Negligible (FL-I)	No	No ignition sources, controls on flammable materials, reliable fire protection system.
Forklift fire	Onsite storage	Forklift crashes and burns.	Negligible (FL-I)	No	DOE guidance recommends using electric forklift.

Table 4–3. Generic Summary of Candidate Onsite Accident Scenarios and Their Likelihood of Occurrence *(continued)*

Hazard	Activity	Postulated Scenario	Frequency of Release[a]	Evaluated Further	Comments[a]
Fire/ explosion nearby	All activities	Fire/explosion at nearby building impacts mercury containers.	Negligible (FL-I)	No	No other facilities containing explosives or potentially flammable materials close enough to impact storage building.
Wildfire	All activities	Wildfire consumes storage building.	Negligible (FL-I)	No	Although wildfires are common, fire monitoring, prevention and suppression systems greatly reduce the likelihood of mercury release.
Earthquake	All activities	Earthquake results in building damage and causes pallets and/or flasks to fall and spill.	Moderate (FL-III)	Yes	Requires an earthquake and failure of flasks or 1-MT containers. Two alternatives considered: building remains recognizably intact or building collapses completely.[b]
Flood	All activities	Storage building floods, causing failure of 3-L flasks or 1-MT containers.	Moderate (FL-III)	Yes	Requires failure of flasks or 1-MT containers. Bounded by earthquake scenario.
Weather	All activities	High winds or tornadoes result in roof failure and cause pallets and/or flasks to fall.	Low (FL-II) or negligible (FL-I) (tornadoes); negligible (FL-I) (high winds)	Yes	Requires failure of flasks or 1-MT containers. Bounded by earthquake scenario.
Weather	All activities	Lightning strike causes small building fire involving limited number of mercury containers.	Negligible (FL-I)	No	Lightning strike as initiator of building fire not considered credible. Assumes building lightning protected as required by building codes.
Weather	All activities	Snow load causes roof collapse, resulting in mercury containers' falling.	Negligible (FL-I)	No	Assumes building designed to requirements of building codes.
Surface transportation	Onsite storage	Vehicle or train crashes into building, resulting in mercury container breach.	Negligible (FL-I)	No	Slow vehicle speeds in vicinity of building.
Aircraft crash	All activities	Aircraft crashes into building, resulting in fire, mercury container breach.	Negligible (FL-I)	No	Limited target area given type of aircraft, flight vectors, and size of storage area within building.

[a] For justification of frequency assignments and comments, see Appendix D, Sections D.2.4 and D.2.5.

[b] No effort is made to split the moderate frequency between earthquake with building collapse and earthquake without building collapse (i.e., conservatively, the frequency of occurrence of both scenarios is moderate).

Key: 1-MT=1-metric-ton; 3-L=3-liter; DOE=U.S. Department of Energy; FL=frequency level.

Table 4–4. Summary of Types of Accidents Considered in Onsite Spill Analysis

Accident Scenario	Could Occur Indoors?	Could Occur Outdoors?
Single-flask spill	Yes	No[a]
Single-pallet spill	Yes	Yes
Triple-pallet spill	Yes	No[b]
1-metric-ton container spill[b]	Yes	Yes
Earthquake spill[c]	Yes[d]	Yes[e]

[a] Mercury flasks are transported and stored in pallets in a 7- by 7-flask configuration. Flasks may be removed from a pallet if they are leaking or if partially filled flasks are consolidated.

[b] Triple-pallet collapse could only occur when the pallets are inside on the storage racks.

[c] This scenario also encompasses the risk from tornadoes, high winds, and floods.

[d] Earthquake leaves building relatively intact.

[e] Earthquake causes building collapse.

Under all of the scenarios in Table 4–4, both indoors and outdoors (except the earthquake with building collapse), the evaporating mercury would mix into the building wake. Appendix D, Section D.4.2.3, shows that the predicted concentrations in the wake are all in the SL-I range. Therefore, the risks to the noninvolved worker and the public from all of these scenarios would be negligible.

For the specific case of an earthquake with building collapse, the rate of evaporation was estimated, and a Gaussian atmospheric dispersion model was used to predict the distances downwind to which the various SLs would be exceeded; see Appendix D, Section D.4.2.4. The results show that, for all of the candidate storage sites, exposures exceeding SL-I would never affect the nearest member of the public, so public risks would be negligible. However, this conclusion may not apply to the No Action Alternative; see below for further discussion.

4.2.9.1.5 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury to the candidate storage sites over the 40-year period of analysis. This transportation could occur by either truck or railcar. For the case of truck transportation, there are two scenarios, as follows:

- Scenario 1: full truck loads from all dispatching sites
- Scenario 2: half-full truck loads from reclamation and recycling facilities, domestic gold-mining facilities, and the Port of New York (shipments from Peru),[10] but full truck loads from Y–12 and chlor-alkali facilities
- These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. Frequencies are estimated for four types of consequences: Crash with spill of elemental mercury onto the ground without fire
- Crash with spill of elemental mercury into water

[10] An estimate of this mercury was included in the quantity estimates as a conservative planning assumption regarding potential contributions to excess elemental mercury. However, the inclusion of an estimate for this mercury does not reflect a conclusion that such mercury would be "generated in the United States" as that phrase is used in the Act.

- Crash with fire in dry weather conditions (without rain) (to analyze the effects of dry deposition)
- Crash with fire in wet weather conditions (with rain) (to analyze the effects of wet deposition)

The results of the frequency analysis for all candidate storage sites are shown in Appendix D, Tables D–12, D–13, D–14, and D–16.

For exposures occurring via evaporation from a spill of elemental mercury with no fire during a transportation accident, the fraction of the mercury being carried by the truck or railcar that would be spilled is highly uncertain. It is extremely unlikely that all 3-L flasks or all 1-metric-ton (1-MT) (1.1-ton) containers would be breached. However, to be conservative, it is assumed that such a catastrophic release could take place. The largest amount of mercury that can be carried in a truck or railcar is that contained in 54 1-MT containers. Assuming that all of this mercury is spilled and spreads until the pool is at its capillary depth of 0.36 centimeters (0.14 inches) (so conservative as to be essentially inconceivable in an outdoor spill),[11] the predicted rate of evaporation that would conservatively apply to all weather conditions would be 7.35×10^{-5} kilograms per second (see Appendix D, Section D.7.1). Running this through the Gaussian model and ranging over all possible combinations of atmospheric stability class and windspeed, the predicted maximum distances to the airborne toxic benchmarks are as follows: SL-IV, less than 100 meters (330 feet); SL-III, about 100 meters (330 feet); and SL-II, about 340 meters (1,115 feet). As a result, a specific individual could not be exposed to concentrations that are greater than SL-I if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that specific individual could only be exposed above SL-I if the crash occurs along a 680-meter (2,230-foot) stretch of road (340 meters [1,115 feet] on each side). This is a small fraction of any of the routes (for example, the average length of a truck trip to GJDS is approximately 2,000 kilometers [1,260 miles]). The frequency of occurrence of a truck crash with spill on the truck routes to GJDS is 0.0031 per year; see Table D–13 (Truck Scenario 2). The product of the fraction of the route and the frequency of occurrence is about 1.1×10^{-6} per year, a low (FL-II) frequency. Under Truck Scenario 1 and the Railcar Scenario, similar reasoning shows that the corresponding frequencies would be negligible (FL-I). Therefore, the risk to a member of the public from transportation spills onto the ground without fire en route to GJDS would be negligible under Truck Scenario 1 and the Railcar Scenario and low under Truck Scenario 2. This analysis applies to all other candidate storage sites.

Spills occurring during a transportation accident could result in leakage of the mercury cargo into the surrounding environment. The most significant and challenging scenario (from a cleanup standpoint) would be a *spill directly into a surface-water body, such as a lake or river*. This could occur if a truck or railcar crashes on a bridge over a river or if it falls into a river or lake while traveling alongside the water body.

It is in principle possible to calculate the frequency at which a truck might crash on a bridge. This is simply (frequency of crash anywhere along the route) × (number of bridge miles directly above water)/(average length of trip). If, for example, there were on average 10 kilometers (6.2 miles) of such bridges on an average 2,000-kilometer (1,260-mile) trip, one would simply multiply the frequency of spill by 10/2,000 = 0.005. This would make the frequency of a truck crash on a bridge low and the frequency of a rail crash on a bridge negligible. This conclusion must be tempered by the observation that probabilities of crashes per mile on bridges might be higher than those on highways in general because, for example, bridges ice up before the neighboring roadway does. However, no good data on this are

[11] Surface tension is what prevents the mercury pool from spreading any further. However, the mercury will only spread until the pool is at its capillary depth of 0.36 centimeters (0.14 inches) if the surface is perfectly smooth. See Appendix D, Section D.7.1.4.

available at the time of writing, so this analysis is not used in estimates of the risk of spillage directly into water.

Another way in which mercury might be spilled into water is if a truck or railcar crashes while traveling beside a river or other body of water. The number of miles for which this is possible is very site specific. For example, Interstate 70 in Colorado follows rivers and streams much of the distance in the state to get to GJDS. These include the Colorado River, Clear Creek, Eagle River, Straight Creek, and Gore Creek. The route to GJDS contains the greatest distance of any route where there might be a potential for spillage into a river, although at the time of writing no information had been collected on the fractions of that route where the road or rail is close enough for it to be plausible that a truck or railcar might crash directly into the river.

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors and humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

This EIS also considers *railcar or truck crashes that involve fires*.

For wooden pallets of 49 3-L flasks, the material of combustion is the wood of the crate.[12] It is assumed that the amount of wood in a truck or railcar full of 1-MT containers is encompassed by the amount of wood in a truck or railcar full of pallets. Either the crash itself or the heat of the fire would rupture an indeterminate number of flasks or 1-MT containers. The mercury is assumed to spread out over the bed of the truck or railcar, with the burning wood standing in or near the pool and causing evaporation by radiative heat transfer. The extent of the pool area is limited: the difficult question of how many flasks or 1-MT containers might rupture is finessed by this assumption. It is believed that this is a conservative scenario—more than likely the mercury would run out of the damaged truck or railcar so that the optimum configuration of burning materials and the pool (i.e., optimum for radiative heat transfer to the

[12] The *Interim Guidance* (DOE 2009c) envisages that 3-L flasks or 1-MT containers may be transported in either wooden or metal pallets. In this EIS, the assumption is that the pallets are made of wood because this gives a conservatively high estimate of the heat that might be available to evaporate mercury.

pool) is unlikely to occur. Essentially, the mercury would reach its boiling point and evaporate at that temperature (at a rate controlled by the windspeed over the surface) until all the available fuel has burned.

Appendix D, Section D.8.4.1, shows that the calculated rate of evaporation for a truck pallet fire is 1.3 kilograms per second and for a railcar pallet fire is 1.6 kilograms per second, with corresponding durations of release of 762 and 1,308 seconds, respectively. Section D.8.4.1 also considers how high the plume, containing products of combustion, mercury vapor, and entrained air, would rise. The analysis shows that 100 meters (330 feet) is realistic or conservative for all conditions of atmospheric stability class and windspeed for truck and railcar scenarios. The plume is therefore assumed to rise to a height of 100 meters (330 feet) immediately above the source of release, at which point it defines the input for the Gaussian dispersion model. Using standard plume rise models, the initial radius of the plume at this height is taken to be about $0.6\Delta h$, where Δh is the height of plume rise.

Mercury released during a fire is converted into the divalent inorganic mercury form. Conservatively, it is assumed that it is all converted into the divalent form (see Appendix D, Section D.7.3.3). In this form, mercury can deposit by dry deposition or wet deposition. Section D.7.3.3 discusses the choice of dry deposition velocities and the rainfall scavenging rate for use in the Gaussian dispersion model.

The Gaussian model calculations for the fire scenarios were carried out in three weather conditions that are representative of the full range of weather conditions:

- Atmospheric Stability Class A with a windspeed of 1.5 meters per second, representative of conditions of low windspeed and high ambient thermally generated turbulence
- Atmospheric Stability Class D with a windspeed of 4.5 meters per second, representative of "average" weather conditions dominated by mechanically generated turbulence
- Atmospheric Stability Class F with a windspeed of 1.5 meters per second, representative of conditions with low ambient turbulence

Human Exposure – Inhalation Pathway

The generic results of the calculations for the inhalation pathway following a crash with fire for any potential site are shown in Table 4–5.

Table 4–5. Predicted Range of Distances (meters) Downwind Within Which Acute Airborne Severity Levels Are Exceeded – Crashes with Fires, All Sites

Type of Accident	Atmospheric Stability Class/Windspeed	0.1×AEGL-2 (SL-II)	AEGL-2 (SL-III)	AEGL-3 (SL-IV)
Truck crash, wooden pallets	A/1.5 m/s	<100–2,600	160–700	Nowhere
	D/4.5 m/s	<100–16,000	Nowhere	Nowhere
	F/1.5 m/s	<100–40,000	600–1,300	Nowhere
Railcar crash, wooden pallets	A/1.5 m/s	<100–2,800	140–840	Nowhere
	D/4.5 m/s	<100–20,000	700–2,300	Nowhere
	F/1.5 m/s	<100–40,000	440–2,100	Nowhere

Note: To convert meters to feet, multiply by 3.281.
Key: <=less than; AEGL=Acute Exposure Guideline Level; m/s=meters per second; SL=severity level.

The combination of the consequence results above with the frequencies of crashes with fires is explained in Appendix D, Section D.4.5, and produces the results in Table 4–6.

Table 4–6. Summary of Inhalation Risks to Human Receptors, Accidents with Fires, All Sites

	Both Truck Scenarios with Pallet Fire	Railcar Scenario with Pallet Fire
Frequency[a]	FL-III	FL-II
Consequence[b]	SL-II	SL-II
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.

[b] The highest consequence in any weather condition.

Key: FL=frequency level; SL=severity level.

Note that the risks presented in the above scenarios are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

Human Exposure – Deposition Pathway

The analyses performed for this EIS show that, under all fire scenarios listed in Table 4–6, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

4.2.9.1.6 Fire – Intentional Destructive Acts

The analysis of intentional destructive acts (IDAs) applies to all sites and all transportation routes. A wide range of IDA scenarios involving a release of mercury can be postulated for the sites and transportation routes being considered for mercury storage. Each involves an action by intruders or insiders that affects mercury inventories either at the storage facility or during transportation to the storage facility. The human health impacts of an IDA are directly related to the amount of mercury available for dispersion, as well as the means of dispersing it to the environment. Other factors that affect impacts include population density, distance to the population, and meteorology.

IDA scenarios were selected based on the amount of mercury at the storage facility or in a transport vehicle. Other factors that were considered include the nature of the IDA event that would result in the highest dispersion of mercury to the environment. The likelihood or frequency of the IDA scenarios analyzed in this section cannot be quantified because of the dependence on unpredictable intruder actions and security measures that would be employed by DOE. Each IDA scenario assumes multiple actions by intruders with no successful mitigation or protection measures by DOE. Conservative analytical assumptions are also imposed on the calculations. The results are presented in terms of consequences, but not annual risks because of the lack of an annual probability or frequency for these IDA events.

The accident analyses in Appendix D show that the largest airborne and ground mercury concentrations would result from scenarios in which a quantity of mercury in containers is exposed to a fire. The energy of a fire would increase the mercury release rate and plume release height. Since the accident analysis evaluates fire scenarios involving available fuel in a truck or railcar that contains mercury, the IDA scenarios were developed to incorporate larger quantities of flammable material in concert with mercury in containers on a truck or railcar. The largest easily accessible and mobile source of large quantities of flammable material is a gasoline tank truck, which may contain between 18,927 and 34,069 liters (5,000 and 9,000 gallons) of gasoline. The IDA scenario postulates that a group of individuals hijack a fully loaded 34,069-liter (9,000-gallon) gasoline tank truck, which they then drive into either a truck or railcar loaded with mercury being carried in either 34.6-kilogram (76-pound) flasks or 1-MT (1.1-ton) containers. Another postulated scenario would involve two groups of armed intruders: one hijacking the loaded tanker truck and the other disabling the train or truck carrying mercury.

The postulated armed intruders would incapacitate any persons accompanying the shipment; release the gasoline in the gasoline tanker on and around the mercury storage containers; and set the gasoline on fire, thereby engulfing the mercury cargo in an unmitigated fire. This IDA event may occur either in transit or at the unloading location at the mercury storage facility. The same quantity of gasoline and mercury are assumed to be available under both scenarios; these quantities would only be limited by the transport capacity of the truck or railcar. The most vulnerable large quantities of mercury were determined to be truck or rail shipments either in transit or at the facility prior to unloading.

IDA scenarios involving an attack on the storage facility other than during unloading of a truck or railcar are predicted to be less likely because of the distribution of mercury within the facility, presence of security, and facility design features that would ameliorate mercury releases to the environment.

Appendix D, Section D.2.6, describes a fire caused by an IDA. The parameters needed for input into the atmospheric dispersion model are discussed in Section D.7.4.2, where it is explained that the railcar fire is a somewhat conservative bounding case for the truck fire. The results of the analyses are as follows.

Human Exposure – Atmospheric Pathway

Per Appendix D, Section D.7.4.2, Table D–63, the duration of release is 10,660 seconds (approximately 3 hours). Interpolation in Section D.3, Table D–22, gives a corresponding AEGL-2 (SL-III) of 1 milligram per cubic meter (1.0×10^{-6} kilograms per cubic meter) and an AEGL-3 (SL-IV) of 4.4 milligrams per cubic meter (4.4×10^{-6} kilograms per cubic meter).

The results of the analysis are as follows:

- In Atmospheric Stability Class D conditions with a windspeed of 4.5 meters per second:
  - The thresholds for SL-IV (AEGL-3) and SL-III (AEGL-2) are not predicted to be exceeded anywhere.
  - Concentrations in the SL-II range (0.1 × AEGL-2 to AEGL-2) could extend out to about 34 kilometers (21 miles).
- In Atmospheric Stability Class D conditions with a windspeed of 4.5 meters per second:
  - SL-II concentrations exceeding 0.1 × AEGL-2 could extend from less than 100 meters (330 feet) out to about 40 kilometers (25 miles).
  - SL-III concentrations exceeding AEGL-2 could extend from about 100 meters (330 feet) out to about 5.6 kilometers (3.5 miles).
  - Concentrations greater than the SL-IV threshold (AEGL-3) could be exceeded in a "hot spot" extending from about 560 to 760 meters (1,800 to 2,500 feet) downwind

It is therefore clear that, should there be an IDA involving a railcar or truck with fire, there would potentially be a need to monitor bodies of water for accumulation of methylmercury in fish to a considerable distance downwind.

Because frequencies are not assigned to IDA scenarios, it is not possible to match the concentrations described above with corresponding estimates of risk.

Human Exposure – Deposition Pathway

The calculations predict that the threshold for SL-II (180 milligrams per kilogram) would not be exceeded anywhere.

4.2.9.2 Normal Operations Risks – No Action Alternative

The generic discussion of normal operations is provided in Section 4.2.9.1.3. For storage of elemental mercury in non-DOE storage facilities under the No Action Alternative, it seems reasonable to assume that normal operations would be carried out to standards sufficient to protect involved workers, noninvolved workers, and members of the public so that their associated risks are negligible. For continued storage at Y–12, the generic analysis applies and the risk there from normal operations is also predicted to be negligible.

4.2.9.3 Facility Accident Risks – No Action Alternative

Many of the potential accident scenarios associated with the storage and movement of elemental mercury under the No Action Alternative would be the same as for transportation to and storage at one of the candidate mercury storage facilities. Thus, it is likely that mercury would be placed in 3-L flasks or 1-MT containers. Therefore, accidents involving the dropping of these or the dropping of pallets would be possible, both indoors and outdoors. Buildings would be vulnerable to external events, such as earthquakes, high winds, and aircraft crashes. It is not known whether all new storage buildings or buildings in which mercury is currently stored or handled are designed to the same standards as required for the candidate storage facilities (for example, in their ability to resist earthquakes or high winds). The consequences of accidents involving severe damage to a building would depend on how much mercury is actually present in the building and on where it is located relative to nearby populations; for example, it is conceivable that the distance to the fence line could be short and that there could be houses backing up to that fence line, in which case the risks could be higher than those predicted for the candidate storage buildings in Section 4.2.9.1.4.

For continued storage at Y–12, the analysis of onsite spills is exactly the same as for the generic analysis and leads to the same conclusions:

- For the involved and noninvolved workers, frequencies would be in the low (FL-II) or moderate (FL-III) range.
- Consequences would be in the SL-I to SL-II range.
- Risks would be in the negligible-to-low range.
- For the public, risks would be negligible.

4.2.9.4 Transportation Risks – No Action Alternative

Under the No Action Alternative, elemental mercury would be transported between various facilities. It seems likely that the total amount transported would be about the same as that used for analysis purposes in this EIS, although the amount transported could be less if some storage occurs at source locations. What is not known is how much would be transported as full truck or railcar loads and how much as partial loads (e.g., one pallet or one 1-MT container on a truck, or fewer flasks than a full pallet), or the distances that mercury might be transported. It would appear that the various transportation spills with fires that were analyzed for the candidate storage facilities would also be possible under the No Action Alternative, with concomitant, but currently unquantifiable, risks to human health (see Section 4.2.9.1.5). However, since the generic predicted consequences of crashes with fires were performed for full trucks or railcars, the results presented in Table 4–5 should bound the magnitude of the consequences.

For transportation under the No Action Alternative, the types of spills directly onto the ground or into bodies of water seem to be similar to those discussed in Section 4.2.9.1.5, so those types of risks would also exist for transportation to new and existing non-DOE mercury storage facilities.

Since there would be no transportation to or from Y–12 under the No Action Alternative, there would be no transportation risks for that site.

4.2.9.5 Intentional Destructive Acts – No Action Alternative

The generic discussion of IDA fires is in Section 4.2.9.1.6. The same types of IDA scenarios would appear to be possible for transportation of elemental mercury under the No Action Alternative. Therefore, the analysis of IDA consequences in Section 4.2.9.1.6 should bound those for commercial transport.

At Y–12, the mercury storage warehouse is located within a high-security area that is protected by the Perimeter Intrusion Detection and Assessment System, which includes a range of physical and personnel security provisions designed to protect nuclear materials at DOE sites. This would appear to make IDAs directly on the storage facility highly unlikely. In addition, under the No Action Alternative, there would be no transportation of mercury to or from Y–12; thus, no transportation IDAs could occur.

4.2.10 Ecological Risk

This section contains a generic discussion of ecological risks, followed by one specific to the No Action Alternative.

4.2.10.1 Ecological Risk – Generic Discussion

The ecological risk assessment considers chronic exposures to the following potentially sensitive ecological receptors:

- Plants
- Soil invertebrates
- The short-tailed shrew
- The American robin
- The red-tailed hawk
- The great blue heron
- The river otter
- Aquatic biota
- Sediment-dwelling (i.e., benthic) biota

Appendix D, Section D.5, contains a discussion of why these representative receptors were chosen. Ecological exposures from elemental mercury deposited onto surface soil, sediment, and surface water are expected to pose the greatest risk to ecological receptors. The ecological health consequence levels for these receptors are expressed in terms of environmental-medium- and receptor-specific ecological benchmark values or equivalent screening values that are the upper concentration limits for mercury in soil, sediment, and/or surface water. The screening values are expressed in milligrams per kilogram or micrograms per liter depending on whether they are for mercury in soil/sediment or mercury in water, respectively. Section D.5 describes how these values are calculated.

Table 4–7 provides the screening values for the receptors listed above. The output of the atmospheric dispersion model provides airborne concentrations in kilograms per cubic meter and amounts of deposited mercury in kilograms per square meter. For ease of comparison with these outputs, the ecological screening values can be converted into equivalent levels of deposited mercury (independent of the mercury release scenario). Note that, for each receptor, there are two screening values: one for ingestion of whatever portion of the deposited mercury is converted into methylmercury in the soil, sediment, or water and one for the portion that remains in the inorganic form.

Table 4–7. Screening Values and Equivalent Deposited Screening Values

Ecological Receptor, Pathway	Inorganic or Methylmercury	Screening Value (mg/kg or µg/L)	Equivalent Deposited Screening Value (kg/m^2)
Plants	Inorganic	3.00×10^{-1}	2.76×10^{-5}
Soil invertebrates	Inorganic	1.00×10^{-1}	9.18×10^{-6}
Short-tailed shrew	Inorganic	1.10×10^{2}	1.01×10^{-2}
River otter, sediment	Inorganic	2.00×10^{0}	2.23×10^{-1}
River otter, water	Inorganic	1.62×10^{3}	2.67×10^{-1}
American robin	Inorganic	7.36×10^{2}	1.84×10^{-4}
Red-tailed hawk	Inorganic	1.40×10^{0}	1.49×10^{-1}
Great blue heron, sediment	Inorganic	5.26×10^{3}	3.12×10^{-2}
Great blue heron, water	Inorganic	1.03×10^{1}	3.61×10^{-2}
Aquatic biota	Inorganic	1.30×10^{0}	3.36×10^{-2}
Sediment-dwelling biota	Inorganic	1.50×10^{-1}	6.35×10^{-6}
Plants	Methyl	None	None
Soil invertebrates	Methyl	2.50×10^{0}	1.13×10^{-2}
Short-tailed shrew	Methyl	8.00×10^{-2}	3.60×10^{-4}
River otter, sediment	Methyl	1.00×10^{-2}	1.31×10^{-4}
River otter, water	Methyl	6.86×10^{0}	7.78×10^{-4}
American robin	Methyl	2.09×10^{0}	4.50×10^{-5}
Red-tailed hawk	Methyl	3.20×10^{-2}	3.09×10^{-2}
Great blue heron, sediment	Methyl	5.40×10^{-1}	5.02×10^{-4}
Great blue heron, water	Methyl	8.00×10^{-3}	3.11×10^{-3}
Aquatic biota	Methyl	2.80×10^{-3}	2.72×10^{-4}
Sediment-dwelling biota	Methyl	None	None

Key: mg/kg=milligrams per kilogram; µg/L=micrograms per liter; kg/m^2=kilograms per square meter.

In a similar manner to the human health evaluation, the SL to which a particular ecological consequence estimate is assigned is obtained by dividing the predicted exposure concentration of mercury by the appropriate screening value for ecological effects. If the ratio is 20 or higher, SL-IV is assigned; between 10 and 20, SL-III; between 1 and 10, SL-II; and below 1, SL-I (which is predicted to be negligible).

4.2.10.1.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation (other than those directly into a water body) are considered to be negligible at all storage sites and along all transportation routes.

4.2.10.1.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2, which also makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that, except for a direct spillage of elemental mercury into a body of water, the consequences to ecological receptors would be negligible. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk to ecological receptors would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty in the above statement regarding this prediction is large.

4.2.10.1.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. The analysis uses the same computer runs as were used for the analysis of human receptors. Analyses have been carried out for the following three weather conditions (the same as for the human health risk assessment):

- Atmospheric Stability Class A with a windspeed of 1.5 meters per second
- Atmospheric Stability Class D with a windspeed of 4.5 meters per second
- Atmospheric Stability Class F with a windspeed of 1.5 meters per second

Table 4–8 shows the results of the consequence calculations in the three stability classes for the specific case of a truck crash with a wooden pallet fire and dry deposition. The results in this table apply to all transportation routes to all sites. The results for a railcar crash with a wooden pallet fire are similar and may be found in Appendix D, Section D.5.4.3.2.

Table 4–8. Summary of Potential Exposure of Receptors to Deposited Mercury at Severity Levels II, III, and IV – Truck Spill with Wooden Pallet Fire and No Rain

Ecological Receptor	Distance (meters) to Which Benchmark is Exceeded (A[a], 1.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (D[a], 4.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (F[a], 1.5 m/s[b])		
	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV
Sediment-dwelling biota	2,000 to 3,000	700 to 1,000	500 to 700	10,000 to 20,000			1,000 to 2,000		
Soil invertebrates	2,000 to 3,000	500 to 700	300 to 500	10,000 to 20,000					
Plants	1,000 to 2,000			5,000 to 7,000					
American robin	1,000 to 2,000			2,000 to 3,000					
River otter	500 to 700								
Aquatic biota									
Short-tailed shrew									
Great blue heron									
Red-tailed hawk									

a Atmospheric Stability Class.

b Windspeed measured at 10 meters.

Note: Shaded cells denote no exceedance of the appropriate benchmark. The ranges in this table indicate that there is uncertainty in the predicted distance to which the various benchmarks are exceeded. The distances downwind at which the various concentrations are first encountered can conservatively be set to 0. To convert meters to feet, multiply by 3.281.

Key: m/s=meters per second; SL=severity level.

Table 4–8 shows characteristic behavior for elevated releases. In Atmospheric Stability Class A conditions, the associated high degree of atmospheric turbulence brings mercury down to ground level quickly, but also dilutes the plume quickly. More receptors are affected than in the other two stability classes, but not for great distances. The results for Stability Class F are strongly affected by the fact that the dry deposition velocity is an order of magnitude lower than it is in the other two weather conditions (see Appendix D, Table D–56). If the dry deposition velocity had been of the same order, many more receptors would have been affected. This leaves Stability Class D as the intermediate case in which the plume does not dilute as quickly as in Stability Class A, but also does not bring mercury down to ground level as quickly near the source.

Table 4–8 shows that, for a truck crash with a wooden pallet fire in dry weather, sediment-dwelling biota and soil invertebrates could be exposed to deposited levels of mercury in the SL-IV range, but over distances of no more than 700 meters (2,300 feet), and then only in Atmospheric Stability Class A conditions. Similarly, it is only in Class A conditions that sediment-dwelling biota and soil invertebrates could be exposed to SL-III levels of deposited mercury out to about 1,000 meters (3,300 feet). In Class A, D, and F conditions, some ecological receptors (not the same number in each class) are predicted to be exposed to deposited levels of mercury in the SL-II range or lower.

The consequences above can be combined with the predicted frequencies of crashes with fires from Appendix D, Tables D–12 and D–13, to provide risks. Appendix D, Tables D–12 and D–13, show that the predicted frequencies of spills with fires are in the FL-III range under both truck scenarios (see Section 4.2.9.1.5) at all of the candidate storage sites. Conservatively, these frequencies are associated with the highest SL predicted in any weather condition in Table 4–8, a conservative assumption.[13] Table 4–9 summarizes the FL, consequence level, and risk under both truck scenarios with fires in dry weather and applies to all candidate storage sites.

Table 4–9. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, All Sites[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level[c]	Risk[d]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Applies equally to all seven candidate sites.
[b] Frequencies of truck crashes with spills from Appendix D, Tables D–12 and D–13.
[c] The highest consequence in any weather condition from Table 4–8.
[d] Applies to both Truck Scenarios 1 and 2.

The following observations apply to the results represented in Table 4–9:

- As noted above, if a particular outcome occurs even in only one of the three representative weather conditions listed above, it is conservatively assumed to occur always (e.g., sediment-dwelling biota would only be exposed to potentially high concentrations in Atmospheric Stability Class A conditions) . This introduces conservatism into the frequency portion of the risk equation.

- The truck results apply to both Scenarios 1 and 2.

- For all receiving sites, there is a high risk that, in the event of a truck crash with fire and no rain somewhere along the truck routes, areas contain deposited mercury in the SL-IV range for sediment-dwelling biota and soil invertebrates living in such areas. Per Figure 4–1, these indicate situations of major concern.

- Though not shown explicitly in Table 4–9, there is also a moderate risk that, somewhere along the truck routes, sediment-dwelling biota and soil invertebrates could be exposed to SL-III levels of deposited mercury in areas in addition to those in the previous bullet.

- For all receiving sites, there is a low risk that, somewhere along the truck routes, areas contain deposited levels of mercury in the SL-II range for nearby plants, American robins, and river otters. Per Figure 4–1, these indicate situations of minimal concern. Furthermore, though not shown explicitly in Table 4–9, there could be a low risk that areas along truck routes (in addition to the areas in the previous two bullets) contain deposited mercury in the SL-II range for sediment-dwelling biota and soil invertebrates.

[13] In principle, one could calculate the probability, conditional on the occurrence of the crash with fire, that an SL-IV consequence for (say) sediment-dwelling biota could occur. This probability is less than unity because it does not occur in all weather conditions. It might be small enough that, when multiplied by the FL-III frequencies mentioned above, it would drop those frequencies into the a lower frequency range. However, this calculation is not possible because the calculations reported in Table 4–8 were only done for the three representative weather conditions, not all weather conditions. Nevertheless, omitting this step in the calculation of frequency does add considerable conservatism.

- For truck routes to all receiving sites, the risks to the short-tailed shrew, aquatic biota, the great blue heron, and the red-tailed hawk are negligible.

It is important to understand the meaning of the risks presented in Table 4–9. A high risk to sediment-dwelling biota with an SL-IV consequence, for example, means that somewhere along the route areas would be contaminated to such an extent that a population of sediment-dwelling biota living entirely within one such area would accumulate enough mercury through normal ingestion activities to cause a high health consequence. Appendix D, Table D–43, does not provide the risk to a specific population of such receptors within a given small area. In any event, for sediment-dwelling biota, such an identification is not possible. If it were possible, the risk to such a specifically identified receptor would be smaller than that indicated in Table 4–9.

The risks of other potential fire scenarios are similarly calculated and are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–10.
- For railcar crashes with wooden pallet fires and without rain (dry deposition), see Table 4–11.
- The predicted frequency of railcar crashes with wooden pallet fires and rain is negligible, so risks are negligible and no summary table is presented.

As can be seen, the scenarios that involve metal pallets have reduced predicted ecological risk.

Table 4–10. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, All Sites[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level	Risk[c]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] Applies equally to all seven candidate sites.
[b] Frequencies of truck crashes with fires and rain from Appendix D, Table D–16.
[c] Applies to both Truck Scenarios 1 and 2.

Table 4–11. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, All Sites[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] Applies equally to all seven candidate sites.
[b] Frequencies of railcar crashes with spills from Appendix D, Table D–14.

4.2.10.1.4 Intentionally Initiated Spills During Transportation with Fires

Table 4–12 summarizes the predicted distances to which ecological receptors would receive various levels of exposure following an intentionally initiated fire caused by crashing a fully loaded gasoline tanker into a train. Table 4–12 is also bounding for deliberately initiated truck fires. The results are similar to those in Table 4–8 except that predicted distances are greater. Table 4–12 can be regarded as an upper bound assessment of consequences for any kind of transportation fire, deliberately initiated or otherwise. The results cannot be put into the perspective of risk because it is not possible to estimate the frequency of an IDA.

4.2.10.2 Ecological Risk – No Action Alternative

Transportation of mercury by road and rail would continue under the No Action Alternative. What is not known is the average, maximum, and minimum loads per truck or railcar. However, accidental or deliberately initiated truck fires or railcar fires could occur, and the generic analysis provides a picture of what kinds of scenarios and risks there might be.

The frequency of onsite fires sufficient to cause a release of mercury at Y–12 is predicted to be negligible, just as it is for all of the candidate sites. In addition, there would be no transportation to or from Y–12 under the No Action Alternative. Therefore, the risks to ecological receptors under the No Action Alternative at Y–12 would be negligible. In addition, there could be no deliberately initiated transportation IDA for Y–12.

4.2.11 Socioeconomics

As indicated in Section 4.2, some non-DOE storage sites may require new construction or need to modify their storage capacity by constructing additional storage space. As discussed in Section 4.2, any analysis of impacts on socioeconomics at non-DOE storage sites would be highly speculative at this time. Under the No Action Alternative, elemental mercury would remain in storage at Y–12. Labor resources associated with mercury storage at Y–12 would remain at less than 0.05 full-time equivalent workers (DLA 2004a:4-26). Therefore, no incremental socioeconomic or related transportation impacts would occur at Y–12.

4.2.12 Environmental Justice

The population of one of the block groups within the 16-kilometer (10-mile) radius surrounding Y–12 was identified as a minority community, the population of another, as a low-income community (see Chapter 3, Section 3.9.11). As discussed in Sections 4.2.9 and 4.2.10, implementing the No Action Alternative would result in negligible offsite human health and ecological risks from mercury emissions during normal operations and accidents. Therefore, no disproportionately high and adverse effects on minority or low-income populations would occur at Y–12 under the No Action Alternative.

Table 4–12. Summary of Potential Exposure of Ecological Receptors to Low, Moderate, or High Levels of Exposure – Intentionally Initiated Railcar Spill with Fire

Ecological Receptor	Dry Deposition						Wet Deposition					
	Distance (meters) to Which Benchmark is Exceeded (D[a], 4.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (F[a], 1.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (D[a], 4.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (F[a], 1.5 m/s[b])		
	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV
Sediment-dwelling biota	>40,000	10,000 to 20,000	5,000 to 7,000	>40,000	2,000 to 3,000	700 to 1,000	>40,000	>40,000	20,000 to 30,000	>40,000	20,000 to 30,000	20,000 to 30,000
Soil invertebrates	>40,000	10,000 to 20,000	2,000 to 3,000	30,000 to 40,000	1,000 to 2,000		>40,000	30,000 to 40,000	20,000 to 30,000	>40,000	20,000 to 30,000	10,000 to 20,000
Plants	>40,000			5,000 to 7,000			>40,000	10,000 to 20,000	7,000 to 10,000	30,000 to 40,000	10,000 to 20,000	10,000 to 20,000
American robin	20,000 to 30,000			3,000 to 5,000			>40,000	7,000 to 10,000[c]	5,000 to 7,000	30,000 to 40,000	10,000 to 20,000	7,000 to 10,000
River otter	2,000 to 3,000			700 to 1,000			20,000 to 30,000	3,000 to 5,000	2,000 to 3,000	20,000 to 30,000	5,000 to 7,000	3,000 to 5,000
Aquatic biota							10,000 to 20,000	2,000 to 3,000	500 to 700	10,000 to 20,000	2,000 to 3,000	1,000 to 2,000
Short-tailed shrew							10,000 to 20,000	1,000 to 2,000		10,000 to 20,000	2,000 to 3,000	700 to 1,000
Great blue heron							7,000 to 10,000	700 to 1,000		10,000 to 20,000	1,000 to 2,000	300 to 500
Red-tailed hawk												

[a] Atmospheric Stability Class.

[b] Windspeed measured at 10 meters (33 feet).

Note: Shaded cells denote no exceedance of the appropriate benchmark. The ranges in this table indicate that there is uncertainty in the predicted distance to which the various benchmarks are exceeded. The distances downwind at which the various concentrations are first encountered can conservatively be set to 0. To convert meters to feet, multiply by 3.281.

Key: >=greater than; m/s=meters per second; SL=severity level.

4.3 LONG-TERM MERCURY MANAGEMENT AND STORAGE AT GRAND JUNCTION DISPOSAL SITE

Under this alternative, a new mercury storage facility would be constructed at DOE's GJDS. GJDS occupies 146 hectares (360 acres) located 29 kilometers (18 miles) southeast of Grand Junction, Colorado, as further described in Chapter 2, Section 2.4.2.

4.3.1 Land Use and Visual Resources

Minor impacts on land use and visual resources are expected from construction and operation of a new mercury storage building at GJDS. Construction of this new facility would result in the disturbance of approximately 3.1 hectares (7.5 acres) for building construction and laydown areas (see Chapter 2, Section 2.3.1). The proposed mercury storage facility would be located in the northwestern corner of the present GJDS complex, adjacent to the existing disposal area. Approximately half of the proposed site area was disturbed from past activities. The completed elemental mercury storage facility boundary would similarly encompass approximately 3.1 hectares (7.5 acres) within its fenced perimeter, which corresponds to approximately 2 percent of the site. The footprint of the mercury storage building would occupy approximately 1.6 hectares (3.9 acres) of this area. The low profile of the new building would only marginally affect the overall viewshed of the surroundings area. Therefore, mercury storage operations would not result in a change to U.S. Bureau of Land Management (BLM) visual resource management (VRM) classifications.

Mesa County land use regulations require that a warehouse or storage facility be located in an industrial or commercial zoning district. The current land use of GJDS is Agricultural Forestry Transitional. An amendment to the land use code would be required for a warehousing use to occur in this zoning district.

As discussed in Chapter 1, Sections 1.6 and 1.7.1, DOE and the Mesa County Board of Commissioners (Mesa County) entered into a Memorandum of Understanding (1996 MOU) (DOE and Mesa County 1996) to provide meaningful consultation with and participation of Mesa County in DOE's use of GJDS. Mesa County's position is that the use of GJDS is restricted per the 1996 MOU and that DOE is obligated to honor this agreement. DOE currently is evaluating the applicability of the 1996 MOU to determine whether it would affect the viability of this site as a reasonable alternative.

4.3.2 Geology, Soils, and Geologic Hazards

4.3.2.1 Geology and Soils

Construction of a new mercury storage facility under this alternative is expected to temporarily disturb no more than about 3.1 hectares (7.5 acres) of land at GJDS; most of this land has been previously disturbed in association with site clearing and construction in support of the existing disposal facility. The depth of excavation required would be less than about 0.6 meters (2 feet), as the new facility would be constructed on a reinforced-concrete slab and atop a gravel base. Additional trenching may be necessary to install foundation footings or to connect the new mercury storage facility with existing utilities; trenches could be about 0.6 meters (2 feet) wide by 1.2 meters (4 feet) deep. Mineral and other geologic resources would be required to support the construction effort, including approximately 4,760 cubic meters (6,200 cubic yards) of concrete and 3,900 cubic meters (5,100 cubic yards) of gravel (see Appendix C, Table C–2). These resources would be procured from local and/or regional commercial vendors; construction aggregate is relatively abundant in the GJDS region.

Although soils cleared for construction would briefly be subject to wind and water erosion, adherence to standard best management practices for soil erosion and sediment control (e.g., use of sediment fencing, staked hay bales, mulching and geotextile matting, and rapid reseeding) during facility construction would serve to minimize soil erosion and loss.

At GJDS, specific construction limitations include stoniness of the soils down to weathered shale, which presents site development limitations due to the potential presence of cobble- and boulder-size rocks in the relatively thick colluvial, terrace, and alluvial deposits across the site (see Chapter 3, Section 3.2.2.2). However, due to the limited extent of and relatively limited depth of excavation, the stoniness of site soils should not present substantial constraints for construction. Loss of erodible soils such as loess, which occurs at the site, particularly on steep slopes, would also present a development constraint. A site survey and geotechnical study would be conducted to confirm site geologic characteristics for facility engineering purposes, and location of the building footprint and adherence to the aforementioned best management practices would serve to minimize construction impacts on nearby slopes.

During operations, previously disturbed areas would not be subject to long-term soil erosion, as the areas within the footprint of the completed mercury storage facility would have been revegetated or would return to natural conditions. There would be no additional impact on geology and soils from operations.

4.3.2.2 Geologic Hazards

Hazards from large-scale geologic conditions, such as earthquakes, and other site geologic conditions with the potential to affect GJDS are summarized in Chapter 3, Section 3.2.2.3. Site geologic conditions would be unlikely to affect the mercury storage facility over the 40-year period of analysis.

Colorado is considered to have minor earthquake activity overall, with low-to-moderate seismicity in the Grand Junction region. Earthquakes have historically produced ground motion effects equivalent to MMI V in the vicinity of the site (see Appendix B, Table B–4). Although the site is located within several kilometers of potentially active faults, the predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.14 *g*. Ground motion in this range could cause slight damage to ordinary structures, but is not expected to affect modern structures designed and constructed to withstand the assessed hazard. DOE applies the seismic engineering provisions from the latest building codes as the minimum standard for the design, construction, and upgrade of its facilities. As further described in Appendix B, Section B.3.2, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. Thus, the mercury storage facility would be sited and designed to address the risk from geologic hazards, and the predicted ground motion would be unlikely to cause a breach in mercury containers from structural failure. An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.3.9.2.

4.3.3 Water Resources

4.3.3.1 Surface Water

There would be no direct impact from construction on natural surface-water drainages in the vicinity of GJDS. The closest surface-water feature to the proposed construction location is an ephemeral wash located approximately 240 meters (800 feet) north of the existing disposal site boundary; this would not be impacted by facility construction. The closest major streams to the site are Kannah Creek and the Gunnison River, which lie about 3.8 and 6.4 kilometers (2.4 and 4 miles), respectively, at their closest point from GJDS. Intervening ephemeral drainages comprise the surface-water flow path to these major streams. In addition, Cheney Reservoir is located approximately 0.6 kilometers (1 mile) southeast of GJDS at its closet point, but it is not along the surface-water flow path from GJDS (see Chapter 3, Section 3.2.3.1).

During construction, stormwater runoff from construction areas could potentially impact downstream surface-water quality. Appropriate soil erosion and sediment control measures, as described in Section 4.3.2.1, and spill prevention practices would be employed to minimize suspended sediment and deleterious material transport (such as from spills and leaks from construction equipment) and potential water quality impacts. An NPDES General Permit Notice of Intent would be filed to address stormwater discharges associated with construction activity (see Chapter 5, Section 5.3). Also, development and implementation of a stormwater pollution prevention plan would be required for the construction activity.

It is conservatively estimated that construction activities would require approximately 1,270,000 liters (336,000 gallons) of water over the 6-month construction period. This volume would primarily be required for dust control and soil compaction. It is anticipated that water would be trucked to the site from approved offsite sources. There would be no diversion of nearby surface water or onsite groundwater. During operations, water use would generally be limited to that required to serve the potable and sanitary needs of the storage facility workforce. Total annual consumption is estimated to be about 88,500 liters (23,375 gallons). At GJDS, a water storage tank would be sufficient to supply this volume, as further discussed in Section 4.3.7.2.

Design, construction, and operation of the mercury storage facility would feature structural controls and practices to prevent the release of elemental mercury and to prevent any spills or other releases, should they occur as a result of abnormal operating conditions, from reaching soils or surfaces where they could be conveyed to surface waters or groundwater. Structural elements include containment and other engineering features, including the use of spill trays, sloped floors, and floors constructed to be impervious to liquid mercury releases, as further described in Appendix C, Section C.2.1. In addition, facility operations would be conducted in accordance with an integrated contingency plan (ICP) and spill prevention, control, and countermeasures (SPCC) plan, or equivalent plans as mandated by state requirements for RCRA-permitted facilities (40 CFR 264.40 et seq.), which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

The site is not located within or adjacent to a 100-year floodplain and is not subject to riverine flooding. The site is subject to sheet flow from higher elevations, as discussed in Chapter 3, Section 3.2.3.1. DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. The potential for sheet flooding and other precipitation effects (e.g., scour and erosion) would be accounted for in the design of foundations, walls, roof structures, and drainage and stormwater management systems for the storage facility. As a result, the operation of the new mercury storage facility would also incorporate appropriate stormwater management controls to safely collect and convey stormwater from the facility while minimizing washout, soil erosion, and offsite water quality impacts.

There would be discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via the existing wastewater collection tanks (see Section 4.3.8). As the facility would be designed and operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.3.3.2 Groundwater

Excavation activities are not expected to impact shallow groundwater that can occur in paleochannels at the site. The site survey and geotechnical study that would be performed would be used to confirm the presence of and avoid any such features prior to construction (see Section 4.3.2.1). As the facility would be designed and operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.3.4 Meteorology, Air Quality, and Noise

4.3.4.1 Meteorology

Meteorological events can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events were considered in selecting the accident events evaluated in Section 4.3.9.2. DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including meteorological events. This includes hurricanes and tornadoes, high winds, excessive snow or ice, etc. DOE Standards 1020-2002 and 1023-95 implement DOE Order 420.1B and provide site assessment criteria and stipulate that DOE facilities, at a minimum, must be designed and constructed to the latest model buildings codes, applicable local building codes, or industry standards. The Order also stipulates natural phenomena hazards mitigation for DOE facilities. RCRA-permitted facilities, such as the proposed mercury storage facility, must also meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31, and applicable state RCRA requirements to prevent the release of stored wastes. As the Grand Junction region is susceptible to regular occurrence of high winds, the new mercury storage facility would be designed and constructed to withstand and mitigate the potential for high winds and other meteorological events, such as heavy snow.

4.3.4.2 Air Quality

Minor short-term air quality impacts would result from construction of a mercury storage facility at GJDS. These impacts would include an increase in criteria and toxic air pollutant concentrations from construction equipment emissions (see Appendix C, Section C.2.3). These emissions would occur over a 6-month construction period and are not expected to result in exceedance of the ambient air quality standards.

Minor short-term air quality impacts would result from an increase in truck or rail activity while mercury is moved to GJDS from storage. Truck and rail transport are discussed in more detail in Section 4.3.9.3. Estimated emissions from truck and rail transportation are presented in Tables 4–15 and 4–16. Over the 40-year period of analysis, the estimated number of truck or rail shipments would diminish over time and resulting emissions would decrease.

Operation of the mercury storage facility at GJDS is expected to have negligible emissions, consisting of emissions from employee vehicles, trucks, semiannual testing of emergency generators, and possibly mercury vapor from any spills or from mercury containers. No localized emissions from space heating are anticipated associated with mercury storage facility operations, as electric heating is anticipated for areas requiring climate control. Compliance with the conformity regulations is discussed in Appendix B, Section B.5.1.2.

Exposures to mercury vapor could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers (those outside the storage facility) or nearby offsite individuals. Appendix D, Section D.4.1, presents a conservative analysis that shows that for a long-term, undetected slow leak inside the proposed mercury storage facility, the predicted long-term average concentration in the building wake never exceeds 80 nanograms per cubic meter. The EPA threshold for chronic exposure to airborne mercury is 300 nanograms per cubic meter, so slow releases of mercury would have a negligible effect on noninvolved workers and the public, with a corresponding negligible risk.

Table 4–13. Air Pollutant Emissions from Transportation of Elemental Mercury by Truck to Candidate Storage Sites

Pollutant	Truck Emissions by Pollutant (metric tons)						
Site	Carbon Monoxide	Nitrogen Dioxide	Volatile Organic Compounds	$PM_{2.5}$	PM_{10}	Sulfur Dioxide	Carbon Dioxide
Grand Junction Disposal Site	3.81	14.2	0.760	0.305	0.382	0.0237	2,540
Hanford Site	5.17	19.2	1.03	0.413	0.518	0.0321	3,440
Hawthorne Army Depot	4.75	17.7	0.948	0.380	0.477	0.0295	3,160
Idaho National Laboratory	4.05	15.1	0.807	0.323	0.406	0.0251	2,690
Kansas City Plant	3.39	12.6	0.676	0.271	0.340	0.0211	2,250
Savannah River Site	4.11	15.3	0.820	0.329	0.413	0.0256	2,740
Waste Control Specialists, LLC	4.42	16.5	0.881	0.353	0.443	0.0275	2,940

Note: Emissions are based on truck mileage (see Section 4.3.9.3) and emission factors calculated using the U.S. Environmental Protection Agency's mobile source emission factor model, Mobile6 (EPA 2003); to convert metric tons to tons, multiply by 1.1023.

Key: PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Table 4–14. Air Pollutant Emissions from Transportation of Elemental Mercury by Rail to Candidate Storage Sites

Pollutant	Locomotive Emissions by Pollutant (metric tons)						
Site	Carbon Monoxide	Nitrogen Dioxide	Volatile Organic Compounds	$PM_{2.5}$	PM_{10}	Sulfur Dioxide	Carbon Dioxide
Grand Junction Disposal Site[a]	1.63	9.48	0.527	0.273	0.283	0.184	645
Hanford Site	2.24	13.2	0.734	0.383	0.395	0.263	857
Hawthorne Army Depot	1.95	11.5	0.639	0.333	0.344	0.229	747
Idaho National Laboratory	1.84	10.8	0.604	0.315	0.325	0.216	705
Kansas City Plant	1.24	7.30	0.406	0.212	0.218	0.145	475
Savannah River Site	1.50	8.85	0.493	0.257	0.265	0.176	575
Waste Control Specialists, LLC	1.94	11.5	0.638	0.333	0.343	0.228	745

[a] The Grand Junction Disposal Site has no rail access, thus mercury would need to be transported from the nearest railhead in the city of Grand Junction. The additional emissions from transportation by truck are included.

Note: Emissions are based on locomotive fuel usage (see Section 4.3.9.3) and the U.S. Environmental Protection Agency emission factors for locomotives (EPA 2009b); to convert metric tons to tons, multiply by 1.1023.

Key: PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

Annual carbon dioxide emissions would be highest during the year 2013, at approximately 257 metric tons (284 tons) per year, as a result of moving elemental mercury to the site by truck; these annual truck emissions would be greater than rail emissions from shipping mercury. The emissions would minimally add to global annual emissions of carbon dioxide, which were estimated to be 26.4 billion metric tons (29.1 billion tons) per year from 2000 through 2005 from fossil fuel use worldwide (IPCC 2007:3), and U.S. carbon dioxide emissions, which were 5.98 billion metric tons (6.59 billion tons) in 2006 (EPA 2008:ES-5). Global climate change is further discussed in Section 4.11.4.2.

4.3.4.3 Noise

Short-term noise impacts at GJDS could result from construction of a mercury storage facility. These impacts would include an increase in traffic to the site and an increase in noise resulting from construction equipment. These impacts would occur during the 6-month construction period. Since the nearest noise-sensitive receptor, a residence, is located 3 kilometers (2 miles) from the site, the increase in noise levels at this location from construction equipment is expected to be negligible. The estimated average noise level during the daytime (8-hour equivalent sound level) from four items of construction equipment operating at this distance is estimated to be 24 decibels A-weighted (dBA), which would likely be below the background sound level. The increase in traffic noise levels along U.S. Route 50 from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on U.S. Route 50.

Short-term noise impacts could occur along U.S. Route 50 as a result of increased truck activity during the period that elemental mercury is transported to the site. The resulting increase in day-night average noise levels along U.S. Route 50 is expected to be less than 1 dBA. As such, the change in truck traffic is not expected to result in a change in noise levels along this route or other shipping routes that would be noticeable to the public or result in an increase in annoyance.

Operation of the mercury storage facility at GJDS is expected to have a negligible impact on noise levels around the site since the noise sources would be limited to a few employee vehicles, occasional delivery trucks, and semiannual testing of the emergency generator.

4.3.5 Ecological Resources

4.3.5.1 Terrestrial Resources

As discussed in Chapter 3, Section 3.2.5.1, the majority of the land upon which the proposed mercury storage facility would be built (approximately 1 hectare [2.5 acres]) is disturbed land within an already developed facility area. The remainder of this land (approximately 0.7 hectares [1.6 acres]) contains native vegetation that would be destroyed by the construction of a new mercury storage facility. Wildlife occurring within both the disturbed and the undisturbed portion of the proposed site would be displaced by construction activities. Additional impacts could include noise and light disturbances resulting from construction and other human activities.

Adherence to best management practices for land cover management (e.g., washing down construction equipment and vehicle tire treads) would serve to reduce the chance of introducing invasive plant species. Impacts on animals from construction would be limited to species adapted to human disturbance. During operations, there would be no additional impacts on terrestrial resources, as temporarily disturbed areas beyond the facility footprint would be revegetated and/or would revert to more-natural conditions.

4.3.5.2 Wetlands and Aquatic Resources

No wetlands or aquatic features currently exist within the proposed mercury storage facility construction site at GJDS. Therefore, no impacts on wetlands or aquatic resources are expected.

4.3.5.3 Threatened and Endangered Species

No threatened or endangered species are known or are expected to exist within the proposed construction site at GJDS. Thus, no impacts on threatened or endangered species are expected from construction or operations. Consultations have been initiated with the appropriate U.S. Fish and Wildlife Service office and state wildlife agency to support this analysis (see Chapter 5, Section 5.4).

4.3.6 Cultural and Paleontological Resources

4.3.6.1 Prehistoric Resources

GJDS and the surrounding area contain a high density of potentially significant cultural resources. More data are needed to determine the eligibility of potentially significant sites for listing in the NRHP by the State Historic Preservation Office (SHPO) (see Chapter 3, Section 3.2.6.1). Therefore, the potential exists for construction impacts and effects from facility operations. DOE has initiated consultation with the Colorado SHPO to support this analysis (see Chapter 5, Section 5.4).

4.3.6.2 Historic Resources

There would be no impact on historic resources at GJDS from construction or operation of the new mercury storage facility. The majority of properties in the vicinity are less than 50 years old and, are therefore ineligible for inclusion in the NRHP. To date, no historic properties have been identified on or near the site (see Chapter 3, Section 3.2.6.2).

4.3.6.3 American Indian Resources

There have been no American Indian sites identified at GJDS based on work performed in support of the existing disposal facility, and no impact on American Indian resources from construction or operations are anticipated (see Chapter 3, Section 3.2.6.3).

4.3.6.4 Paleontological Resources

There would be no impact on unique paleontological resources as none have been identified or are likely to occur on the site.

4.3.7 Site Infrastructure

4.3.7.1 Ground Transportation

Construction and operations of a new mercury storage facility at GJDS are not expected to appreciably increase demands on the road system leading to the site. Projected peak traffic volumes and the number of shipments associated with mercury storage operations are presented in Section 4.3.11.

4.3.7.2 Electricity, Fuel, and Water

The projected electricity, fuel, and water requirements for construction and operations of a new mercury storage facility are summarized in Appendix C, Tables C–2 and C–4. To support construction, electric power would likely be supplied via a diesel-fired generator. Diesel fuel would also be required to operate construction equipment. Total diesel fuel demand for construction is estimated at 193,000 liters (51,000 gallons) over the 6-month construction timeframe. Liquid fuels are not considered to be limiting resources as they would be provided by local or regional suppliers and delivered to the point of use as needed. Raw water would be required for dust control, soil compaction, and other construction uses; some potable water would also be required for sanitary uses by the construction workforce. Raw water would likely be delivered to the site via a refillable water truck, as there is no public water service to the site. Construction is projected to require approximately 1,230,000 liters (325,000 gallons) of raw water and about 40,900 liters (10,800 gallons) of potable water, for a total of 1,270,000 liters (336,000 gallons).

On an annualized basis, utility demands for mercury storage facility operations would be relatively small compared with construction. Electricity requirements would total 253 megawatt-hours annually for facility lighting, ventilation, and heating. An estimated 606 liters (160 gallons) of diesel fuel would be consumed annually for operation of an emergency onsite generator. Water use would be limited to that required to support the potable and sanitary needs of the facility workforce and would total about 88,500 liters (23,400 gallons) per year (see Appendix C, Table C–4).

At GJDS, the operational electricity demand would have a moderate impact on the existing electric power infrastructure. The electrical distribution infrastructure would need to be upgraded or an additional electrical substation would need to be tied into the site's distribution system to provide adequate electricity for mercury storage facility operations. GJDS is operating at 14 percent of its installed annual electric power capacity of 109 megawatt-hours. Electric power requirements for a new mercury storage facility would increase the site's annual electrical energy consumption to 268 megawatt-hours. The increase would be nearly 2.5 times the site's existing capacity.

While diesel fuel is not routinely used or stored at GJDS, the projected diesel fuel required for emergency generator operations would be negligible and would be supplied from local vendors.

Public water is not available at GJDS, and potable water needs are supplied via bottled water. Current process water used at the site is supplied from offsite sources and stored in a 37,850-liter (10,000-gallon) supply tank. Water demands for operation of a new mercury storage facility at the site would need to be supplied via bottled water and a new water storage tank dedicated to the mercury storage facility.

4.3.8 Waste Management

Waste generation associated with the proposed construction and operation of the RCRA-permitted mercury storage facility at GJDS would have a negligible impact on the site considering the relatively small volumes of hazardous and nonhazardous waste projected to be generated.

Construction of the proposed mercury storage facility is estimated to generate 271 cubic meters (355 cubic yards) of nonhazardous solid waste (construction debris) and approximately 9,850 liters (2,600 gallons) of nonhazardous sanitary liquid waste (see Appendix C, Table C–2). Construction debris would be shipped off site to the Mesa County Landfill. Portable toilet facilities, serviced by a local or regional contractor, would be used to serve the sanitary needs of the construction workforce.

It is estimated that 910 55-gallon (208-liter) drums of hazardous waste would be generated over the 40-year period of analysis for mercury storage facility operations. This generation volume equates to an average annual generation rate of 23 55-gallon drums, or approximately 5 cubic meters (6.5 cubic yards) (approximately 1 metric ton [1.1 tons or 2,200 pounds] by weight) of hazardous waste. This waste would primarily consist of cleaning rags used during facility maintenance activities, PPE used during monitoring activities, materials used during spill response activities, and mercury vapor filters used in the Handling Area. Although GJDS does not currently generate hazardous waste, the estimated yearly generation rate of mercury-contaminated waste would be a relatively small volume compared with most facilities that manage hazardous waste. As necessary, mercury-contaminated waste would be disposed of off site using licensed hazardous waste disposal contractors. Operation of the proposed mercury storage facility would require GJDS to obtain an EPA identification number and applicable RCRA TSD facility permit.

Facility operations would also generate an estimated 59,000 liters (15,600 gallons) of nonhazardous sanitary waste annually (see Appendix C, Table C–4). The site's existing onsite wastewater tank system would be used to collect this wastewater; the system would be emptied as needed using a licensed contractor.

4.3.9 Occupational and Public Health and Safety

If GJDS is chosen as the site for mercury storage, a new facility would be built. Most of the risks that pertain to GJDS are the same as those discussed in Sections 4.2.9.1 through 4.9.2.5, with a few exceptions, as discussed below.

4.3.9.1 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites. Consequences to the involved worker are predicted to be negligible because involved workers would never be exposed to airborne concentrations of mercury vapor above the ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. This corresponds to keeping exposures to the involved worker in the SL-I (negligible) range.[14] This would be achieved by adherence to good operating practices, in particular, attention to ventilation, inspection, monitoring, and use of PPE, as described in the *Interim Guidance* (DOE 2009c). Therefore, the risks to involved workers would be negligible during normal operations.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.1.2, shows that the predicted long-term average concentration in the building wake for new construction is about 2.0×10^{-5} milligrams per cubic meter. This is well below EPA's chronic-inhalation-exposure RfC of 3.0×10^{-4} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and the public would be negligible.

4.3.9.2 Facility Accidents

Table 4–3 provides a summary of the likelihood of occurrence of candidate mercury storage facility accident scenarios initiated by failures of engineered systems, human errors, or external events, and Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible frequency from Table 4–3. These are the scenarios that are analyzed for GJDS.

With specific reference to GJDS, commentors asked whether the aircraft crash scenario should be predicted to have negligible (FL-I) frequency in light of the fact that students in light aircraft fly over the site while training. Statistics on how often this occurs are not available, but some general observations can be made. As discussed in Appendix D, Section D.2.5.7, a previous analysis of a small aircraft crash into a hazardous and radioactive waste storage facility concluded that 9 drums would fail and 22 drums would leak based on both the aircraft engine impact and subsequent aircraft fuel fire. The earthquake accident analysis described in Section D.2.5.2 assumes that all the 3-L flasks and 1-MT containers would fail inside the storage building. The storage building is designed to hold 6,000 1-MT containers and over 100,000 3-L flasks. Therefore, in the event of a general aviation aircraft that is being used for flying lessons crashing into the building, approximately 31 flasks or containers could be damaged by impact and fire loads to the extent that they leak mercury. The resultant pool of mercury and release to the environment from such an event would constitute a very small fraction (less than 0.1 percent) of that calculated for the earthquake event. In addition, the analysis in Section D.2.5.7 shows that, in several independent analyses, the frequency of small aircraft crashes into specific buildings at DOE sites is less than 10^{-6} per year. The predicted frequency of earthquakes severe enough to cause spills is 4.0×10^{-4} per year (see Section D.2.5.2). It is unlikely that the presence of training aircraft would increase aircraft crash frequencies by more than two orders of magnitude. Therefore, the earthquake risk bounds the aircraft risk, probably by a large margin.

[14] For definitions of SLs for various types of exposures, see Section 4.2.9.1.1 and Appendix D, Section D.1.1.1. For a discussion on how risk is assessed, see Sections 4.2.9.1.1 and D.1.2.

4.3.9.2.1 Worker Inside Building – All Onsite Spill Scenarios

The analysis of risks to the involved worker under all onsite scenarios is the same as in Section 4.2.9.1.4, which shows the following:

- The predicted frequencies of all the scenarios in Table 4–3 are in the moderate (FL-III) or low (FL-II) range.
- The predicted consequences to the involved worker are all in the SL-I to -II range. This is based on a qualitative analysis of how quickly a worker can walk out of the building and on the observation that the saturated vapor density of mercury vapor at the assumed release temperature of 20 °C (68 °F) is only 14 milligrams per cubic meter, so that less than a factor of two extra dilution is required to bring that vapor density below the 30-minute IDLH of 10 milligrams per cubic meter or the 30-minute AEGL-3 of 8.9 milligrams per cubic meter.
- Per Figure 4–1, the resulting risks would be in the negligible-to-low range.

4.3.9.2.2 Predicted Concentrations in Building Wake – All Onsite Spill Scenarios

As mentioned above, a new facility would be built at GJDS for mercury storage. All non-buoyant releases that occur inside the building or immediately adjacent to it would be mixed into the turbulent building wake, as described in Appendix D, Section D.7.2.1. For new construction at GJDS, these concentrations in the turbulent building wake are all below one-tenth of AEGL-2 (0.17 milligrams per cubic meter for a duration of release of 1 hour). Therefore, the predicted concentrations are SL-I for both noninvolved workers and members of the public.

The only scenario from Table 4–3 that does not result in mixing in the building wake is the outside earthquake scenario. Under this scenario, the building is assumed to have collapsed completely, so that the resulting mercury pool is effectively outside. Appendix D, Section D.7.1.2, describes how the release rate is calculated in these circumstances. As shown in Table D–52, the release rate of the outside earthquake scenario in Atmospheric Stability Class D with a windspeed of 4.5 meters per second is 7.98×10^{-4} kilograms per second. This release rate was input into a ground-level Gaussian dispersion model, which calculated downwind concentrations in a spectrum of weather conditions, ranging from Atmospheric Stability Classes A through F, and in four discrete ranges of windspeed (the calculated rate of release is representative or conservative for all but a small fraction of higher-windspeed conditions).

From this calculation, the maximum downwind distance to which a concentration greater than AEGL-3 could be exceeded at GJDS is predicted to be less than 100 meters (330 feet) (the model is not valid at distances shorter than 100 meters [330 feet]); AEGL-2 could be exceeded downwind to a distance of about 300 meters (980 feet); and a concentration between 0.1 × AEGL-2 and AEGL-2 could be exceeded to a distance of about 1.1 kilometers (0.68 miles). At GJDS, the proposed new building is expected to be no more than 30 meters (98 feet) from the site boundary to the north and west. However, the nearest residence in those directions is more than 4 kilometers (2.5 miles) away.[15] Therefore, the concentration to which any resident individual could be exposed negligible, and the corresponding risk would be negligible.

The other possibility is that there could be an individual in the vicinity of the site boundary at the time of an accidental spill. The most likely place for such an individual to be is on the site access road, which enters the site just south of the proposed storage facility. However, the frequency of such an event is given by the product of four statistically independent factors: (1) the frequency of occurrence of the earthquake (4×10^{-4} per year); (2) the probability that the earthquake, given its occurrence, is severe

[15] This information was obtained using Google Earth.

enough to cause the total collapse of the building; (3) the probability that the individual will be near the site boundary at the time of the accident; and (4) the probability that the wind is blowing towards the individual at that time. From the Gaussian computer runs, the latter probability is 0.09 or approximately 0.1. The other two probabilities (complete building collapse and an individual's being in the vicinity) are unknown, but it seems reasonable to suppose that their product does not exceed 1/40, which would take the overall probability (and hence risk) below 10^{-6} per year (i.e., negligible).[16] Table 4–15 summarizes the results for all accidental spills of elemental mercury on site (without fire).

Table 4–15. Summary of Risks of all Onsite Elemental Mercury Spill Scenarios – Grand Junction Disposal Site

Scenario	Frequency	Consequence[b]	Risk
Spills Inside Building[a]			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for all inside spills
Noninvolved worker	FL-II – FL-III	SL-II	N for all inside spills
Member of the public	FL-II – FL-III	SL-II	N for all inside spills
Spills Outside Building			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for outside earthquake spill; N for all other outside spills
Noninvolved worker	FL-II – FL-III	SL-I – SL-II	
Member of the public			
1-metric-ton container spill	FL-II	SL-I	N
Single-pallet spill	FL-III	SL-I	N
Earthquake with building collapse[c]	FL-III	SL-I	N

[a] The inside spill scenarios considered are single flask, single pallet, triple pallet, 1-metric-ton container, full spill tray under a pallet, and earthquake with intact building walls.

[b] For definitions of severity levels, see Section 4.2.9.1.1.

[c] This scenario encompasses the risk from floods, high winds, and tornadoes.

Key: FL=frequency level; L=low; N=negligible; SL=severity level.

4.3.9.3 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury over a 40-year period of analysis to GJDS. These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. The results of the analysis are shown in Table 4–16.

[16] It is recognized that the foregoing reasoning is subjective.

Table 4–16. Frequency Analysis of Truck and Railcar Accidents – Grand Junction Disposal Site

Scenario	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires (per year)	Frequency of Accidents with Death (per year)[a]
Truck – Scenario 1	909,667	1.1×10^{-2}	1.9×10^{-3}	1.5×10^{-4}	5.1×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Moderate – FL-III
Truck – Scenario 2	1,559,319	1.6×10^{-2}	3.1×10^{-3}	2.5×10^{-4}	8.7×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Moderate – FL-III
Railcar	317,260	2.0×10^{-3}	9.2×10^{-6}	2.1×10^{-5}	1.3×10^{-4}
	–	Moderate – FL-III	Low – FL-II	Low – FL-II	Moderate – FL-III

[a] Fatality caused by mechanical impact, not by exposure to mercury.
Note: To convert miles to kilometers, multiply by 1.60934.
Key: FL=frequency level.

The above frequencies are for an accident anywhere along any of the transportation routes taken over a 40-year period of analysis. To estimate the probability of a crash in the vicinity of or on the site, begin with the average length of a truck or rail trip to GJDS (about 2,000 kilometers [1,260 miles]) and approximate an onsite crash with a crash in the last mile of the trip. The frequency of a crash in the last mile of those trips is a fraction, 0.00079, of the frequencies in Table 4–16. The frequency of accidents with spills would be low under both truck scenarios and negligible under the Railcar Scenario. The frequency of crashes with fires or death would be negligible under all scenarios.

With specific reference to GJDS, the railhead is in the city of Grand Junction. In the Railcar Scenario, pallets would need to be transferred from railcars to trucks and then driven approximately 32 kilometers (20 miles) to GJDS. The predicted frequency of a crash with a spill during that 32-kilometer (20-mile) stretch would be $20 \times 8.5 \times 10^{-8}$ per truck (see Appendix D, Table D–10), or 1.7×10^{-6} per trip. Per Table D–9, there would be on average 59 pallets and 150 1-MT containers shipped per year. In principle, these would take up just over 17 trucks. Conservatively assuming they would be shipped in half truckloads, there would be 35 truckloads per year, leading to an estimated crash with spill frequency of approximately 6.0×10^{-5} per year. This increases the frequency of a crash with a spill by about a factor of 6, since the railcar frequency of a crash with a spill is estimated to be only 9.2×10^{-6} per year. However, the increase of 6.0×10^{-5} per year is still well below the Truck Scenario 2 frequency of a crash with a spill of 3.1×10^{-3} per year. Thus, conservatively bounding the consequences of spills by those from railcars, the risks from spills with no fire could increase six-fold over the risk from rail transportation alone, but would still be much less than the risk of shipping by truck alone.

In addition, there would be transfer operations at the Grand Junction goods yard. The operations taking place at that yard would be to transfer pallets and 1-MT containers from railcars to trucks. As stated above, 59 pallets and 150 1-MT containers would be shipped per year. The probability of a drop per handling event is 2.0×10^{-5}. Therefore, the probability of pallet drop per year is approximately 0.002 per year, and the probability of a 1-MT container drop per year is 0.003. These are both moderate (FL-III) frequencies. If the transfer operations take place adjacent to large buildings, the wake effect could make the consequences SL-I, in which case risks would be negligible. In the absence of buildings, runs of the Gaussian computer model show concentrations at the SL-II level extending to only about 40 meters, which would likely be well inside the distance to any public receptor. Based on this analysis, the transfer operations in Grand Junction do not appear to add greater than negligible risk.

With respect to transportation accidents involving spills of mercury, the following four scenarios were considered:

- Spill of elemental mercury onto the ground without fire
- Spill of elemental mercury directly into water
- Fire with mercury spill
  - In dry weather
  - In wet weather

4.3.9.3.1 Transportation Accident with Spill of Elemental Mercury onto the Ground

For exposures occurring via the inhalation pathway from a spill with no fire during a transportation accident, the fraction of the mercury being carried by the truck or railcar that would be spilled is highly uncertain. It is extremely unlikely that all flasks or all 1-MT containers would be breached. However, to be conservative, it is assumed that such a catastrophic release could take place. The largest amount of mercury that can be carried in a truck or a railcar is that contained in 54 1-MT containers. Assuming that all of this mercury is spilled and spreads until the pool is at its capillary depth of 0.36 centimeters (0.14 inches) (so conservative as to be essentially inconceivable in an outdoor spill),[17] the predicted rate of evaporation would be 1.25×10^{-5} kilograms per second (see Appendix D, Section D.4.3.1). Running this through the Gaussian model and ranging over all possible combinations of atmospheric stability class and windspeed, the predicted maximum distances to the airborne toxic benchmarks are as follows: AEGL-3, less than 100 meters (330 feet); AEGL-2, about 100 meters (330 feet); and 0.1 × AEGL-2, about 340 meters (1,115 feet). As a result, a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that individual could only be exposed above 0.1 × AEGL-2 if the crash occurs along a 680-meter (2,230-foot) stretch of road (340 meters [1,115 feet] on either side). This is a small fraction of any of the routes (i.e., the average length of a truck trip to GJDS is approximately 2,000 kilometers [1,260 miles]). The frequency of occurrence of a truck crash with spill on the truck routes to GJDS is 0.0031 per year; see Table 4–16 (Truck Scenario 2). The product of the fraction of the route and the frequency of occurrence is about 1.1×10^{-6} per year, a low frequency. Under Truck Scenario 1 and the Railcar Scenario, the frequencies would be negligible. Therefore, the risk to a member of the public from transportation spills onto the ground without fire en route to GJDS would be negligible under Truck Scenario 1 and the Railcar Scenario and low under Truck Scenario 2.

4.3.9.3.2 Transportation Accident with Spill of Elemental Mercury Directly into Water

Spills occurring during a transportation accident could result in leakage of the mercury cargo into the surrounding environment. The most significant and challenging scenario (from a cleanup standpoint) would be a spill directly into a surface-water body such as a lake or river. This could occur if a truck or railcar crashes on a bridge over a river or if it falls into a river or lake while traveling alongside the water body.

With specific reference to GJDS, Interstate 70 in Colorado follows rivers and streams much of the distance in the state to get to GJDS. These include the Colorado River, Clear Creek, Eagle River, Straight Creek, and Gore Creek. Interstate 70 crosses streams and rivers repeatedly and is often elevated directly above streams or rivers, especially over Vail Pass, through Glenwood Canyon, and through Debeque Canyon. Thus, the route to GJDS contains the greatest distance of any route where there is potential for spillage into a river to occur, although at the time of writing no information had been collected on the fractions of

[17] Surface tension is what prevents the mercury pool from spreading any further. However, the mercury will only spread until the pool is at its capillary depth of 0.36 centimeters (0.14 inches) if the surface is perfectly smooth. See Appendix D, Section D.7.1.4.

that route where the road or rail is close enough for it to be plausible that a truck or railcar might crash directly into the river.

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

Table 4–17 summarizes the risks associated with accidental spillages of elemental mercury during transportation to GJDS.

Table 4–17. Summary of Transportation Risks to Human Receptors, Spills of Elemental Mercury onto the Ground or into Water, Grand Junction Disposal Site

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto the Ground			
Frequency[a]	FL-I	FL-II	FL-I
Consequence	SL-II	SL-II	SL-II
Risk	*Negligible*	*Low*	*Negligible*
Spill into Water			
Frequency[b]	FL-III	FL-III	FL-II
Consequence	SL-I – SL-II	SL-I – SL-II	SL-I – SL-II
Risk[c]	*Negligible to low*	*Negligible to low*	*Negligible to low*

[a] Frequency at which spill occurs close enough to a specific individual to cause Acute Exposure Guideline Level 2 to be exceeded.

[b] Frequencies of railcar or truck crashes with spills from Table 4–16.

[c] These estimates of risk are subject to large uncertainty.

Key: FL=frequency level; SL=severity level.

4.3.9.3.3 Transportation Accident with Fire

The fire calculations are described in Section 4.2.9.1.5. Table 4–18 shows the results of the calculations of acute-inhalation risks from transportation accidents with fires on transportation routes to GJDS. The table encompasses both truck scenarios and the Railcar Scenario.

Table 4–18. Summary of Acute-Inhalation Risks to Human Receptors, Accidents with Fires, Transportation Routes to Grand Junction Disposal Site

	Both Truck Scenarios with Wooden Pallets	Railcar Scenario with Wooden Pallets
Frequency[a]	FL-III	FL-II
Consequence[b]	SL-II	FL-II
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.
[b] The highest consequence in any weather condition.
Key: FL=frequency level; SL=severity level.

Note that the risks presented in the above scenarios are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

The analyses performed for this EIS show that, under all fire scenarios, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

Table 4–19 summarizes the human health risks associated with all transportation spills.

Table 4–19. Summary of Transportation Risks to Human Receptors, Grand Junction Disposal Site

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto ground	Negligible	Low	Negligible
Spill into water	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty
Spill with fire – inhalation, wooden pallets	Low	Low	Low
Spill with fire – dry and wet deposition, wooden pallets	Negligible	Negligible	Negligible

4.3.9.4 Intentional Destructive Acts

The discussion of IDAs is the same for all sites and transportation routes (see Section 4.2.9.1.6).

4.3.10 Ecological Risk

There is a generic analysis of ecological risk in Section 4.2.10.1, which applies without modification to GJDS.

4.3.10.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike inorganic compounds formed from divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation are considered to be negligible at all storage sites and along all transportation routes.

4.3.10.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2, which also makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.
- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to ecological receptors could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

4.3.10.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5, and Section 4.2.10.1.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. Table 4–20 summarizes the FL, consequence level, and risk to ecological receptors in the case of a truck crash with pallet fire and no rain (dry deposition) and applies to all candidate storage sites.

For the interpretation of Table 4–20, see Section 4.2.10.1.3. The risks of other potential fire scenarios are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–21.
- For railcar crashes with wooden pallet fires and without rain (dry deposition), see Table 4–22.
- The predicted frequency of railcar crashes with pallet fires and rain is negligible, so risks would be negligible and no summary table is presented.

Table 4–20. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, Grand Junction Disposal Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Tables D–12 and D–13.

[b] Applies to both Truck Scenarios 1 and 2.

Table 4–21. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, Grand Junction Disposal Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of truck crashes with fires and rain from Appendix D, Table D–16.

[b] Applies to both Truck Scenarios 1 and 2.

Table 4–22. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, Grand Junction Disposal Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of railcar crashes with fires from Appendix D, Table D–14.

4.3.10.4 Intentionally Initiated Transportation Fires

The analysis of the ecological effects of intentionally initiated transportation fires is the same for all sites (see Section 4.2.10.1.4).

4.3.11 Socioeconomics

Employment during construction is expected to average 18 people for approximately 6 months. Operation of the facility is estimated to require approximately 8 individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and approximately 5 individuals thereafter, resulting in an increase of the full-time equivalent workforce at GJDS of a factor of 3 to 5. In spite of this projected increase in jobs supporting construction and operations at GJDS and associated indirect employment, this alternative would have a negligible-to-minor impact on socioeconomic conditions (i.e., overall employment, population trends, and traffic) in the ROI because the largest estimated increase in employment would only increase the ROI workforce by approximately 0.01 percent.

Construction-related transportation, including employee vehicle trips and equipment and materials shipments, is not expected to adversely impact traffic conditions on roads leading to the site. It is assumed that there would be approximately 1.5 employees per vehicle, and every vehicle is counted twice to account for round trips. It is estimated that average construction transportation of 45 vehicles a day could increase the average annual daily traffic count on U.S. Route 50 by less than 0.5 percent.

Transportation impacts during the operations phase would include employee vehicle trips and shipments of elemental mercury for storage. Appendix C, Section C.1, provides an estimate of the number of shipments by truck. The additional vehicles due to facility operations are not expected to noticeably increase traffic volumes on roads leading to the site. The greatest impact would be during the first 2 years of operations, when it is estimated that approximately 11 vehicles a day could increase the average annual daily traffic count on U.S. Route 50 by approximately 0.1 percent. During this time, it is estimated that up to 78 shipments of elemental mercury would be made each year. Approximately 96 percent of the additional vehicles would be attributed to employee transportation.

4.3.12 Environmental Justice

None of the block groups within either the 16-kilometer (10-mile) or the 3-kilometer (2-mile) radius surrounding GJDS contain a disproportionately high number of minority or low-income individuals (see Chapter 3, Section 3.2.11). Therefore, no disproportionately high and adverse effects on minority or low-income populations are expected.

4.4 LONG-TERM MERCURY MANAGEMENT AND STORAGE AT HANFORD SITE

Under this alternative, a new mercury storage facility would be constructed at DOE's Hanford. Hanford occupies 151,775 hectares (approximately 375,040 acres) along the Columbia River in the southeastern portion of the state of Washington. Within this site, the new mercury storage facility would be built in the 200-West Area adjacent to the Central Waste Complex (CWC), as further described in Chapter 2, Section 2.4.3.

4.4.1 Land Use and Visual Resources

Negligible impacts on land use and visual resources are expected from construction and operation of a new mercury storage building at Hanford. Construction of this new facility would require the disturbance of approximately 3.1 hectares (7.5 acres) for building construction and laydown areas (see Chapter 2, Section 2.3.1). The site would be located adjacent to the existing CWC in the 200-West Area. This area of Hanford is highly developed and has been subject to disturbance from past operations. The completed facility boundary would similarly encompass approximately 3.1 hectares (7.5 acres) within its fenced perimeter, which corresponds to less than 0.1 percent of the land within the 200 Areas at Hanford. The footprint of the mercury storage building would occupy approximately 1.6 hectares (3.9 acres) of this area.

Mercury storage operations would be compatible with DOE's Industrial-Exclusive land use designation for this area. The low profile of the new building is not expected to affect the overall viewshed of this area from on- or offsite vantage points. Therefore, mercury storage operations would not result in a change to BLM VRM classifications.

4.4.2 Geology, Soils, and Geologic Hazards

4.4.2.1 Geology and Soils

Construction of a new mercury storage facility in the Hanford 200-West Area would generally have the same direct impacts on geology and soils in terms of land area disturbed, depth of excavation, and geologic resource demands as described in Section 4.3.2.1. Geologic resources, including concrete and coarse aggregate (gravel) totaling 8,640 cubic meters (11,300 cubic yards), would be required for construction (see Appendix C, Table C–2) and would be procured from local and/or regional commercial vendors. Trenching may be necessary to place foundation footers or to connect the new mercury storage facility with existing 200-West Area utilities. As the new facility would be located adjacent to the existing CWC, the area has largely been disturbed by historical activities. Excavation in the 200-West Area would encounter the gravel-dominated sediments of the Hanford formation, which are up to 100 meters (330 feet) thick across the 200 Areas (see Chapter 3, Section 3.3.2). Nevertheless, the lateral and vertical extent of subsurface strata would not be greatly impacted by excavation and site-clearing activities, and no special construction techniques should be necessary to work in these materials. Although boulder-size rocks can occur in the Hanford formation, a site survey and geotechnical study would be conducted to confirm site geologic characteristics for facility siting and engineering purposes.

Natural soils comprising alluvial and windblown sands across the 200-West Area could be more prone to erosion. However, adherence to standard best management practices for soil erosion and sediment control during construction would serve to minimize soil erosion and loss (see Section 4.3.2.1). During operations, the previously disturbed areas would not be subject to long-term soil erosion, and temporarily disturbed areas would likely revert to natural conditions. There would be no additional impact on geology and soils from operations.

4.4.2.2 Geologic Hazards

Hazards from large-scale geologic conditions, such as earthquakes, and other site geologic conditions with the potential to affect the 200-West Area at Hanford are summarized in Chapter 3, Section 3.3.2.3. The seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the magnitude of these events, is lower than that of other regions in the Pacific Northwest. However, the 200-West Area is located approximately 8 kilometers (5 miles) from the potentially active Central Gable Mountain Fault. The Hanford region is one of relatively moderate to high seismicity overall. Ground shaking of MMI VII associated with postulated earthquakes is possible and supported by the historical record for the region (see Appendix B, Table B–4). The predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.18 *g*. Ground motion in this range could cause slight to moderate damage to ordinary structures, but is not expected to affect modern structures designed and constructed to withstand the assessed hazard. As further described in Appendix B, Section B.3.2, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. Thus, the mercury storage facility would be sited and designed to address the risk from geologic hazards, and the predicted ground motion would be unlikely to cause a breach in mercury containers from structural failure. An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.4.9.2.

4.4.3 Water Resources

4.4.3.1 Surface Water

Facility construction activities are not expected to have any direct impact on surface water features, including the Columbia River, as there are no natural, perennial surface water drainages in the vicinity of CWC in the 200-West Area. The closest surface water feature to CWC is Cold Creek, an ephemeral stream located approximately 4.8 kilometers (3 miles) southwest of the site.

Stormwater runoff from the construction site would be unlikely to reach Cold Creek, and appropriate soil erosion and sediment control measures and spill prevention and waste management practices would be employed to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts, as noted in Section 4.3.3.1.

Construction activities would require as much as 1,270,000 liters (336,000 gallons) of water over the 6-month construction period. This volume would primarily be required for dust control and soil compaction. It is anticipated that water would be trucked to the construction site and supplied from the 200 Area water system, which draws from the Columbia River. During operations, water use would generally be limited to that required to serve the potable and sanitary needs of the storage facility workforce. Total annual consumption is estimated to be no more than about 88,500 liters (23,375 gallons). Depending on the number of personnel drawn from the existing DOE workforce at Hanford, water use by dedicated mercury storage facility staff could be greatly reduced. These construction and operations volumes are very small compared with the volume of water currently withdrawn and used by DOE in the 200 Areas (see Section 4.4.7.2).

As previously noted in Section 4.3.3.1, design, construction, and operation of the mercury storage facility would incorporate structural controls and practices to prevent the release of elemental mercury and to prevent any spills or other releases, should they occur as a result of abnormal operating conditions, from reaching soils or surfaces where they could be conveyed to surface waters or groundwater. Facility operations would be conducted in accordance with an ICP and SPCC plan, or equivalent plans as mandated by state requirements governing the site, which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

The site is not located within or adjacent to a 100-year floodplain and is not subject to riverine or stream flooding from Cold Creek. CWC is also located beyond the estimated probable maximum flood boundary of Cold Creek (see Chapter 3, Section 3.3.3.1). Regardless, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. The potential for sheet flooding and other precipitation effects (e.g., scour and erosion) would be accounted for in the design of foundations, walls, roof structures, and drainage and stormwater management systems for the storage facility. Consequently, the new mercury storage facility would also incorporate appropriate stormwater management controls to safely collect and convey stormwater from the facility while minimizing washout, soil erosion, and offsite water quality impacts.

There would be no direct discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via either the existing CWC sanitary waste system or a new sanitary waste disposal system permitted by the Washington State Department of Health (see Section 4.4.8).

4.4.3.2 Groundwater

Facility construction is not expected to have any impact on groundwater hydrology or existing contaminant plumes in the 200-West Area due to the depth to groundwater and the shallow depth of excavation. As the facility would be designed and operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.4.4 Meteorology, Air Quality, and Noise

4.4.4.1 Meteorology

Meteorological events can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events were considered in selecting the accident events evaluated in Section 4.4.9.2. As previously detailed and described in Section 4.3.4.1, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including meteorological events. RCRA-permitted facilities, such as the proposed mercury storage facility, must also meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31 and applicable state RCRA requirements to prevent the release of stored wastes. As the Hanford region is susceptible to occasional occurrence of high winds, the mercury storage facility would be designed and constructed to withstand the potential for high winds and other meteorological events, such as heavy snow.

4.4.4.2 Air Quality

Minor short-term air quality impacts would result from construction of a mercury storage facility in the 200-West Area. These impacts would include an increase in criteria and toxic air pollutant concentrations from construction equipment emissions (see Appendix C, Section C.2.3). These emissions would occur over a 6-month construction period and are not expected to result in exceedance of the ambient air quality standards.

Operation of the mercury storage facility in the 200-West Area is expected to have negligible emissions, consisting of emissions from employee vehicles, trucks or trains, semiannual testing of emergency generators, and possibly mercury vapor from any spills or from mercury containers. No localized emissions from space heating are anticipated associated with mercury storage facility operations, as electric heating is anticipated for areas requiring climate control. Compliance with the conformity regulations is discussed in Appendix B, Section B.5.1.2.

Exposures to mercury vapor could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers (those outside the storage facility) or nearby offsite individuals. Appendix D, Section D.4.1, presents a conservative analysis that shows that for a long-term, undetected slow leak inside the proposed mercury storage facility, the predicted long-term average concentration in the building wake never exceeds 80 nanograms per cubic meter. The EPA threshold for chronic exposure to airborne mercury is 300 nanograms per cubic meter, so slow releases of mercury would have a negligible effect on noninvolved workers and the public, with a corresponding negligible risk.

Air quality impacts from transportation of mercury to Hanford would be similar to those discussed in Section 4.3.4.2. Truck and rail transport are discussed in more detail in Section 4.4.9.3. Estimated emissions from truck and rail transportation are presented in Tables 4–15 and 4–16.

Annual carbon dioxide emissions would be highest during the year 2013, at approximately 380 metric tons (419 tons) per year, as a result of moving elemental mercury to the site by truck; these annual truck emissions would be greater than rail emissions from shipping mercury. As similarly noted in Section 4.3.4.2, such emissions would minimally add to global and U.S. annual emissions of carbon dioxide. Global climate change is further discussed in Section 4.11.4.2.

4.4.4.3 Noise

Short-term noise impacts at Hanford could result from construction of a mercury storage facility in the 200-West Area. These impacts would include an increase in traffic to the site and an increase in noise resulting from construction equipment. These impacts would occur during the 6-month construction period. Since the nearest residence is located more than 8 kilometers (5 miles) from the site, the increase in noise levels at this location from construction equipment is expected to be negligible. The increase in traffic noise levels along Washington State Routes 240 and 24 from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on State Routes 240 and 24.

Short-term noise impacts could occur along State Route 240 as a result of increased truck activity during the period that elemental mercury is transported to the site. The resulting increase in day-night average noise levels along State Route 240 is expected to be less than 1 dBA. As such, the change in truck traffic is not expected to result in a change in noise levels along this route or other shipping routes that would be noticeable to the public or result in an increase in annoyance. If the mercury is shipped by rail instead of by truck, some additional rail activity from placing railcars at the site could result in some increase in noise levels near the site.

Operation of the mercury storage facility at Hanford is expected to have a negligible impact on noise levels around the site since the noise sources would be limited to a few employee vehicles, occasional delivery trucks, and semiannual testing of the emergency generator.

4.4.5 Ecological Resources

4.4.5.1 Terrestrial Resources

Habitat in the immediate vicinity of the proposed mercury storage facility location adjacent to CWC in the 200-West Area consists of disturbed land within a developed setting. Little native vegetation remains within the area; impacts would be limited to introduced species in an already disturbed landscape. Adherence to best management practices for land cover management (e.g., washing down construction equipment and vehicle tire treads) would serve to reduce the chance of introducing invasive plant species. Impacts on animals from construction would be limited to species adapted to human disturbance. During operations, there would be no additional impacts on terrestrial resources, as temporarily disturbed areas beyond the facility footprint would be revegetated and/or would revert to more-natural conditions.

4.4.5.2 Wetlands and Aquatic Resources

No wetlands or aquatic resources exist within the vicinity of the proposed construction site in the 200-West Area. Therefore, no impacts on wetlands or aquatic habitats are expected.

4.4.5.3 Threatened and Endangered Species

No threatened or endangered species are known or are expected to exist within the area of the proposed mercury storage facility in the 200-West Area. Thus, no impacts on threatened or endangered species are expected from construction or operations. Consultations have been initiated with the appropriate U.S. Fish and Wildlife Service office and state wildlife agency to support this analysis (see Chapter 5, Section 5.4).

4.4.6 Cultural and Paleontological Resources

4.4.6.1 Prehistoric Resources

As noted in Chapter 3, Section 3.3.6.1, White Bluffs Road, which was in use prior to the exploration and settlement of the area, traverses the northwestern portion of the 200-West Area in a south-to-northeast direction. The only other prehistoric resources found in the 200 Areas were two cryptocrystalline flakes found northwest of White Bluffs Road and one cryptocrystalline projectile point base located just east of the 200-East Area. Thus, there would be no impact on these prehistoric resources from construction and operations of a new mercury storage facility in the 200-West Area adjacent to CWC.

4.4.6.2 Historic Resources

Much of the 200 Areas have been altered by Hanford operations. As previously stated in Chapter 3, Section 3.3.6.2, White Bluffs Road is of historic significance for its role in European-American immigration, development, agriculture and Hanford operations. Buildings associated with the Manhattan Project and Cold War era are also found within the 200-East and 200-West Areas, along with a small portion of one of the Hanford Atmospheric Dispersion Test Facility arc roads; however, none of these structures would be impacted by construction or operations of the proposed mercury storage facility. DOE has initiated consultation with the Washington SHPO to support this analysis (see Chapter 5, Section 5.4).

4.4.6.3 American Indian Resources

No American Indian resources would be directly affected in the 200 Areas by facility construction and operations. Although there have been no traditional cultural properties identified in the 200 Areas, White Bluffs Road, which was originally used as an American Indian trail, traverses the 200-West Area. Also many sites used for American Indian hunting and religious activities lie just to the north on Gable Mountain and Gable Butte. These sites are associated with the Gable Mountain/Gable Butte Cultural District and within the viewshed of the 200 Areas (see Chapter 3, Section 3.3.6.3). DOE has initiated the consultation process with area and regional tribal nations who may have an interest in the proposed action and alternatives (see Chapter 5, Section 5.4).

4.4.6.4 Paleontological Resources

There would be no impacts on known or unique paleontological resources under this alternative, as no such resources have been discovered within the 200 Areas (see Chapter 3, Section 3.3.6.4). As is the case for other cultural resources at Hanford, if any paleontological resources were found, procedures are in place to properly manage the discovery site.

4.4.7 Site Infrastructure

4.4.7.1 Ground Transportation

Construction and operations of a new mercury storage facility at Hanford are not expected to appreciably increase demands on the road and rail systems leading to the site. Projected peak traffic volumes and the number of shipments associated with mercury storage operations are presented in Section 4.4.11.

4.4.7.2 Electricity, Fuel, and Water

Utility resource demands and associated assumptions for construction and operation of a new mercury storage facility in Hanford's 200-West Area would be very similar to those described in Section 4.3.7.2.

The 200 Areas' current annual electricity consumption is 51 percent of its capacity. Under this alternative, the projected annual operational electricity requirements (253 megawatt-hours) of a new mercury storage facility would have a negligible impact (0.6 percent increase) when compared with the 200-West Area's current annual electrical energy use. This increase could easily be accommodated by the 200 Areas' existing electric power distribution infrastructure (see Chapter 3, Section 3.3.7.2).

Fuel oil is the primary liquid fuel used across the 200 Areas. Fuel availability at Hanford is limited only by the ability to ship it to the site; volume can be increased as needed. Diesel fuel consumption (606 liters [160 gallons]) to support mercury storage operations would be negligible (0.02 percent increase) when compared with the 200 Areas' annual consumption of fuel oil (see Chapter 3, Section 3.3.7.3).

Water requirements for construction and operation of a new mercury storage facility would be negligible compared with the sitewide water usage and capacity of the 200 Areas and Hanford as a whole (see Chapter 3, Section 3.3.7.4). Water requirements during construction (1,270,000 liters [336,000 gallons]) would temporarily increase annual sitewide water consumption by 0.16 percent. The annual water demand for mercury storage operations (88,500 liters [23,400 gallons]) would constitute about 0.03 percent of the 200 Areas' consumption and 0.003 percent of Hanford's potable water production capacity.

4.4.8 Waste Management

Waste generation associated with construction and operations of a new mercury storage facility in Hanford's 200-West Area would be similar to that discussed in Section 4.3.8. Facility construction activities would generate an estimated 271 cubic meters (355 cubic yards) of nonhazardous solid waste and 9,850 liters (2,600 gallons) of nonhazardous sanitary liquid waste. These nonhazardous waste streams are minimal compared with the current onsite generation rate of nonhazardous waste at Hanford from construction and demolition activities (see Chapter 3, Section 3.3.8.1). It is assumed that construction-generated solid waste would be disposed of off site at the Roosevelt Regional Landfill. Portable toilet facilities, serviced by a local or regional contractor, would be used to serve the sanitary needs of the construction workforce.

As further described in Section 4.3.8, operation of a new mercury storage facility at Hanford is expected to generate an estimated 910 55-gallon (208-liter) drums of hazardous waste over the 40-year period of analysis. This equates to about 23 55-gallon drums, or approximately 5 cubic meters (6.5 cubic yards) annually. This hazardous waste volume is negligible as it represents only 1 percent of the forecasted Hanford sitewide hazardous waste generation volume for fiscal year 2008 (see Chapter 3, Section 3.3.8). Various RCRA-regulated hazardous waste streams are actively generated and managed at Hanford (see Chapter 3, Section 3.3.8.1). No changes in Hanford's generator status would be required to construct and operate the proposed mercury storage facility, nor are any substantial effects on Hanford's waste management infrastructure expected.

Facility operations would also generate an estimated 59,000 liters (15,600 gallons) of nonhazardous sanitary waste annually. This yearly generation rate is miniscule (0.03 percent) compared with Hanford's sitewide average sanitary waste generation rate of 219 million liters (57.9 million gallons) (DOE 2000:3-139). Sanitary wastewater would either be discharged to existing sewer systems and/or septic systems or to a new, dedicated septic system permitted by the Washington State Department of Health.

DOE continues to manage several ongoing programs and projects at Hanford in support of sitewide remediation. Neither construction nor operation of the proposed mercury storage facility is anticipated to impact resources (e.g., funding, labor, facilities, and equipment) associated with current and/or future site environmental restoration efforts.

4.4.9 Occupational and Public Health and Safety

If Hanford is chosen as the site for mercury storage, a new facility would be built. Most of the risks that pertain to Hanford are the same as those discussed in Sections 4.2.9.1 through 4.2.9.5.

4.4.9.1 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites. Consequences to the involved worker are predicted to be negligible because involved workers would never be exposed to airborne concentrations of mercury vapor above the ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. This corresponds to keeping exposures to the involved worker in the SL-I (negligible) range.[18] This would be achieved by adherence to good operating practices, in particular attention to ventilation, inspection, monitoring, and use of PPE, as described in the *Interim Guidance* (DOE 2009c). Therefore, the risks to involved workers would be negligible during normal operations.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.1.2, shows that the predicted long-term average concentration in the building wake for new construction is about 2.0×10^{-5} milligrams per cubic meter. This is well below EPA's chronic-inhalation-exposure RfC of 3.0×10^{-4} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and the public would be negligible.

4.4.9.2 Facility Accidents

Section 4.2.1.9.4 provides a discussion of facility accident risks that applies to all sites. Table 4–3 contains a summary of the likelihood of occurrence of candidate facility accident scenarios initiated by failures of engineered systems, human errors, or external events, and Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible frequency from Table 4–3. The analysis of the scenarios at Hanford is exactly the same as described in Section 4.2.1.9.4, with the exception of a member of the public in the case of an outside earthquake spill. The atmospheric dispersion calculations show that, for this spill, the maximum distance downwind to which a concentration greater than AEGL-3 could be exceeded is less than 100 meters (330 feet); for AEGL-2, the corresponding distance is approximately 300 meters (980 feet); and for $0.1 \times$ AEGL-2, it is 1.1 kilometers (0.68 miles). However, the distance to the closest site boundary from Hanford's 200 Areas is 3.5 kilometers (2.2 miles), so consequences and hence risks to members of the public would be negligible. Table 4–23 summarizes the results for all accidental spills of elemental mercury on site (without fire).

[18] For definitions of SLs for various types of exposures, see Section 4.2.9.1.1 and Appendix D, Section D.1.1.1. For a discussion of how risk is assessed, see Sections 4.2.9.1.1 and D.1.1.2.

Table 4–23. Summary of Risks of all Onsite Elemental Mercury Spill Scenarios – Hanford Site

Scenario	Frequency	Consequence[b]	Risk
Spills Inside Building[a]			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for all inside spills
Noninvolved worker	FL-II – FL-III	SL-II	N for all inside spills
Member of the public	FL-II – FL-III	SL-II	N for all inside spills
Spills Outside Building			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for outside earthquake spill; N for all other outside spills
Noninvolved worker	FL-II – FL-III	SL-I – SL-II	
Member of the public			
1-metric-ton container spill	FL-II	SL-I	N
Single-pallet spill	FL-III	SL-I	N
Earthquake with building collapse[b]	FL-III	SL-I	N

[a] The inside spill scenarios considered are single flask, single pallet, triple pallet, 1-metric-ton container, full spill tray under a pallet, and earthquake with intact building walls.

[b] This scenario encompasses the risk from floods, high winds, and tornadoes.

Key: FL=frequency level; L=low; N=negligible; SL=severity level.

4.4.9.3 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury over a 40-year period of analysis to Hanford. These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. The results of the analysis are shown in Table 4–24.

Table 4–24. Frequency Analysis of Truck and Railcar Accidents – Hanford Site

Scenario	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires in Dry Weather (per year)	Frequency of Accidents with Fires in Wet Weather (per year)	Frequency of Accidents with Death[a] (per year)
Truck – Scenario 1	1,251,164	1.4×10^{-2}	2.5×10^{-3}	2.0×10^{-4}	6.4×10^{-6}	7.0×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Truck – Scenario 2	2,112,527	1.9×10^{-2}	4.1×10^{-3}	3.4×10^{-4}	1.1×10^{-5}	1.2×10^{-3}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Railcar	453,317	2.8×10^{-3}	1.3×10^{-5}	3.0×10^{-5}	9.6×10^{-7}	1.9×10^{-4}
	–	Moderate – FL-III	Low – FL-II	Low – FL-II	Negligible – FL-I	Moderate – FL-III

[a] Fatality caused by mechanical impact, not by exposure to mercury.

Note: To convert miles to kilometers, multiply by 1.60934.

Key: FL=frequency level.

The above frequencies are for an accident anywhere along any of the transportation routes taken over a 40-year period of analysis to Hanford. A crash that occurs in the last mile of the trip was used to estimate the frequency of an onsite crash in the vicinity of the storage building. The frequency of such accidents with spills would be low under both truck scenarios and negligible under the Railcar Scenario. The frequency of crashes with fires or death would be negligible under all scenarios.

With respect to transportation accidents involving spills of mercury, the following four scenarios were considered:

- Spill of elemental mercury onto the ground without fire
- Spill of elemental mercury directly into water
- Fire with mercury spill
  - In dry weather
  - In wet weather

4.4.9.3.1 Transportation Accident with Spill of Elemental Mercury onto the Ground

Section 4.2.9.1.5 contains an analysis of spills of elemental mercury onto the ground following a truck or railcar crash without fire. A conservative estimate of the rate of evaporation from the resulting pool and the subsequent atmospheric dispersion (applicable to all sites) shows that a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that individual could only be exposed to such concentrations if the crash occurs along a specific 680-meter (2,230-foot) stretch of any of the routes to Hanford. The same reasoning as is used in the generic discussion in Section 4.2.9.1.5 shows that the risk to a member of the public from transportation spills onto the ground without fire en route to Hanford would be negligible under Truck Scenario 1 and the Railcar Scenario, but low under Truck Scenario 2.

4.4.9.3.2 Transportation Accident with Spill of Elemental Mercury Directly into Water

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

Table 4–25 summarizes the risks to human receptors arising from spillages of elemental mercury during transportation to Hanford.

Table 4–25. Summary of Transportation Risks to Human Receptors, Spills of Elemental Mercury onto the Ground or into Water, Hanford Site

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto the Ground			
Frequency[a]	FL-I	FL-II	FL-I
Consequence	SL-II	SL-II	SL-II
Risk	*Negligible*	*Low*	*Negligible*
Spill into Water			
Frequency[b]	FL-III	FL-III	FL-II
Consequence	SL-I – SL-II	SL-I – SL-II	SL-I – SL-II
Risk[c]	*Negligible to low*	*Negligible to low*	*Negligible to low*

[a] Frequency at which spill occurs close enough to a specific individual to cause Acute Exposure Guideline Level 2 to be exceeded.

[b] Frequencies of railcar or truck crashes with spills from Table 4–24.

[c] These estimates of risk are subject to large uncertainty.

Key: FL=frequency level; SL=severity level.

4.4.9.3.3 Transportation Accident with Fire

The fire calculations are described in Section 4.2.9.1.5. Table 4–26 shows the results of the calculations of acute-inhalation risks from transportation accidents with fires on transportation routes to Hanford. The table encompasses both truck scenarios and the Railcar Scenario.

Table 4–26. Summary of Acute-Inhalation Risks to Human Receptors, Accidents with Fires, Transportation Routes to Hanford Site

	Both Truck Scenarios with Wooden Pallets	Railcar Scenario with Wooden Pallets
Frequency[a]	FL-III	FL-II
Consequence[b]	SL-II	FL-II
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.

[b] The highest consequence in any weather condition.

Key: FL=frequency level; SL=severity level.

Note that the risks presented in the above scenarios are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

The analyses performed for this EIS show that, under all fire scenarios listed in Table 4–26, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

Table 4–27 summarizes the human health risks associated with all transportation spills.

Table 4–27. Summary of Transportation Risks to Human Receptors, Hanford Site

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto ground	Negligible	Low	Negligible
Spill into water	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty
Spill with fire – inhalation, wooden pallets	Low	Low	Low
Spill with fire – dry and wet deposition, wooden pallets	Negligible	Negligible	Negligible

4.4.9.4 Intentional Destructive Acts

The discussion of IDAs is the same for all sites and transportation routes (see Section 4.2.9.1.6).

4.4.10 Ecological Risk

There is a generic analysis of ecological risk in Section 4.2.10.1, which applies without modification to Hanford.

4.4.10.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike inorganic compounds formed from divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation are considered to be negligible at all storage sites and along all transportation routes.

4.4.10.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2, which also makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to ecological receptors could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

4.4.10.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5, and Section 4.2.10.1.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. Table 4–28 summarizes the FL, consequence level, and risk to ecological receptors in the case of a truck crash with a pallet fire and no rain (dry deposition) and applies to all candidate storage sites.

Table 4–28. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, Hanford Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Frequencies of truck crashes with spills from **Appendix D**, **Tables D–12** and **D–13**.

[b] Applies to both Truck Scenarios 1 and 2.

For the interpretation of Table 4–28, see Section 4.2.10.1.3. The risks of other potential fire scenarios are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–29.
- For rail crashes with wooden pallet fires and without rain (dry deposition), see Table 4–30.
- The predicted frequency of railcar crashes with pallet fires and rain is negligible, so risks would be negligible and no summary table is presented.

4.4.10.4 Consequences – Intentionally Initiated Fire with Mercury Spill

The consequences of intentionally initiated fires to ecological receptors are the same for all sites and transportation routes (see Section 4.2.10.1.4).

Table 4–29. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, Hanford Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

a Frequencies of truck crashes with spills from Appendix D, Table D–16.

b Applies to both Truck Scenarios 1 and 2.

Table 4–30. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, Hanford Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

a Frequencies of rail crashes with fires from Appendix D, Table D–14.

4.4.11 Socioeconomics

Under this alternative, a new facility for long-term storage of elemental mercury would be constructed in the 200-West Area. Employment during construction is expected to average 18 people for approximately 6 months. Operation of the facility is estimated to require approximately 8 individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and approximately 5 individuals thereafter, resulting in a possible increase of the existing Hanford workforce of less than 0.1 percent and an increase in the ROI workforce of approximately 0.006 percent. Neither construction nor operation of a new facility is expected to generate substantial direct or indirect employment. Thus, negligible impacts on socioeconomic conditions (i.e., overall employment, population trends, and traffic) in the ROI would result from implementing this alternative.

Construction-related transportation, including employee vehicle trips and equipment and materials shipments, is not expected to adversely impact traffic conditions on roads leading to the site. It is assumed that there would be approximately 1.5 employees per vehicle, and every vehicle is counted twice to account for round trips. It is estimated that average construction transportation of 45 vehicles a day could increase the average annual daily traffic counts by as little as 1 percent, if utilizing State Route 240, to as much as 5 percent, if utilizing State Route 24. It is likely that these additional vehicles would use a combination of routes, thus the additional load would not be concentrated on one route. Fifty-three percent of these vehicles would be attributed to employee transportation.

Transportation impacts during the operations phase would include employee vehicle trips and shipments of elemental mercury to the site for storage. Appendix C, Section C.1, provides an estimate of the number of shipments by truck. The additional vehicles due to facility operations are not expected to noticeably increase traffic volumes on roads leading to the site. The greatest impact would be during the first 2 years of operations, when it is estimated that approximately 11 vehicles a day could increase the average annual daily traffic counts by as little as 0.3 percent, if utilizing State Route 240, to slightly over 1 percent, if utilizing State Route 24. During this time, it is estimated that up to 78 shipments of elemental mercury would be made each year. Approximately 96 percent of the additional vehicles would be attributed to employee transportation.

4.4.12 Environmental Justice

No populations have been identified within the 16-kilometer (10-mile) radius surrounding the 200 Areas at Hanford (see Chapter 3, Section 3.3.11). Therefore, no disproportionately high and adverse effects on minority or low-income populations are expected. Consultations have been initiated with regional tribal nations including the Confederated Tribes and bands of the Yakama Nation, and the Confederated Tribes f the Umatilla Indian reservation, as discussed in Section 4.4.6.3.

4.5 LONG-TERM MERCURY MANAGEMENT AND STORAGE AT HAWTHORNE ARMY DEPOT

Under this alternative, elemental mercury would be stored at the Hawthorne Army Depot. The depot comprises 59,500 hectares (147,000 acres) and is located approximately 16 kilometers (10 miles) from Hawthorne, Nevada. Implementation of this alternative would involve modification of a maximum of 29 existing storage buildings within the depot's Central Magazine Area to accommodate mercury storage, as further described in Chapter 2, Section 2.4.4.

4.5.1 Land Use and Visual Resources

No additional impacts on land use or visual resources are anticipated at the Hawthorne Army Depot since no new construction or other substantial ground-disturbing activities would be required. Elemental mercury would be stored within up to 29 storage buildings located in Group 110 within the Central Magazine Area adjacent to the buildings where U.S. Department of Defense mercury is presently planned for storage; each building would provide approximately 929 square meters (10,000 square feet) of floor space. Collectively, these 29 buildings would provide up to 27,000 square meters (290,000 square feet) of space for DOE storage of elemental mercury. Receipt, staging, and storage activities would generally take place inside the buildings and would not require the use of any additional site acreage. Therefore, onsite land use would remain predominantly light industrial, and viewsheds would not be affected. Scheduled maintenance and repairs to the storage buildings would be consistent with the existing land use and visual character of the site. Storage of elemental mercury is likewise not expected to affect offsite land uses and viewsheds from public vantage points in the vicinity of the Hawthorne Army Depot. No applicable land use plans, policies, or controls have been identified that would restrict storage of elemental mercury at this location (Hartman 2009a). Because there would be no change to the visual landscape as a result of this alternative, there would be no associated change in BLM VRM classifications.

4.5.2 Geology, Soils, and Geologic Hazards

4.5.2.1 Geology and Soils

Upgrades and internal modifications of the 29 structures in the Central Magazine Area at the Hawthorne Army Depot would have a very small impact on geology and soils. Direct impacts would be limited to trenching between existing depot structures and the storage buildings and between the storage buildings to install utilities and other systems (e.g., fire suppression). The depth of excavation required would be about

0.6 meters (2 feet) wide by 1.2 meters (4 feet) deep, where necessary for utility trenching, and geologic resource requirements would likely be a fraction of the 4,740 cubic meters (6,200 cubic yards) of concrete and 3,900 cubic meters (5,100 cubic yards) of gravel required for a new storage facility (see Appendix C, Table C–2).

Soil disturbance for utility trenching and to areas outside the perimeter of the storage buildings to support upgrades to flooring inside the facilities would be minimal. Nevertheless, adherence to standard best management practices for soil erosion and sediment control (e.g., use of sediment fencing, staked hay bales, mulching and geotextile matting, and rapid reseeding) in of any disturbed areas would serve to minimize any soil erosion and loss. There would be no additional impact on geology and soils from operations.

4.5.2.2 Geologic Hazards

Hazards from large-scale geologic conditions, such as earthquakes, and other site geologic conditions with the potential to affect Hawthorne Army Depot are summarized in Chapter 3, Section 3.4.2.3. The region surrounding the depot is one of high seismicity. The Walker Lake Valley, in which the depot is located, is bisected by an active fault, part of the regional Walker Lake fault zone (see Chapter 3, Section 3.4.2.1). While the Hawthorne area has historically experienced ground shaking of MMI VIII (see Appendix B, Table B–4), no depot facilities have suffered structural damage due to earthquakes during over 60 years of operations. Nevertheless, the predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.57 *g*. Ground motion in this range could cause considerable damage to ordinary substantial buildings, although it is only expected to cause slight damage to specially designed structures. This magnitude of ground motion is also supported by the historical record for the area. As further described in Appendix B, Section B.3.2, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, or upgraded as necessary, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. Upgrade and modification of existing storage facilities in the Central Magazine Area would include retrofits to flooring to contain any mercury spills, should they occur (see Appendix C, Table C–1). However, the original construction of the structures is particularly unique in that the facilities are constructed of reinforced concrete and are designed to be resistant to accidental detonation of ammunition. Such facilities would be unlikely to collapse or be destroyed by the maximum predicted earthquake ground motion at the site, even without structural upgrade. Thus, such ground motion would be unlikely to cause a breach in mercury containers from structural failure.

An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.5.9.2.

4.5.3 Water Resources

4.5.3.1 Surface Water

Building upgrades and modifications in the Central Magazine Area would not have any impact on surface water features. The closest natural surface water features are ephemeral streams that flow into Walker Valley from the mountains to the north of the Central Magazine Area. The closest surface drainage feature is the Pamlico Ditch, a runoff diversion ditch located approximately 0.6 kilometers (0.4 miles) south of the southern end of the designated DOE mercury storage area.

Walker Valley is extremely arid, and stormwater runoff from the work sites in the Central Magazine Area would be unlikely to reach any ephemeral drainages on the valley floor or Pamlico Ditch. Regardless, appropriate soil erosion and sediment control measures and spill prevention and waste management practices would be employed to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts, as noted in Section 4.3.3.1. As necessary, an NPDES Construction Stormwater General Permit would be obtained from the Nevada Division of Environmental Protection.

Water requirements to support building modifications and upgrades at Hawthorne Army Depot would be relatively small. Some water may be necessary for dust control and soil compaction, for utility trenching, and to support floor repairs within the existing storage structures, but the volume would be very small compared with that required for construction of a new mercury storage facility. It is anticipated that any water would be trucked to the work areas on an as-needed basis. During operations, it is expected that water use would be relatively small under normal operations and limited to that required to serve the potable and sanitary needs of the storage facility workforce. Total annual consumption is estimated to be no more than about 88,500 liters (23,375 gallons). Depending on the number of personnel drawn from the existing depot workforce, water use by dedicated mercury storage facility staff could be greatly reduced. These construction and operations volumes are very small compared with the volume of surface water and supplemental groundwater currently withdrawn and used by Hawthorne Army Depot (see Section 4.5.7.2).

As previously noted in Section 4.3.3.1, design, construction, and operation of the mercury storage facility would incorporate structural controls and practices to prevent the release of elemental mercury and to prevent any spills or other releases, should they occur as a result of abnormal operating conditions, from reaching soils or surfaces where they could be conveyed to surface waters or groundwater. The existing storage facilities in the Central Magazine Area would be modified as necessary to meet these requirements, as summarized in Appendix C, Table C–1. Facility operations would be conducted in accordance with an ICP and SPCC plan, or equivalent plans as mandated by state requirements governing the site, which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

The 29 storage structures are not located within or adjacent to a 100-year floodplain and the storage area is not subject to stream flooding. Some portions of the depot facility complex are subject to periodic flash flooding. A runoff diversion ditch (Pamlico Ditch) and flood levee are located approximately 0.6 kilometers (0.4 miles) south of the southern end of the designated DOE mercury storage area. These are designed to capture and redirect any substantial runoff moving northwest across the valley floor and across the southern portion of the Central Magazine Area. DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. The potential for sheet flooding and other precipitation effects (e.g., scour and erosion) would be accounted for in the modification of the 29 structures composing the storage facility. Consequently, the upgraded mercury storage buildings at the Hawthorne Army Depot would incorporate appropriate stormwater management controls to safely collect and convey stormwater from the facility while minimizing washout, soil erosion, and offsite water quality impacts.

There would be no direct discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via either the depot's existing sanitary waste system or a new sanitary waste disposal system permitted by the State of Nevada (see Section 4.5.8).

4.5.3.2 Groundwater

Storage building modifications are not expected to have any impact on groundwater hydrology or existing contaminant plumes at the Hawthorne Army Depot, as the depth to groundwater is 60 meters (200 feet) or more across the southern portion of the depot. As the facility would be designed and operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.5.4 Meteorology, Air Quality, and Noise

4.5.4.1 Meteorology

Meteorological events can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events were considered in selecting the accident events evaluated in Section 4.5.9.2. As previously detailed and described in Section 4.3.4.1, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including meteorological events. RCRA-permitted facilities, such as the proposed mercury storage facility, must also meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31 and applicable state RCRA requirements to prevent the release of stored wastes. As the Hawthorne region is susceptible to regular occurrence of high winds, mercury would be housed in structures modified to withstand the potential for high winds and other meteorological events, such as heavy snow.

4.5.4.2 Air Quality

Negligible-to-very-minor short-term air quality impacts with little or no measurable effect on air quality would result from modification of existing structures for mercury storage in the Central Magazine Area. Criteria and toxic air pollutant emissions from construction equipment (see Appendix C, Section C.2.3) would be limited to those from construction employee vehicles and work trucks; little or no heavy equipment is expected to be used.

Emissions from operation of the 29 storage facilities in the Central Magazine Area would be very small, consisting of emissions from employee vehicles, trucks or trains, semiannual testing of emergency generators, and possibly mercury vapor from any spills or from mercury containers. No localized emissions from space heating are anticipated associated with mercury storage facility operations, as electric heating is anticipated for areas requiring climate control. Compliance with the conformity regulations is discussed in Appendix B, Section B.5.1.2.

Exposures to mercury vapor could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers (those outside the storage facility) or nearby offsite individuals. Appendix D, Section D.4.1, presents a conservative analysis that shows that for a long-term, undetected slow leak inside the proposed mercury storage facility, the predicted long-term average concentration in the building wake never exceeds 80 nanograms per cubic meter. The EPA threshold for chronic exposure to airborne mercury is 300 nanograms per cubic meter, so slow releases of mercury would have a negligible effect on noninvolved workers and the public, with a corresponding negligible risk.

Air quality impacts from transportation of mercury to Hawthorne Army Depot would be similar to those discussed in Section 4.3.4.2. Truck and rail transport are discussed in more detail in Section 4.5.9.3. Estimated emissions from truck and rail transportation are presented in Tables 4–15 and 4–16.

Annual carbon dioxide emissions would be highest during the year 2013, at approximately 367 metric tons (405 tons) per year, as a result of moving elemental mercury to the site by truck; these annual truck emissions would be greater than rail emissions from shipping mercury. As similarly noted in Section 4.3.4.2, such emissions would minimally add to global and U.S. annual emissions of carbon dioxide. Global climate change is further discussed in Section 4.11.4.2.

4.5.4.3 Noise

Short-term noise impacts at the Hawthorne Army Depot could result from modification of the existing storage buildings for mercury storage. These impacts would include an increase in traffic to the site and an increase in noise resulting from construction equipment. These impacts would occur during the 6-month construction period. Since the nearest noise-sensitive receptor, a residence, is located 4.9 kilometers (3 miles) from the site, the increase in noise levels at this location from construction equipment is expected to be negligible. The estimated average noise level during the daytime (8-hour equivalent sound level) from one item of construction equipment operating at this distance is estimated to be 4 dBA, which would be well below the background sound level. The increase in traffic noise levels along U.S. Route 95 from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on U.S. Route 95.

Short-term noise impacts could occur along U.S. Route 95 as a result of increased truck activity during the period that elemental mercury is transported to the site. The resulting increase in day-night average noise levels along U.S. Route 95 is expected to be less than 1 dBA. As such, the change in truck traffic is not expected to result in a change in noise levels along this route or other shipping routes that would be noticeable to the public or result in an increase in annoyance. If the mercury is shipped by rail instead of by truck, some additional rail activity from placing railcars at the site could result in some increase in noise levels near the site.

Operation of the mercury storage facility at the Hawthorne Army Depot is expected to have a negligible impact on noise levels around the site since the noise sources would be limited to a few employee vehicles, occasional delivery trucks, and semiannual testing of the emergency generator.

4.5.5 Ecological Resources

4.5.5.1 Terrestrial Resources

Habitat in the immediate vicinity of the Central Magazine Area consists of disturbed land within a developed setting. Little native vegetation remains within the area of the 29 structures designated for the proposed mercury storage facility. Since existing structures would be used for mercury, no new land or habitat would be disturbed under this alternative. Adherence to best management practices for land cover management (e.g., washing down construction equipment and vehicle tire treads) would serve to reduce the chance of introducing invasive plant species. Impacts on animals from construction would be limited to species adapted to human disturbance. During operations, there would be no additional impacts on terrestrial resources, as temporarily disturbed areas beyond the facility footprint would be revegetated and/or would revert to more-natural conditions.

4.5.5.2 Wetlands and Aquatic Resources

No wetlands or aquatic resources exist within the area of the proposed mercury storage facility within the Central Magazine Area. Therefore, no impacts on wetlands or aquatic habitats are expected.

4.5.5.3 Threatened and Endangered Species

No threatened or endangered species are known or are expected to exist within the area of the proposed mercury storage facility within the Central Magazine Area. Thus, no impacts on threatened or endangered species are expected from facility modifications or operations. Consultations have been initiated with the appropriate U.S. Fish and Wildlife Service office and state wildlife agency to support this analysis (see Chapter 5, Section 5.4).

4.5.6 Cultural and Paleontological Resources

4.5.6.1 Prehistoric Resources

Previous surveys have identified 15 prehistoric sites at the Hawthorne Army Depot that are designated for listing in the NRHP. Additional archaeological sites were identified on property adjacent to the depot (see Chapter 3, Section 3.4.6.1). Since the structures that may be used for mercury storage are located on property that has been disturbed by construction, it is unlikely that any prehistoric resources would be impacted. DOE has initiated consultation with the Nevada SHPO to support this analysis (see Chapter 5, Section 5.4).

4.5.6.2 Historic Resources

An NRHP nomination for architectural resources was drafted for Hawthorne Army Depot in 1989 for its significance as the largest depot in the world; its importance in World War II; and its integrity of landscape, infrastructure, and architecture (see Chapter 3, Section 3.4.6.2). As there would be no new construction and the existing structures that may be used for mercury storage are located on property that has been disturbed by construction, it is unlikely that any historic resources would be impacted. However, as some modification of existing structures is likely, DOE has initiated consultation with the Nevada SHPO (see Chapter 5, Section 5.4).

4.5.6.3 American Indian Resources

The Walker River Indian Reservation is located approximately 13 kilometers (8 miles) north of the Hawthorne Army Depot (see Chapter 3, Section 3.4.6.3). As no new construction would be required, no impact on American Indian resources is expected. However, DOE has initiated consultation with the Walker River Paiute Tribe (see Chapter 5, Section 5.4).

4.5.6.4 Paleontological Resources

There would be no impact on unique paleontological resources at Hawthorne Army Depot as none have been identified; construction activity at the site would be limited to completing of modifications of existing storage facilities on already disturbed land.

4.5.7 Site Infrastructure

4.5.7.1 Ground Transportation

Construction and operations of a new mercury storage facility at the Hawthorne Army Depot are not expected to appreciably increase demands on the road and rail systems leading to the site. Projected peak traffic volumes and the number of shipments associated with mercury storage operations are presented in Section 4.5.11.

4.5.7.2 Electricity, Fuel, and Water

Utility resource demands and associated assumptions to establish and operate a mercury storage facility at the Hawthorne Army Depot would generally be similar to those described in Section 4.3.7.2. However, construction requirements would likely be less than those at GJDS, as activities would be limited to modifying, upgrading, and refurbishing the existing structures. Conversely, utility demands such as electricity consumption for operation of the 29 storage buildings modified for mercury storage could be slightly greater than those for a single, new storage facility. Nevertheless, for electrical energy, annual electricity consumption at Hawthorne Army Depot is 7 percent of its sitewide capacity (see Chapter 3, Section 3.4.7). The projected annual operational electricity requirements to support mercury storage

(253 megawatt-hours) would be minor (3.4 percent increase) when compared with the current annual sitewide electricity usage, and would be about 0.2 percent of the annual sitewide electric supply capacity.

Fuel oil is the main liquid fuel used at Hawthorne Army Depot; fuel consumption (606 liters [160 gallons]) for the operation of buildings in the Central Magazine Area for mercury storage would be negligible (0.02 percent) when compared with the depot's annual consumption of fuel oil.

Water requirements for facility modifications and mercury storage operations in the Central Magazine Area would be negligible compared with the Hawthorne Army Depot's sitewide water usage and capacity (see Chapter 3, Section 3.4.7). Water requirements for facility modifications (of less than 1,270,000 liters [336,000 gallons]) would temporarily increase annual sitewide water consumption by no more than 0.4 percent. The annual water demand for mercury storage operations (88,500 liters [23,400 gallons]) would constitute about 0.03 percent of the depot's consumption and 0.004 percent of the site's total water production capacity.

4.5.8 Waste Management

Waste generation associated with modification of existing facilities to support operation of a new mercury storage facility at Hawthorne Army Depot would be similar to that discussed in Section 4.3.8. Modification of 29 of the depot's storage buildings is expected to generate much less than the 271 cubic meters (355 cubic yards) of nonhazardous solid waste and 9,850 liters (2,600 gallons) of nonhazardous sanitary liquid waste projected to be generated during construction of a new facility. Nevertheless, the maximum volumes are negligible compared with the current waste generation activities at the depot, as described in Chapter 3, Section 3.4.8.1. If approved, construction-generated solid waste would be disposed of within the onsite state-permitted construction and demolition landfill. Portable toilet facilities, serviced by a local or regional contractor, would be used to serve the sanitary needs of the construction workforce.

Operation of the existing structures, as modified for mercury storage, within the Central Magazine Area is expected to generate an estimated 910 55-gallon (208-liter) drums of hazardous waste over the 40-year period of analysis, as further described in Section 4.3.8. This equates to about 23 55-gallon drums, or approximately 5 cubic meters (6.5 cubic yards) annually. This estimated yearly hazardous waste generation rate is minor (about 2 percent) compared with the 47,442 kilograms (104,590 pounds) of hazardous waste managed each year by the Hawthorne Army Depot (see Chapter 3, Section 3.4.8.1). The Hawthorne Army Depot is a listed hazardous waste large-quantity generator. No changes in generator status would be required to operate the proposed mercury storage facility, nor are any substantial effects on the depot's waste management infrastructure expected. Further, the Hawthorne Army Depot has existing plans and procedures for site-specific management of mercury-contaminated materials (Tetra Tech 2007). Existing storage buildings modified for mercury storage would require an RCRA TSD facility permit.

Facility operations would also generate an estimated 59,000 liters (15,600 gallons) of nonhazardous sanitary waste annually. This yearly generation rate of is very small (0.2 percent) compared with the depot's average sanitary waste generation rate of 34.5 million liters (9.1 million gallons) (DLA 2004a:3-74). Sanitary wastewater would be discharged to the depot's sanitary sewer system.

Waste management activities at Hawthorne Army Depot include ongoing munitions recycling activities and RCRA-based remediation investigations. Neither facility modifications nor operation of the proposed mercury storage facility is anticipated to impact site resources (e.g., funding, labor, facilities, and equipment) associated with current and/or future site environmental restoration efforts.

4.5.9 Occupational and Public Health and Safety

The analysis of risk at the Hawthorne Army Depot is similar to that presented in Sections 4.2.9.1 through 4.2.9.5. Mercury at Hawthorne Army Depot would not be stored in a single, large building, but in up to 29 buildings with dimensions of approximately 61 meters (200 feet) long, 15 meters (50 feet) wide, and 12 meters (39 feet) high (see Appendix D, Table D–51). However, this difference in dimensions does not change the generic conclusions about human health risks.

4.5.9.1 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites. Consequences to the involved worker are predicted to be negligible because involved workers would never be exposed to airborne concentrations of mercury vapor above the ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. This corresponds to keeping exposures to the involved worker in the SL-I (negligible) range.[19] This would be achieved by adherence to good operating practices, in particular attention to ventilation, inspection, monitoring, and use of PPE, as described in the *Interim Guidance* (DOE 2009c). Therefore, the risks to involved workers would be negligible during normal operations.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.1.2, shows that the predicted long-term average concentration in the building wake for existing buildings is about 8.0×10^{-5} milligrams per cubic meter. This is well below EPA's chronic-inhalation-exposure RfC of 3.0×10^{-4} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and the public would be negligible.

4.5.9.2 Facility Accidents

Section 4.2.9.1.4 provides a discussion of facility accident risks that applies to all sites. Table 4–3 contains a summary of the likelihood of occurrence of candidate facility accident scenarios initiated by failures of engineered systems, human errors, or external events, and Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible frequency from Table 4–3. The analysis of the scenarios at the Hawthorne Army Depot is similar to that for the same scenarios in Section 4.2.9.1.4. The different dimensions of the buildings affect the building wake calculations, but do not affect conclusions about the magnitude of the risks. For a member of the public in the case of an outside earthquake spill, the rate of evaporation calculated for Hawthorne Army Depot is somewhat larger than that for new construction (because of the somewhat greater floor space available in the 29 separate buildings at the Hawthorne Army Depot). The atmospheric dispersion calculations show that, for this spill, the maximum distance downwind to which a concentration greater than AEGL-3 could be exceeded is less than 100 meters (330 feet); for AEGL-2, the corresponding distance is about 380 meters (1,250 feet); and for 0.1 × AEGL-2, it is approximately 1.6 kilometers (1 mile). However, the distance to the closest site boundary from the proposed mercury storage facilities is 3.7 kilometers (2.3 miles), so consequences and hence risks to members of the public would be *negligible*. Table 4–31 summarizes the results for all accidental spills of elemental mercury on site (without fire).

[19] For definitions of SLs for various types of exposures, see Section 4.2.9.1.1 and Appendix D, Section D.1.1.1. For a discussion of how risk is assessed, see Sections 4.2.9.1.1 and D.1.1.2.

Table 4–31. Summary of Risks of all Onsite Elemental Mercury Spill Scenarios – Hawthorne Army Depot

Scenario	Frequency	Consequence	Risk
Spills Inside Building[a]			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for all inside spills
Noninvolved worker	FL-II – FL-III	SL-II	N for all inside spills
Member of the public	FL-II – FL-III	SL-II	N for all inside spills
Spills Outside Building			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for outside earthquake spill; N for all other outside spills
Noninvolved worker	FL-II – FL-III	SL-I – SL-II	
Member of the public			
1-metric-ton container spill	FL-II	SL-I	N
Single-pallet spill	FL-III	SL-I	N
Earthquake with building collapse[b]	FL-III	SL-I	N

[a] The inside spill scenarios considered are single flask, single pallet, triple pallet, 1-metric-ton container, full spill tray under a pallet, and earthquake with intact building walls.

[b] This scenario encompasses the risk from floods, high winds, and tornadoes.

Key: FL=frequency level; L=low; N=negligible; SL=severity level.

4.5.9.3 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury over a 40-year period of analysis to the Hawthorne Army Depot. These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. The results of the analysis are shown in Table 4–32.

Table 4–32. Frequency Analysis of Truck and Railcar Accidents – Hawthorne Army Depot

Scenario	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires in Dry Weather (per year)	Frequency of Accidents with Fires in Wet Weather (per year)	Frequency of Accidents with Death[a] (per year)
Truck – Scenario 1	1,161,577	1.3×10^{-2}	2.3×10^{-3}	1.9×10^{-4}	6.1×10^{-6}	6.5×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Truck – Scenario 2	1,943,587	1.8×10^{-2}	3.8×10^{-3}	3.1×10^{-4}	9.9×10^{-6}	1.1×10^{-3}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Railcar	394,922	2.5×10^{-3}	1.1×10^{-5}	2.6×10^{-5}	8.3×10^{-7}	1.6×10^{-4}
	–	Moderate – FL-III	Low – FL-II	Low – FL-II	Negligible – FL-I	Moderate – FL-III

[a] Fatality caused by mechanical impact, not by exposure to mercury.

Note: To convert miles to kilometers, multiply by 1.60934.

Key: FL=frequency level.

The above frequencies are for an accident anywhere along any of the transportation routes taken over a 40-year period of analysis to the Hawthorne Army Depot. A crash that occurs in the last mile of the trip was used to estimate the frequency of an onsite crash in the vicinity of the storage building. The frequency of such accidents with spills would be low under both truck scenarios and negligible under the Railcar Scenario. The frequency of crashes with fires or death would be negligible under all scenarios.

Specific to the routes to the Hawthorne Army Depot, the length of road or railroad that lies within the Walker River Indian Reservation is about 32 kilometers (20 miles).[20] This is about 1 percent of the average length of a truck or rail route to the Hawthorne Army Depot. Therefore, the frequencies of the various types of spills or fires in Table 4–32 should be multiplied by 0.01 to obtain the predicted frequencies of accidents with spills on the reservation; doing so yields the following:

- The frequency of all railcar spills would be negligible (FL-I), with the result that the associated risk would always be negligible.
- Under the truck scenarios, the frequencies of spills with fires in wet weather would be negligible (FL-I) and so would the associated risks.
- Under the truck scenarios with spills of elemental mercury with or without fire, the frequencies would be low (FL-II).

With respect to transportation accidents involving spills of mercury, the following four scenarios were considered:

- Spill of elemental mercury onto the ground without fire
- Spill of elemental mercury directly into water
- Fire with mercury spill
  - In dry weather
  - In wet weather

4.5.9.3.1 Transportation Accident with Spill of Elemental Mercury onto the Ground

Section 4.2.9.1.5 contains an analysis of spills of elemental mercury onto the ground following a truck or railcar crash without fire. A conservative estimate of the rate of evaporation from the resulting pool and the subsequent atmospheric dispersion (applicable to all sites) shows that a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that individual could only be exposed to such concentrations if the crash occurs along a specific 680-meter (2,230-foot) stretch of any of the routes to the Hawthorne Army Depot. The same reasoning as is used in the generic discussion in Section 4.2.9.1.5 shows that the risk to a member of the public from transportation spills onto the ground without fire en route to the Hawthorne Army Depot would be negligible under Truck Scenario 1 and the Railcar Scenario, but low under Truck Scenario 2.

4.5.9.3.2 Transportation Accident with Spill of Elemental Mercury Directly into Water

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.
- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

[20] Information from www.nevadadot.com.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

Table 4–33 summarizes the risks to human receptors arising from spillages of elemental mercury during transportation to the Hawthorne Army Depot.

Table 4–33. Summary of Transportation Risks to Human Receptors, Spills of Elemental Mercury onto the Ground or into Water, Hawthorne Army Depot

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto the Ground			
Frequency[a, b]	FL-I	FL-II	FL-I
Consequence	SL-II	SL-II	SL-II
Risk	*Negligible*	*Low*	*Negligible*
Spill into Water			
Frequency[c, d]	FL-III	FL-III	FL-II
Consequence	SL-I–SL-II	SL-I–SL-II	SL-I–SL-II
Risk[e]	*Negligible to low*	*Negligible to low*	*Negligible to low*

[a] Frequency at which spill occurs close enough to a specific individual to cause Acute Exposure Guideline Level 2 to be exceeded.

[b] For spills on the Walker River Indian Reservation, all of these frequencies would be FL-I, and the risks would be negligible.

[c] Frequencies of railcar or truck crashes with spills from Table 4–32.

[d] These estimates of risk are subject to large uncertainty.

[e] For spills on the Walker River Indian Reservation, the frequency of spills into water bodies would be negligible and so would the associated risks.

Key: FL=frequency level; SL=severity level.

4.5.9.3.3 Transportation Accident with Fire

The fire calculations are described in Section 4.2.9.1.5. Table 4–34 shows the results of the calculations of acute-inhalation risks from transportation accidents with fires on transportation routes to the Hawthorne Army Depot. The table encompasses both truck scenarios and the Railcar Scenario.

Table 4–34. Summary of Acute-Inhalation Risks to Human Receptors, Accidents with Fires, Transportation Routes to Hawthorne Army Depot

	Both Truck Scenarios with Wooden Pallets	Railcar Scenario with Wooden Pallets
Frequency[a]	FL-III[c]	FL-II[d]
Consequence[b]	SL-II	FL-II
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.

[b] The highest consequence in any weather condition.

[c] For spills on the Walker River Indian Reservation, this frequency would be FL-II, and the risks would be low.

[d] For spills on the Walker River Indian Reservation, the frequency of this scenario would be FL-I, and the risks would be negligible.

Key: FL=frequency level; SL=severity level.

Note that the risks presented in the above scenarios are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

The analyses performed for this EIS show that, under all fire scenarios listed in Table 4–34, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

Table 4–35 summarizes the human health risks associated with all transportation spills.

Table 4–35. Summary of Transportation Risks to Human Receptors, Hawthorne Army Depot[a]

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto ground	Negligible	Low	Negligible
Spill into water	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty
Spill with fire – inhalation, wooden pallets	Low	Low	Low
Spill with fire – dry and wet deposition, wooden pallets	Negligible	Negligible	Negligible

[a] Does not include risks of spills on the Walker River Indian Reservation (see Tables 4–33 and 4–34).

4.5.9.4 Intentional Destructive Acts

The discussion of IDAs is the same for all sites and transportation routes (see Section 4.2.9.1.6).

4.5.10 Ecological Risk

There is a generic analysis of ecological risk in Section 4.2.10.1, which applies without modification to the Hawthorne Army Depot.

4.5.10.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike inorganic compounds formed from divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation are considered to be negligible at all storage sites and along all transportation routes.

4.5.10.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2, which also makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to ecological receptors could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

4.5.10.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5, and Section 4.2.10.1.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. Table 4–36 summarizes the FL, consequence level, and risk to ecological receptors in the case of a truck crash with a pallet fire and no rain (dry deposition) and applies to all candidate storage sites.

Table 4–36. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, Hawthorne Army Depot[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level	Risk[c]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] For spills on the Walker River Indian Reservation, the frequency level would be FL-II. The risks to sediment-dwelling biota and soil invertebrates would be moderate; the risks to all other receptors would not change.

[b] Frequencies of truck crashes with spills from Appendix D, Tables D–12 and D–13.

[c] Applies to both Truck Scenarios 1 and 2.

For the interpretation of Table 4–36, see Section 4.2.10.1.3. The risks of other potential fire scenarios are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–37.
- For railcar crashes with wooden pallet fires and without rain (dry deposition), see Table 4–38.
- The predicted frequency of railcar crashes with pallet fires and rain is negligible, so risks would be negligible and no summary table is presented.

Table 4–37. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, Hawthorne Army Depot[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level	Risk[c]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] For spills on the Walker River Indian Reservation, the frequency level would be FL-I, and the risks to all receptors would be negligible.

[b] Frequencies of truck crashes with spills from Appendix D, Table D–16.

[c] Applies to both Truck Scenarios 1 and 2.

Table 4–38. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, Hawthorne Army Depot[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] For spills on the Walker River Indian Reservation, the frequency level would be FL-I, and the risks to all receptors would be negligible.

[b] Frequencies of railcar crashes with fires from Appendix D, Table D–14.

4.5.10.4 Consequences – Intentionally Initiated Fire with Mercury Spill

The consequences of intentionally initiated fires to ecological receptors are the same for all sites (see Section 4.2.10.1.4).

4.5.11 Socioeconomics

Under this alternative, existing storage facilities (igloos) in the Hawthorne Army Depot's Central Magazine Area would be modified for long-term storage of elemental mercury. Employment during renovations is expected to be less than that estimated for constructing a new facility, as described in Section 4.3.11. Appendix C, Table C–1, summarizes the necessary modifications to bring the existing storage buildings at Hawthorne Army Depot up to specifications to support mercury storage. Operation of the facility is estimated to require approximately 8 individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and approximately 5 individuals thereafter, resulting in a possible increase in the depot's workforce of approximately 1 to 2 percent and an increase in the ROI workforce of 0.02 percent. Neither modification nor operation of the storage buildings is expected to generate substantial new, direct or indirect employment. Thus, negligible impacts on socioeconomic conditions (i.e., overall employment, population trends, and traffic) in the ROI would result from implementing this alternative.

Construction-related transportation needed to modify the existing facility, including employee vehicle trips and equipment and materials shipments, is not expected to adversely impact traffic conditions on roads leading to the site. It is likely that significantly fewer than the 45 vehicles a day estimated for construction of a new mercury storage facility would be needed to support facility modification (see Section 4.3.11). Therefore, construction-related transportation is expected to increase the average annual daily traffic count on U.S. Route 95 by no more than 2 percent.

Transportation impacts during the operations phase would include employee vehicle trips and shipments of mercury to the site for storage. Appendix C, Section C.1, provides an estimate of the number of shipments by truck. The additional vehicles due to facility operation are not expected to noticeably increase traffic volumes on roads leading to the site. The greatest impact would be during the first 2 years of operations, when it is estimated that approximately 11 vehicles a day could increase the average annual daily traffic count on U.S. Route 95 by less than 0.5 percent. During this time, it is estimated that up to 78 shipments would be made each year. Approximately 96 percent of the additional vehicles would be attributed to employee transportation.

4.5.12 Environmental Justice

None of the block groups within the 16-kilometer (10-mile) radius surrounding the proposed storage site at the Hawthorne Army Depot contain a disproportionately high number of minority or low-income individuals, and no populations have been identified within the 3-kilometer (2-mile) radius surrounding the storage site (see Chapter 3, Section 3.4.11). Therefore, no disproportionately high and adverse effects on minority or low-income populations are expected. The Walker River Indian Reservation lies outside the 16-kilometer (10-mile) radius of the proposed storage site; however, transportation of mercury through the reservation is a consideration. Therefore, consultation has been initiated with the Walker River Paiute Tribe, as discussed in Section 4.5.6.3.

4.6 LONG-TERM MERCURY MANAGEMENT AND STORAGE AT IDAHO NATIONAL LABORATORY

Under this alternative, elemental mercury would be stored at DOE's INL. INL is a 230,323-hectare (569,135-acre) area located in southeastern Idaho. Two options have been identified at INL: (1) construction of a new mercury storage facility within the Idaho Nuclear Technology and Engineering Center (INTEC) or (2) modification of existing waste storage facilities at the Radioactive Waste Management Complex (RWMC) to accommodate mercury storage. These options are further described in Chapter 2, Section 2.4.5. In the following sections, differences in potential impacts between the options are identified, where appropriate.

4.6.1 Land Use and Visual Resources

Idaho Nuclear Technology and Engineering Center Option

Negligible impacts on land use and visual resources are expected from construction and operation of a new mercury storage building at INTEC at INL. Construction of this new facility would require the disturbance of approximately 3.1 hectares (7.5 acres) for building construction and laydown areas (see Chapter 2, Section 2.3.1). The proposed mercury storage facility would be located in the southeastern corner of INTEC. This area of INL is highly developed and has been subject to disturbance from past operations. The completed facility boundary would similarly encompass approximately 3.1 hectares (7.5 acres) within its fenced perimeter, which corresponds to approximately 3 percent of the land within INTEC. The footprint of the mercury storage building would occupy approximately 1.6 hectares (3.9 acres) of this area. Mercury storage operations would be compatible with DOE facility operations currently conducted within the INL Central Core Area. The low profile of the new building is not expected to affect the overall viewshed of this area from on- or offsite vantage points. Therefore, mercury storage operations would not result in a change to BLM VRM classifications.

Radioactive Waste Management Complex Option

No additional impacts on land use or visual resources are anticipated from storing elemental mercury at RWMC at INL since no new construction or other substantial ground-disturbing activities would be required. Elemental mercury would be stored within seven existing RCRA-permitted modular buildings located along the eastern perimeter of RWMC; each building would provide approximately 2,700 square meters (29,000 square feet) of floor space. Collectively, these seven buildings would provide approximately 19,000 square meters (196,000 square feet) of space for DOE storage of elemental mercury. Receipt, staging, and storage activities would generally take place inside these storage modules and would not require the use of any additional site acreage, although some minor modifications to the existing buildings might be required (see Chapter 2, Section 2.4.5.2). Therefore, onsite land use would remain predominantly industrial, and viewsheds would not be affected. Scheduled maintenance and repairs to the storage buildings would be consistent with the existing land use and visual character of the site. Storage of elemental mercury is likewise not expected to affect offsite land uses and viewsheds from public vantage points in the vicinity of RWMC. Mercury storage operations would be compatible with DOE hazardous waste storage operations currently conducted in these buildings. Because there would be no change to the visual landscape as a result of this alternative, there would be no associated change in BLM VRM classifications.

4.6.2 Geology, Soils, and Geologic Hazards

4.6.2.1 Geology and Soils

Idaho Nuclear Technology and Engineering Center Option

Construction of a new mercury storage facility in the southeastern portion of INTEC would generally have the same direct impacts on geology and soils in terms of land area disturbed, depth of excavation, and geologic resource demands as described in Section 4.3.2.1. Geologic resources, including concrete and coarse aggregate (gravel) totaling 8,640 cubic meters (11,300 cubic yards), would be required for construction (see Appendix C, Table C–2) and would be procured from local and/or regional commercial vendors. Trenching may be necessary to install foundation footings or to connect the new mercury storage facility with existing INTEC utilities. Areas within the INTEC perimeter have largely been disturbed by historical activities. Excavation at INTEC would encounter Big Lost River alluvium, composed of gravel-sand-silt mixtures that are from 7.6 to 19.8 meters (25 to 65 feet) thick. Due to the relatively shallow depth of excavation and nature of the surficial geologic strata, it is not expected that basaltic bedrock would be encountered (see Chapter 3, Section 3.5.2). Nevertheless, a site survey and geotechnical study would be conducted to confirm site geologic characteristics for facility siting and engineering purposes.

Natural and disturbed soils at INTEC could be more prone to erosion. However, adherence to standard best management practices for soil erosion and sediment control during construction would serve to minimize soil erosion and loss (see Section 4.3.2.1).

Due to the potential risk of excavating contaminated soils, the construction area would also be surveyed prior to any ground disturbance. Any contamination would be remediated as necessary. During operations, the previously disturbed areas would not be subject to long-term soil erosion, and temporarily disturbed areas would be revegetated. There would be no additional impact on geology and soils from operations.

Radioactive Waste Management Complex Option

Internal modifications of the existing storage modules would have a negligible impact on geology and soils, as activities would largely be limited to reinforcing the concrete floors of the existing structures. Some trenching could be necessary to upgrade or install utilities and other systems (e.g., fire suppression). Any contamination would be remediated as necessary. The depth of excavation required would be about 0.6 meters (2 feet) wide by 1.2 meters (4 feet) deep, where necessary for utility trenching. If necessary, trenching could encounter basaltic bedrock, as surface sediments vary in thickness from about 0.6 to 7 meters (2 to 23 feet). A site survey and geotechnical study would be conducted to confirm site geologic characteristics for facility siting and engineering purposes. Geologic resource requirements would likely be a fraction of the volume required for a new storage facility.

Soil disturbance for utility trenching and to areas outside the perimeter of the existing storage modules to support upgrades to flooring inside the facilities would be minimal. Nevertheless, adherence to standard best management practices for soil erosion and sediment control (e.g., use of sediment fencing, staked hay bales, mulching and geotextile matting, and rapid reseeding) in any disturbed areas would serve to minimize any soil erosion and loss.

4.6.2.2 Geologic Hazards

Hazards from large-scale geologic conditions, such as earthquakes, and other site geologic conditions with the potential to affect INL facilities would be substantially similar for INTEC and RWMC, as summarized in Chapter 3, Section 3.5.2.3. Such conditions have been extensively evaluated in previous analyses. To be specific, the Eastern Snake River Plain, on which INL is situated, is a region of relatively low seismicity, although higher rates of seismic activity are indicated for regions in the surrounding Basin and Range Physiographic Province. The Arco Segment of the Lost River Fault terminates approximately 32 kilometers (20 miles) to the west of INTEC. The Lost River Fault is considered to be capable or potentially active. Ground shaking of MMI VI has been reported on the site in the recent past, associated with a major earthquake epicenter in the Borah Peak Range northwest of INL and in association with the Lost River Fault. Otherwise, relatively few and minor earthquakes have occurred in the area surrounding INL. MMI VI shaking typically causes only slight damage to ordinary structures, while MMI VII shaking can cause moderate damage in well-constructed, ordinary structures but is not expected to damage facilities that have been specially designed or upgraded (see Appendix B, Table B–4). The predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.12 *g*. Peak ground motion in this range is only expected to cause slight damage to ordinary structures and is consistent with effects at the site associated with historical activity in the Borah Peak Range. As further described in Appendix B, Section B.3.2, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, upgraded as necessary, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. The Order also stipulates natural phenomena hazards mitigation for DOE facilities.

In the case of existing RWMC storage modules, upgrades would include retrofits to flooring to ensure structural stability and floor coatings to prevent penetration of spills, should they occur (see Appendix C, Table C–1). Neither newly designed and constructed facilities nor the existing specially designed and upgraded RWMC facilities would be likely to suffer substantial structural damage from the maximum predicted earthquake ground motion at the site. Thus, predicted ground motion would be unlikely to cause a breach in mercury containers from structural failure.

An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.6.9.2.

Further, the volcanic hazard at INL has been extensively studied. The most recent eruptions within the INL area occurred about 2,100 years ago in an area 31 kilometers (19 miles) southwest of the site at the Craters of the Moon Wilderness Area. The estimated recurrence interval (repeat time) for volcanism associated with the five identified volcanic zones ranges from 16,000 to 100,000 years. As a result, volcanism is not expected to reoccur within the 40-year design life of the mercury storage facility. INL seismic stations are located near or within identified volcanic rift zones to provide early warning of any signs of renewed volcanic activity.

4.6.3 Water Resources

4.6.3.1 Surface Water

Idaho Nuclear Technology and Engineering Center Option

Facility construction activities are not expected to have any direct impact on surface water features, including the Big Lost River. INTEC is situated on an alluvial plain with its northwestern corner located approximately 60 meters (200 feet) from the Big Lost River channel near the channel's intersection with Lincoln Boulevard. However, the proposed new mercury storage facility site is situated approximately 900 meters (3,000 feet) from the channel. INTEC is surrounded by a stormwater drainage ditch system that directs runoff from most areas to an abandoned gravel pit on the northeastern side of INTEC where it infiltrates into the subsurface. Facility construction would not impact these features.

Stormwater runoff from the construction site would be unlikely to reach the Big Lost River, and appropriate soil erosion and sediment control measures and spill prevention and waste management practices would be employed to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts, as noted in Section 4.3.3.1. At INL, all construction and other ground-disturbing activities would be conducted in accordance with the current NPDES General Permit for Storm Water Discharges from Construction Sites. Stormwater pollution prevention plans are completed for individual construction projects (see Chapter 3, Section 3.5.3.1).

Construction activities would require as much as 1,270,000 liters (336,000 gallons) of water over the 6-month construction period. This volume would primarily be required for dust control and soil compaction. It is anticipated that water would be trucked to the construction site and supplied from the INTEC water system. During operations, water use would generally be limited to that required to serve the potable and sanitary needs of the storage facility workforce. Total annual consumption is estimated to be no more than about 88,500 liters (23,375 gallons). Depending on the number of personnel drawn from the existing DOE workforce at INTEC, water use by dedicated mercury storage facility staff could be greatly reduced. These construction and operations volumes are relatively small compared with the volume of water currently withdrawn and used by DOE at INTEC (see Section 4.6.7.2).

As previously noted in Section 4.3.3.1, design, construction, and operation of the mercury storage facility would incorporate structural controls and practices to prevent the release of elemental mercury and to prevent any spills or other releases, should they occur as a result of abnormal operating conditions, from reaching soils or surfaces where they could be conveyed to surface waters or groundwater. Facility operations would be conducted in accordance with an ICP and SPCC plan, or equivalent plans as mandated by state requirements governing the facility, which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

While located at INTEC on an alluvial plain adjacent to the Big Lost River, there is no record of historical flooding at the site. The INL diversion dam was designed to secure INL facilities, including INTEC, from the 300-year flood, and the latest flood studies performed for the site indicate the potential for substantially less flooding at INL facilities than predicted by previous studies. Nevertheless, the analysis of the probable maximum flood, which included failure of Mackay Dam upstream of INL, predicts a peak surface water elevation at INTEC equal to the average elevation at that facility. This would flood INTEC and result in ponding in low-lying areas, although predicted flood velocities would be fairly slow and water depths shallow. This could impact certain facilities, with the greatest potential for impact in the northern part of INTEC (see Chapter 3, Section 3.5.3.1). The proposed location of the new mercury storage facility greatly minimizes the potential for flooding over the long term. DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. The potential for sheet flooding and other precipitation effects (e.g., scour and erosion) would be accounted for in the design and upgrade of foundations, walls, roof structures, and drainage and stormwater management systems for the storage facility. Consequently, the new mercury storage facility would incorporate appropriate stormwater management controls to safely collect and convey stormwater from the facility while minimizing washout, soil erosion, and offsite water quality impacts.

There would be no direct discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via the existing INTEC sanitary waste system (see Section 4.6.8).

<u>Radioactive Waste Management Complex Option</u>

Modification of the existing RWMC storage modules to support mercury storage would not have any impact on surface water features. The closest surface water features are the INL diversion spreading areas, located about 1.6 kilometers (1 mile) east of RWMC, and the Big Lost River channel, located approximately 3.2 kilometers (2 miles) southeast of RWMC.

Appropriate soil erosion and sediment control measures and spill prevention and waste management practices would be employed to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts. As under the INTEC Option, any exterior work that may be required would be subject to the current INL NPDES General Permit for Storm Water Discharges from Construction Sites.

Water requirements to support modifications and upgrades at RWMC would be very small compared with those under the INTEC Option for construction of a new mercury storage facility. It is anticipated that any water needed could be obtained from the existing RWMC groundwater supply system. During operations, it is expected that water use would be relatively small under normal operations and limited to that required to serve the potable and sanitary needs of the storage facility workforce. Total annual consumption is estimated to be no more than about 88,500 liters (23,375 gallons). Moreover, there may be no net increase in water use, as use of the RWMC facilities for elemental mercury storage would substitute for existing waste management activities, especially if mercury storage staff are drawn from the existing INTEC workforce.

Use and operations of the RWMC storage modules for mercury storage must include the structural controls and practices to prevent and respond to any release of elemental mercury, as discussed under the INTEC Option. As necessary, the RWMC storage modules would be modified to meet these requirements, as summarized in Appendix C, Table C–1. Likewise, facility operations would be conducted in accordance with an ICP and SPCC plan or updated existing plans, which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

RWMC is separated from the Big Lost River by a lava ridge that serves as a hydraulic barrier; therefore, the Big Lost River is not a surface water flowpath. Analysis of the probable maximum flood due to the failure of Mackay Dam showed that RWMC would not be inundated from flow from the Big Lost River. RWMC has experienced flooding as a result of rapid snowmelt and heavy precipitation, with the latest event in 1982. However, upgrades to the perimeter drainage system have greatly reduced the likelihood of local basin flooding affecting RWMC. RWMC has a peripheral drainage ditch and a main discharge channel that are designed for a maximum 10,000-year combined rain-on-snow storm event (see Chapter 3, Section 3.5.3.1). Regardless, as further described above under the INTEC Option, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. Use of the RWMC storage modules for mercury storage would require that they be evaluated and upgraded, as necessary, to incorporate any additional appropriate stormwater management controls to safely collect and convey stormwater from the facility while minimizing washout, soil erosion, and offsite water quality impacts.

There would be no direct discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via the RWMC existing sewage disposal system.

4.6.3.2 Groundwater

Idaho Nuclear Technology and Engineering Center Option

Facility construction is not expected to have any impact on groundwater hydrology or existing contaminant plumes beneath INTEC due to the depth to groundwater and the shallow depth of excavation. As the facility would be operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

Radioactive Waste Management Complex Option

Storage module modifications are not expected to have any direct impact on groundwater hydrology or existing contaminant plumes as there would be little excavation activity required, although trenching, if required, could encounter locally perched groundwater conditions at depths ranging from about 0.6 to 7 meters (2 to 23 feet). In such cases, the excavations may have to be dewatered and the groundwater contained for testing and treatment, if found to be contaminated, prior to discharge. As the facility would be operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.6.4 Meteorology, Air Quality, and Noise

4.6.4.1 Meteorology

Meteorological events can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events were considered in selecting the accident events evaluated in Section 4.6.9.2. As previously detailed and described in Section 4.3.4.1, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including meteorological events. RCRA-permitted facilities, such as the proposed mercury storage facility, must also meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31 and applicable state RCRA requirements to prevent the release of stored wastes. As the INL region is susceptible to regular occurrence of high winds, the existing RWMC facilities would be upgraded or modified and the new mercury storage facility at INTEC designed and constructed to withstand the potential for high winds and other meteorological events, such as heavy snow.

4.6.4.2 Air Quality

Idaho Nuclear Technology and Engineering Center Option

Minor short-term air quality impacts would result from construction of a mercury storage building at INTEC. These impacts would include an increase in criteria and toxic air pollutant concentrations from construction equipment emissions (see Appendix C, Section C.2.3). These emissions would occur over a 6-month construction period and are not expected to result in exceedance of air quality standards.

Emissions from operation of a new mercury storage facility at INTEC would be very small, consisting of emissions from employee vehicles, trucks or trains, semiannual testing of emergency generators, and possibly mercury vapor from any spills or from mercury containers. No localized emissions from space heating are anticipated associated with mercury storage facility operations, as electric heating is anticipated for areas requiring climate control. Compliance with the conformity regulations is discussed in Appendix B, Section B.5.1.2.

Exposures to mercury vapor could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers (those outside the storage facility) or nearby offsite individuals. Appendix D, Section D.4.1, presents a conservative analysis that shows that for a long-term, undetected slow leak inside the proposed mercury storage facility, the predicted long-term average concentration in the building wake never exceeds 80 nanograms per cubic meter. The EPA threshold for chronic exposure to airborne mercury is 300 nanograms per cubic meter, so slow releases of mercury would have a negligible effect on noninvolved workers and the public, with a corresponding negligible risk.

Air quality impacts from transportation of mercury to INL would be similar to those discussed in Section 4.3.4.2. Truck and rail transport are discussed in more detail in Section 4.6.9.3. Estimated emissions from truck and rail transportation are presented in Tables 4–15 and 4–16.

Annual carbon dioxide emissions would be highest during the year 2013, at approximately 304 metric tons (335 tons) per year, as a result of moving elemental mercury to the site by truck; these annual truck emissions would be greater than rail emissions from shipping mercury. As similarly noted in Section 4.3.4.2, such emissions would minimally add to global and U.S. annual emissions of carbon dioxide. Global climate change is further discussed in Section 4.11.4.2.

Radioactive Waste Management Complex Option

Negligible short-term air quality impacts with little or no measurable effect on air quality would result from modification of the existing storage modules for mercury storage at RWMC. Criteria and toxic air pollutant emissions from construction equipment (see Appendix C, Section C.2.3) would be limited to those from construction employee vehicles and work trucks; no heavy equipment is expected to be used.

Emissions and air quality impacts from RWMC facility operations would be similar to but likely less than those described above for the INTEC Option.

Air quality impacts from transportation of mercury to INL would be similar to those discussed above for the INTEC Option and further discussed in Section 4.3.4.2.

4.6.4.3 Noise

<u>Idaho Nuclear Technology and Engineering Center Option</u>

Short-term noise impacts at INL could result from construction of a new mercury storage facility within INTEC. These impacts would include some increase in traffic to the site and an increase in noise resulting from construction employee vehicles, equipment delivery, and heavy equipment operations. These impacts would occur during the 6-month construction period. Since the nearest noise-sensitive receptor, a residence, is located more than 16 kilometers (10 miles) from the site, the increase in noise levels at this location from construction equipment is expected to be negligible. The increase in traffic noise levels along U.S. Route 20 from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on U.S. Route 20.

Short-term noise impacts could occur along U.S. Route 20 as a result of increased truck activity during the period that elemental mercury is transported to the site. The resulting increase in day-night average noise levels along U.S. Route 20 is expected to be less than 1 dBA. As such, the change in truck traffic is not expected to result in a change in noise levels along this route or other shipping routes that would be noticeable to the public or result in an increase in annoyance. If the mercury is shipped by rail instead of by truck, some additional rail activity from placing railcars at the site could result in some increase in noise levels near the site.

Operation of the mercury storage facility within INTEC is expected to have a negligible impact on noise levels around the site since the noise sources would be limited to a few employee vehicles, occasional delivery trucks, and semiannual testing of the emergency generator.

<u>Radioactive Waste Management Complex Option</u>

Activities and associated noise impacts from modification of the RWMC storage modules to accommodate mercury storage would be similar to but somewhat smaller than those described for the INTEC Option. Similarly, since the nearest noise-sensitive receptor, a residence, is located 16 kilometers (10 miles) from the site, the increase in noise levels at this location from construction equipment is expected to be negligible. The increase in traffic noise levels along U.S. Route 20 from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on U.S. Route 20.

Noise impacts from mercury storage facility operations would be similar to those discussed for the INTEC Option.

4.6.5 Ecological Resources

4.6.5.1 Terrestrial Resources

Habitat in the immediate vicinity of INTEC and RWMC consists of disturbed land within a developed setting. Little native vegetation remains within the area of the proposed mercury storage facilities; impacts would be limited to introduced species in an already disturbed landscape. Adherence to best management practices for land cover management (e.g., washing down construction equipment and vehicle tire treads) would serve to reduce the chance of introducing invasive plant species. Impacts on animals from construction would be limited to species adapted to human disturbance. During operations, there would be no additional impacts on terrestrial resources, as temporarily disturbed areas beyond the facility footprint would be revegetated and/or would revert to more-natural conditions.

4.6.5.2 Wetlands and Aquatic Resources

No wetlands or aquatic resources exist within the area of the proposed mercury storage facilities at INTEC or RWMC. Therefore, no impacts on wetlands or aquatic habitats are expected.

4.6.5.3 Threatened and Endangered Species

No threatened or endangered species are known or are expected to exist within the areas designated for the proposed mercury storage facility at INTEC or RWMC. Thus, no impacts on threatened or endangered species are expected from facility modifications, construction, or operations. Consultations have been initiated with the appropriate U.S. Fish and Wildlife Service office and state wildlife agency to support this analysis (see Chapter 5, Section 5.4).

4.6.6 Cultural and Paleontological Resources

4.6.6.1 Prehistoric Resources

Most of the prehistoric sites or locations at INL appear to be concentrated along Big Lost River and Birch Creek, atop buttes and within craters or caves. There would be no impact on these resources under either the INTEC or RWMC Options. Given the high density of prehistoric sites at INL, there is always a possibility of identifying a new site, although construction of a new mercury storage facility would be conducted within the heavily disturbed INTEC. Nevertheless, any inadvertent discoveries of resources would be managed in accordance with the *Idaho National Laboratory Cultural Resource Management Plan* (DOE 2009a) (see Chapter 3, Section 3.5.6.1).

4.6.6.2 Historic Resources

There are at least 200 historical properties at INL, including the Experimental Breeder Reactor I, which is a National Historic Landmark. Many of these properties are considered eligible for listing in the NRHP because of their exceptional scientific and engineering significance since World War II. Previous projects and ground-disturbing activities were reviewed in accordance with the *Idaho National Laboratory Cultural Resource Management Plan* in 2007 (see Chapter 3, Section 3.5.6.2). No adverse effects on historic properties were identified. No impact on historical resources is expected under either the INTEC or RWMC Options for mercury storage. DOE has initiated consultation with the Idaho SHPO to support this analysis (see Chapter 5, Section 5.4).

4.6.6.3 American Indian Resources

The INL site is considered part of the Shoshone-Bannock Tribes' ancestral homeland. DOE has an agreement that allows unrestricted access to certain areas of INL to Shoshone-Bannock tribal members. The agreement provides for routine tribal participation in new and ongoing INL projects (see Chapter 3, Section 3.5.6.3). Consultation with the Shoshone-Bannock Tribe has been initiated by DOE (see Chapter 5, Section 5.4). However, no impacts on American Indian resources are expected under either the INTEC or RWMC Options.

4.6.6.4 Paleontological Resources

No impacts on unique paleontological resources are expected under either the INTEC or RWMC Options as the affected sites have been previously disturbed. As is the case for other cultural resources, if any paleontological resources were found (see Chapter 3, Section 3.5.6.4), procedures are in place to properly manage the discovery site.

4.6.7 Site Infrastructure

4.6.7.1 Ground Transportation

Construction or modification and operations of a new mercury storage facility at INL are not expected to appreciably increase demands on the road and rail systems leading to the site. Projected peak traffic volumes and the number of shipments associated with mercury storage operations are presented in Section 4.6.11.

4.6.7.2 Electricity, Fuel, and Water

Utility resource demands and associated assumptions for construction and operation of a new mercury storage facility at INL under the INTEC and RWMC Options would generally be similar to those described in Section 4.3.7.2. However, under the RWMC Option, utility requirements for construction would likely be considerably less than those for construction of a new facility as activities would be limited to modification of the existing storage modules for mercury storage at RWMC. Use of the existing RWMC facilities for mercury storage would likely have little or no incremental operational impact on site utility infrastructure, as the storage modules are or have previously been in operation for other uses.

INTEC's current annual electricity consumption is about 10 percent of the INL site capacity. RWMC's current electricity consumption is 0.6 percent of the available sitewide capacity. The projected annual operational electricity requirement to support mercury storage (253 megawatt-hours) would be negligible (0.6 and 8 percent increase at INTEC and RWMC, respectively) when compared with the current annual INTEC and RWMC electricity usage, and would be about 0.05 percent of the annual sitewide electric supply capacity.

The availability of liquid fuels at INL is not limited, and volume can be increased as needed. Diesel fuel consumption (606 liters [160 gallons]) to support operations of a new mercury storage facility would be negligible (0.01 percent increase) when compared with INL's annual consumption of liquid fuels (see Chapter 3, Section 3.5.7.3).

Water requirements for construction and operation of a new mercury storage facility would similarly be negligible compared with INTEC's and RWMC's water usage and INL site capacity (see Chapter 3, Section 3.5.7.4). INTEC's and RWMC's current annual water usage are 1 and 0.02 percent, respectively, of the INL water rights capacity. Water requirements for new construction (1,270,000 liters [336,000 gallons]) would temporarily increase INTEC's water use by no more than 0.3 percent. The annual water demand for mercury storage operations (88,500 liters [23,400 gallons]) would constitute about 0.02 and 0.8 percent, respectively, of INTEC's and RWMC's water consumption.

4.6.8 Waste Management

Both modification and operation of the existing RWMC waste storage modules (RWMC Option) for mercury storage and construction and operation of a new mercury storage facility at INTEC (INTEC Option) are expected to have a negligible impact on waste generation and waste management infrastructure at INL. Internal modification of RWMC storage modules for interim mercury storage is expected to generate much less than the 271 cubic meters (355 cubic yards) of nonhazardous solid waste and 9,850 liters (2,600 gallons) of nonhazardous sanitary liquid waste projected to be generated during construction of a new facility. Nevertheless, the maximum volumes are negligible compared with the current waste generation activities at INL, as described in Chapter 3, Section 3.5.8. It is assumed that construction-generated solid waste would be disposed of either in the INL Central Facilities Area landfill or off site at the Bonneville County Landfill. Portable toilet facilities, serviced by a local or regional contractor, would be used to serve the sanitary needs of the construction workforce under either option.

Operation of the mercury storage facility within either RWMC or INTEC is expected to generate an estimated 910 55-gallon (208-liter) drums of hazardous waste over the 40-year period of analysis, as further described in Section 4.3.8. This equates to about 23 55-gallon drums, or approximately 5 cubic meters (6.5 cubic yards) annually. This estimated yearly hazardous waste generation rate is negligible (about 0.2 percent) compared to the hazardous and other waste volumes (which include mercury-contaminated waste) generated and managed each year at INL (see Chapter 3, Section 3.5.8). INL is a listed hazardous waste generator. No changes in generator status would be required to operate the proposed mercury storage facility, nor are any substantial effects on INL's waste management infrastructure expected.

New mercury storage facility operations would also generate an estimated 59,000 liters (15,600 gallons) of nonhazardous sanitary wastewater annually. Nonetheless, operation of the RWMC storage modules is not expected to result in a substantial increase in sanitary waste generation as the modules are already in operation for other purposes. Under the INTEC Option, the projected annual sanitary waste generation rate from operation of a new mercury storage facility would be miniscule (0.003 percent) compared with the 1,698 million liters (448.5 million gallons) of wastewater collected, treated, and discharged to the INTEC New Percolation Ponds each year (DOE 2008a:5.8).

DOE continues to manage several ongoing programs and projects at INL in support of sitewide remediation. Neither construction or modification nor operation of the proposed mercury storage facilities is anticipated to impact resources (e.g., funding, labor, facilities, and equipment) associated with current and/or future site environmental restoration efforts.

4.6.9 Occupational and Public Health and Safety

There are two options for mercury storage at INL: new construction at INTEC or use of existing buildings at RWMC. Under the RWMC Option, the principal difference is that elemental mercury would not be stored in a single large building, but in up to seven buildings with approximate dimensions of 61 meters (200 feet) long, 43 meters (140 feet) wide, and 7.4 meters (24 feet) high (see Appendix D, Table D–51). Most of the risks that pertain to both options are the same as those discussed in Sections 4.2.9.1 through 4.9.2.5.

4.6.9.1 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites. Consequences to the involved worker are predicted to be negligible because involved workers would never be exposed to airborne concentrations of mercury vapor above the ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. This corresponds to keeping exposures to the involved worker in the SL-I (negligible) range.[21] This would be achieved by adherence to good operating practices, in particular attention to ventilation, inspection, monitoring, and use of PPE, as described in the *Interim Guidance* (DOE 2009c). Therefore, the risks to involved workers would be negligible during normal operations.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.1.2, shows that the predicted long-term average concentration in the building wake for new construction is about 2.0×10^{-5} milligrams per cubic meter and about 4.0×10^{-5} milligrams

[21] For definitions of SLs for various types of exposures, see Section 4.2.9.1.1 and Appendix D, Section D.1.1.1. For a discussion of how risk is assessed, see Sections 4.2.9.1.1 and D.1.1.2.

per cubic meter in the wake of existing buildings at RWMC. This is well below EPA's chronic-inhalation exposure RfC of 3.0×10^{-4} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and the public would be negligible.

4.6.9.2 Facility Accidents

Section 4.2.9.1.4 provides a discussion of facility accident risks that applies to all sites. Table 4–3 contains a summary of the likelihood of occurrence of candidate facility accident scenarios initiated by failures of engineered systems, human errors, or external events, and Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible frequency from Table 4–3. The analysis of the scenarios at INL is similar to that for the same scenarios in Section 4.2.9.1.4. There are some differences because the RWMC Option includes interim storage of elemental mercury in up to seven relatively small buildings at RWMC within INL. For a member of the public in the case of an outside earthquake spill at RWMC, the atmospheric dispersion calculations show that the maximum distance downwind to which a concentration greater than AEGL-3 could be exceeded is less than 100 meters (330 feet); for AEGL-2, the corresponding distance is about 320 meters (1,050 feet); and for 0.1 × AEGL-2, it is approximately 1.3 kilometers (0.8 miles). However, the distance to the closest site boundary from the proposed INL storage site is 5.8 kilometers (3.6 miles), so consequences and hence risks to members of the public would be negligible. Similar reasoning leads to the same conclusion for new construction at INTEC. Table 4–39 summarizes the results for all accidental spills of elemental mercury on site (without fire).

Table 4–39. Summary of Risks for all Onsite Spill Scenarios of Elemental Mercury – Idaho National Laboratory (RWMC and INTEC)

Scenario	Frequency	Consequence	Risk
Spills Inside Building[a]			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for all inside spills
Noninvolved worker	FL-II – FL-III	SL-II	N for all inside spills
Member of the public	FL-II – FL-III	SL-II	N for all inside spills
Spills Outside Building			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for outside earthquake spill; N for all other outside spills
Noninvolved worker	FL-II – FL-III	SL-I – SL-II	
Member of the public			
1-metric ton container spill	FL-II	SL-I	N
Single pallet spill	FL-III	SL-I	N
Earthquake with building collapse[b]	FL-III	SL-I	N

[a] The inside spill scenarios considered are single flask, single pallet, triple pallet, 1-metric-ton container, full spill tray under a pallet, and earthquake with intact building walls.

[b] This scenario encompasses the risk from floods, high winds, and tornadoes.

Key: FL=frequency level; INTEC=Idaho Nuclear Technology and Engineering Center; L=low; N=negligible; RWMC=Radioactive Waste Management Complex; SL=severity level.

4.6.9.3 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury over a 40-year period of analysis to INL. These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. The transportation analysis applies equally to new construction at INTEC and existing buildings at RWMC. The results of the analysis are shown in Table 4–40.

Table 4–40. Frequency Analysis of Truck and Railcar Accidents – Idaho National Laboratory

Scenario	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires in Dry Weather (per year)	Frequency of Accidents with Fires in Wet Weather (per year)	Frequency of Accidents with Death[a] (per year)
Truck – Scenario 1	984,288	1.2×10^{-2}	2.0×10^{-3}	1.6×10^{-4}	5.1×10^{-6}	5.5×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Truck – Scenario 2	1,654,225	1.6×10^{-2}	3.3×10^{-3}	2.7×10^{-4}	8.6×10^{-5}	9.2×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Railcar	394,112	2.5×10^{-3}	1.1×10^{-5}	2.6×10^{-5}	8.3×10^{-7}	1.6×10^{-4}
	–	Moderate – FL-III	Low – FL-II	Low – FL-II	Negligible – FL-I	Moderate – FL-III

[a] Fatality caused by mechanical impact, not by exposure to mercury.
Note: To convert miles to kilometers, multiply by 1.60934.
Key: FL=frequency level.

The above frequencies are for an accident anywhere along any of the transportation routes taken over a 40-year period of analysis to INL. A crash that occurs in the last mile of the trip was used to estimate the frequency of an onsite crash in the vicinity of the storage building(s). The frequency of accidents with spills would be low under both truck scenarios and negligible under the Railcar Scenario. The frequency of crashes with fires or death would be negligible under all scenarios.

With respect to transportation accidents involving spills of mercury, four scenarios were considered:

- Spill of elemental mercury onto the ground without fire
- Spill of elemental mercury directly into water
- Fire with mercury spill
  - In dry weather
  - In wet weather

4.6.9.3.1 Transportation Accident with Spill of Elemental Mercury onto the Ground

Section 4.2.9.1.5 contains an analysis of spills of elemental mercury onto the ground following a truck or railcar crash without fire. A conservative estimate of the rate of evaporation from the resulting pool and the subsequent atmospheric dispersion (applicable to all sites) shows that a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that individual could only be exposed to such concentrations if the crash occurs along a specific 680-meter (2,230-foot) stretch of any of the routes to INL. The same reasoning as is used in the generic discussion in Section 4.2.9.1.5 shows that the risk to a member of the public from transportation spills onto the ground without fire en route to INL would be negligible under Truck Scenario 1 and the Railcar Scenario, but low under Truck Scenario 2.

4.6.9.3.2 Transportation Accident with Spill of Elemental Mercury Directly into Water

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

Table 4–41 summarizes the risks to human receptors arising from spillages of elemental mercury during transportation to INL.

Table 4–41. Summary of Transportation Risks to Human Receptors, Spills of Elemental Mercury onto the Ground or into Water, Idaho National Laboratory

	Truck Scenario 1	**Truck Scenario 2**	**Railcar Scenario**
Spill onto the Ground			
Frequency[a]	FL-I	FL-II	FL-I
Consequence	SL-II	SL-II	SL-II
Risk	*Negligible*	*Low*	*Negligible*
Spill into Water			
Frequency[b]	FL-III	FL-III	FL-II
Consequence	SL-I–SL-II	SL-I–SL-II	SL-I–SL-II
Risk[c]	*Negligible to low*	*Negligible to low*	*Negligible to low*

[a] Frequency at which spill occurs close enough to a specific individual to cause Acute Exposure Guideline Level 2 to be exceeded.

[b] Frequencies of railcar or truck crashes with spills from Table 4–40.

[c] These estimates of risk are subject to large uncertainty.

Key: FL=frequency level; SL=severity level.

4.6.9.3.3 Transportation Accident with Fire

The fire calculations are described in Section 4.2.9.1.5. Table 4–42 shows the results of the calculations of acute-inhalation risks from transportation accidents with fires on transportation routes to INL (both INTEC and RWMC). The table encompasses both truck scenarios and the Railcar Scenario.

Note that the risks presented in the above scenario are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

Table 4–42. Summary of Acute-Inhalation Risks to Human Receptors, Accidents with Fires, Transportation Routes to Idaho National Laboratory

	Both Truck Scenarios with Wooden Pallets	Railcar Scenario with Wooden Pallets
Frequency[a]	FL-III	FL-II
Consequence[b]	SL-II	SL-II
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.

[b] The highest consequence in any weather condition.

Key: FL=frequency level; SL=severity level.

The analyses performed for this EIS show that, under all fire scenarios listed in Table 4–42, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

Table 4–43 summarizes the human health risks associated with all transportation spills.

Table 4–43. Summary of Transportation Risks to Human Receptors, Idaho National Laboratory

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto ground	Negligible	Low	Negligible
Spill into water	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty
Spill with fire – inhalation, wooden pallets	Low	Low	Low
Spill with fire – dry and wet deposition, wooden pallets	Negligible	Negligible	Negligible

4.6.9.4 Intentional Destructive Acts

The discussion of IDAs is the same for all sites and transportation routes (see Section 4.2.9.1.6).

4.6.10 Ecological Risk

There is a generic analysis of ecological risk in Section 4.2.10.1, which applies without modification to INL (both INTEC and RWMC).

4.6.10.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike inorganic compounds formed from divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation are considered to be negligible at all storage sites and along all transportation routes.

4.6.10.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2,

which also makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.
- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to ecological receptors could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

4.6.10.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5, and Section 4.2.10.1.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. Table 4–44 summarizes the FL, consequence level, and risk to ecological receptors in the case of a truck crash with a pallet fire and no rain (dry deposition) and applies to all candidate storage sites.

Table 4–44. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, Idaho National Laboratory

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Tables D–12 and D–13.

[b] Applies to both Truck Scenarios 1 and 2.

For the interpretation of Table 4–44, see Section 4.2.10.1.3. The risks of other potential fire scenarios are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–45.
- For railcar crashes with wooden pallet fires and without rain (dry deposition), see Table 4–46.
- The predicted frequency of railcar crashes with pallet fires and rain is negligible, so risks would be negligible and no summary table is presented.

Table 4–45. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, Idaho National Laboratory

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Table D–16.

[b] Applies to both Truck Scenarios 1 and 2.

Table 4–46. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, Idaho National Laboratory

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of railcar crashes with fires from Appendix D, Table D–14.

4.6.10.4 Consequences – Intentionally Initiated Fire with Mercury Spill

The consequences of intentionally initiated fires to ecological receptors are the same for all sites (see Section 4.2.10.1.4).

4.6.11 Socioeconomics

Idaho Nuclear Technology and Engineering Center Option

Under the INTEC Option at INL, a new facility for long-term storage of elemental mercury would be constructed. Employment during construction is expected to average 18 people for approximately 6 months. Operation of the facility is estimated to require approximately 8 individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and approximately 5 individuals thereafter, resulting in a possible increase of the INL workforce of less than 0.1 percent and an increase in the ROI of 0.006 percent. This estimate assumes that new employees would be hired for construction and operations of the new facility rather than drawn from existing onsite personnel. Regardless, neither construction nor operation of a new facility is expected to generate substantial direct or indirect employment. Thus, negligible impacts on socioeconomic conditions (i.e., overall employment, population trends, and traffic) in the ROI would result from implementing this alternative.

Construction-related transportation, including employee vehicle trips and equipment and materials shipments, is not expected to adversely impact traffic conditions on roads leading to the site. It is assumed that there would be approximately 1.5 employees per vehicle, and every vehicle is counted twice to account for round trips. It is estimated that average construction transportation of 45 vehicles a day could increase the average annual daily traffic count on State Route 33 by approximately 7 percent. Fifty-three percent of these vehicles would be attributed to employee transportation.

Transportation impacts during the operations phase would include employee vehicle trips and shipments of mercury to the site for storage. Appendix C, Section C.1, provides an estimate of the number of shipments by truck. The additional vehicles due to facility operations are not expected to noticeably increase traffic volumes on roads leading to the site. The greatest impact would be during the first 2 years of operations, when it is estimated that approximately 11 vehicles a day could increase the average annual traffic count on State Route 33 by approximately 2 percent. During this time, it is estimated that up to 78 shipments would be made each year. Approximately 96 percent of the additional vehicles would be attributed to employee transportation.

Radioactive Waste Management Complex Option

Modifications of the existing RWMC storage modules and subsequent operations for interim storage of elemental mercury under the RWMC Option would result in additional but substantially smaller socioeconomic impacts than those described above for the INTEC Option. However, even combined with the INTEC Option, the total impact on socioeconomic conditions in the ROI surrounding INL would be negligible. Appendix C, Table C–1, summarizes the necessary modifications to the RWMC storage modules to meet the specifications for interim mercury storage.

4.6.12 Environmental Justice

Idaho Nuclear Technology and Engineering Center Option

None of the block groups within either the 16-kilometer (10-mile) radius or the 3-kilometer (2-mile) radius surrounding INTEC contain a disproportionately high number of minority or low-income individuals (see Chapter 3, Section 3.5.11). Therefore, no disproportionately high and adverse effects on minority or low-income populations are expected. The Fort Hall Reservation lies well beyond the 16-kilometer (10-mile) radius of the proposed storage site; however, it is possible that mercury shipments originating from points south and east of the site could be transported through the reservation. Therefore, consultation has been initiated with the Shoshone-Bannock Tribe of the Fort Hall Reservation, as described in Section 4.6.6.3.

Radioactive Waste Management Complex Option

None of the block groups within either the 16-kilometer (10-mile) radius or the 3-kilometer (2-mile) radius surrounding RWMC contain a disproportionately high number of minority or low-income individuals (see Chapter 3, Section 3.5.11). Therefore, no disproportionately high and adverse effects on minority or low-income populations are expected. The Fort Hall Reservation lies well beyond the 16-kilometer (10-mile) radius of the proposed storage site; however, it is possible that mercury shipments originating from points south and east of the site could be transported through the reservation. Therefore, consultation has been initiated with the Shoshone- Bannock Tribe of the Fort Hall Reservation, as described in Section 4.6.6.3.

4.7 LONG-TERM MERCURY MANAGEMENT AND STORAGE AT KANSAS CITY PLANT

Under this alternative, elemental mercury would be stored at DOE's KCP. KCP is part of the 125-hectare (310-acre) Bannister Federal Complex located 13 kilometers (8 miles) south of downtown Kansas City, Missouri. KCP occupies 55 hectares (136 acres) of the complex and is under the custody and control of DOE's National Nuclear Security Administration. Implementation of this alternative would involve modification of an existing building (i.e., Main Manufacturing Building [Building 1]), as further described in Chapter 2, Section 2.4.6.

4.7.1 Land Use and Visual Resources

No additional impacts on land use or visual resources are anticipated at KCP since no new construction or other substantial ground-disturbing activities would be required. Elemental mercury would be stored in an existing building within the central portion of the site complex, where approximately 14,000 square meters (150,000 square feet) of floor space would initially be available if National Nuclear Security Administration operations move to a new facility in 2013. Receipt, staging, and storage activities would generally take place inside the available storage space and would not require the use of any additional site acreage, although some minor modifications to the existing building might be required (see Chapter 2, Section 2.4.6). Onsite land use is expected to remain predominantly light industrial, and viewsheds would not be affected. Scheduled maintenance and repairs to the storage building would be consistent with the existing land use and visual character of the site. Although no applicable land use plans, policies, or controls have been identified that would specifically restrict storage of elemental mercury, such storage might not be considered compatible with proposed redevelopment of the site, adjacent residential zoning, or the proximity of sensitive populations (at a hospital and schools) within 0.8 kilometers (0.5 miles) of this location (Neef 2009). Because there would be no change to the visual landscape in the vicinity of KCP as a result of this alternative, there would be no associated change in BLM VRM classifications.

4.7.2 Geology, Soils, and Geologic Hazards

4.7.2.1 Geology and Soils

Renovation of the existing Main Manufacturing Building at KCP would have little or no impact on geology and soils, because activities would largely be limited to installing concrete spill containment curbing within the existing warehouse, and the existing structures are within a previously disturbed industrial complex. The structure has sufficient storage space and existing perimeter security, which would limit the need for facility additions. The facility has previously undergone structural upgrades for seismic safety.

As described in Chapter 3, Section 3.6.2.2, some areas of soil contamination have been identified at KCP. Any contamination identified during building renovation would be remediated as necessary. Due to the vintage of the building space, refurbishment or enhancement of some building systems (e.g., fire protection) may be necessary and could necessitate some trenching and other temporary ground-disturbing activity around the existing structure. The depth of excavation required would be about 0.6 meters (2 feet) wide by 1.2 meters (4 feet) deep, where necessary for utility trenching. Adherence to standard best management practices for soil erosion and sediment control (e.g., use of sediment fencing, staked hay bales, mulching and geotextile matting, and rapid reseeding) in any disturbed areas would serve to minimize any soil erosion and loss. There would be no additional impact on geology and soils from operations.

4.7.2.2 Geologic Hazards

Most of Missouri's earthquake activity has been concentrated in the southeastern corner of the state, which is associated with the New Madrid seismic zone (see Chapter 3, Section 3.6.2.3). In contrast, the northwestern portion of the state, where KCP is located, is seismically stable. Nevertheless, it is estimated that the maximum ground shaking across northwestern Missouri and KCP from the great New Madrid earthquake sequence of 1811–1812 was in the MMI VI to VII range. MMI VI shaking typically causes only slight damage to ordinary structures, while MMI VII shaking can cause moderate damage in well-constructed, ordinary structures but is not expected to damage facilities that have been specially designed or upgraded to withstand the assessed hazard (see Appendix B, Table B–4). The predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.05 *g*. Peak ground motion in this range would be felt but is not expected to cause damage to either ordinary or specialized structures. As further described in Appendix B, Section B.3.2, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. The existing KCP warehouse has been seismically upgraded. Thus, the building is not expected to suffer substantial structural damage from the predicted earthquake ground motion at the site. The predicted ground motion would also be unlikely to cause a breach in mercury containers from structural failure. An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.7.9.2.

4.7.3 Water Resources

4.7.3.1 Surface Water

Modification of the existing structure to support mercury storage would not have any impact on surface water features, including the Blue River and Indian Creek, which border the site complex. Renovation activities are expected to be confined to the interior of the facility, although limited, temporary disturbance of areas around the exterior of the warehouse is not out of the question. Should exterior ground-disturbing activity be necessary, appropriate soil erosion and sediment control measures and spill prevention and waste management practices would be employed to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts, as noted in Section 4.3.3.1.

Water requirements to support facility renovations at KCP would be very small compared with construction of a new mercury storage facility. It is anticipated that any water needed could be obtained from the existing municipal water system that serves KCP. During operations, it is expected that water use would be relatively small under normal operations and limited to that required to serve the potable and sanitary needs of the storage facility workforce. Total annual consumption is estimated to be no more than about 88,500 liters (23,375 gallons). Moreover, there may be little incremental water use at KCP, as use of the warehouse facilities for elemental mercury storage would substitute for existing operational activities, especially if mercury storage staff are drawn from the existing KCP workforce.

As previously noted in Section 4.3.3.1, design, construction, and operation of the mercury storage facility would incorporate structural controls and practices to prevent the release of elemental mercury and to prevent any spills or other releases, should they occur as a result of abnormal operating conditions, from reaching soils or surfaces where they could be conveyed to surface waters or groundwater. The existing building space at KCP would be modified as necessary to meet these requirements as summarized in Appendix C, Table C–1. Facility operations would be conducted in accordance with an ICP and SPCC plan, or equivalent plans as mandated by state requirements governing the facility, which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

While the Blue River and Indian Creek are subject to frequent flooding due to intense urban development, seasonal floods have typically only affected vacant portions of the Bannister Federal Complex to the northeast of the proposed mercury storage location. A flood protection system completed in 1994 is designed to prevent 500-year floods from reaching any of the structures located within the site complex (see Chapter 3, Section 3.6.3.1). However, the flood protection system is not a passive one. Effective operation of the system requires manual closing of floodgates and placement of stop logs and sandbags. It has been estimated that it would take 32 workers approximately 4 hours to close the floodgates. DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. Use of the KCP Main Manufacturing Building for mercury storage would require that the structure and flood protection system be evaluated and further upgraded, as necessary, and that any additional appropriate stormwater management controls be incorporated to safely collect and convey stormwater from the facility while minimizing washout, soil erosion, and offsite water quality impacts.

There would be no discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via the existing connection to the Kansas City sanitary sewer system (see Section 4.7.8). As the facility would be operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.7.3.2 Groundwater

Facility renovation is not expected to have any impact on groundwater hydrology or existing contaminant plumes beneath KCP as activities would generally be confined to the interior of the renovated structures. As necessary, identified contaminant plumes would be evaluated prior to renovation to assess the potential for impacts.

4.7.4 Meteorology, Air Quality, and Noise

4.7.4.1 Meteorology

Meteorological events can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events were considered in selecting the accident events evaluated in Section 4.7.9.2. As previously detailed and described in Section 4.3.4.1, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including meteorological events. RCRA-permitted facilities, such as the proposed mercury storage facility, must also meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31, and applicable state RCRA requirements to prevent the release of stored wastes. As the KCP region is susceptible to regular occurrence of high winds, mercury storage would be housed in facilities modified and rated to withstand the potential for high winds and other meteorological events, such as heavy snow.

4.7.4.2 Air Quality

Negligible short-term air quality impacts with little or no measurable effect on air quality would result from modification of the existing Main Manufacturing Building at KCP. Criteria and toxic air pollutant emissions from construction equipment (see Appendix C, Section C.2.3) would be limited to those from construction employee vehicles and work trucks; no heavy equipment is expected to be used.

Emissions during KCP mercury storage operations would be very small, consisting of those from employee vehicles, trucks or trains, semiannual testing of emergency generators, and possibly mercury vapor from any spills or from mercury containers. No localized emissions from space heating are anticipated associated with mercury storage facility operations, as electric heating is anticipated for areas requiring climate control. Although the KCP Main Manufacturing Building is heated by natural gas, it is anticipated that facility modifications would include isolating the mercury storage area from the existing heating system. Compliance with the conformity regulations is discussed in Appendix B, Section B.5.1.2.

Exposures to mercury vapor could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers (those outside the storage facility) or nearby offsite individuals. Appendix D, Section D.4.1, presents a conservative analysis that shows that for a long-term, undetected slow leak inside the proposed mercury storage facility, the predicted long-term average concentration in the building wake never exceeds 80 nanograms per cubic meter. The EPA threshold for chronic exposure to airborne mercury is 300 nanograms per cubic meter, so slow releases of mercury would have a negligible effect on noninvolved workers and the public, with a corresponding negligible risk.

Air quality impacts from transportation of mercury to KCP would be similar to those discussed in Section 4.3.4.2. Truck and rail transport are discussed in more detail in Section 4.7.9.3. Estimated emissions from truck and rail transportation are presented in Tables 4–15 and 4–16.

Annual carbon dioxide emissions would be highest during the year 2013, at approximately 145 metric tons (160 tons) per year, as a result of moving elemental mercury to the site by truck; these annual truck emissions would be greater than the rail emissions from shipping mercury. As similarly noted in Section 4.3.4.2, such emissions would minimally contribute to global and U.S. annual emissions of carbon dioxide. Global climate change is further discussed in Section 4.11.4.2.

4.7.4.3 Noise

Short-term noise impacts at KCP could result from modification of warehouse space to accommodate mercury storage. These impacts would include some increase in traffic to the site and an increase in noise resulting from construction employee vehicles and some equipment delivery. These impacts would occur during the 6-month construction period. Since the nearest noise-sensitive receptor, a residence, is located 150 meters (500 feet) from the site, there would be a small increase in noise levels at this location; however, because these activities would be indoors, noise impacts would be negligible. The estimated average noise level during the daytime (8-hour equivalent sound level) from one item of construction equipment operating at this distance is estimated to be 52 dBA, which might result in an increase in average noise levels at the nearest residence. The maximum sound level from operation of this equipment could be about 65 dBA, which would likely be heard above existing daytime noise at the nearest residence. The increase in traffic noise levels along access routes from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on routes such as East Bannister Road.

Short-term noise impacts could occur along East Bannister Road as a result of increased truck activity during the period that elemental mercury is transported to the site. The resulting increase in day-night average noise levels along such routes as East Bannister Road is expected to be less than 1 dBA. As such, the change in truck traffic is not expected to result in a change in noise levels along this route or other shipping routes that would be noticeable to the public or result in an increase in annoyance. If the mercury is shipped by rail instead of by truck, some additional rail activity from placing railcars at the site could result in some increase in noise levels near the site.

Operation of the mercury storage facility at KCP is expected to have a negligible impact on noise levels around the site since the noise sources would be limited to a few employee vehicles, occasional delivery trucks, and semi-annual testing of the emergency generator.

4.7.5 Ecological Resources

4.7.5.1 Terrestrial Resources

KCP constitutes an industrial area with little habitat available. Thus, little native vegetation remains within the site. Further, since an existing building would be used for mercury storage, there would be no impacts on terrestrial resources from internal facility modifications and subsequent operations.

4.7.5.2 Wetlands and Aquatic Resources

No wetlands or aquatic resources exist within the facility complex or would be affected by activities to upgrade the existing building to house the proposed mercury storage facility. Thus, no impacts on wetlands or aquatic habitats are expected.

4.7.5.3 Threatened and Endangered Species

No threatened or endangered species are known or are expected to exist within the area of the Bannister Federal Complex. Therefore, no impacts on threatened or endangered species are expected from facility modifications or normal operations. Consultations have been initiated with the appropriate U.S. Fish and Wildlife Service office and state wildlife agency to support this analysis (see Chapter 5, Section 5.4).

4.7.6 Cultural and Paleontological Resources

4.7.6.1 Prehistoric Resources

There would be no impact on prehistoric resources at KCP from use of the existing warehouse for mercury storage. A 2007 cultural resource assessment of the Bannister Federal Complex and areas adjacent to KCP identified no prehistoric resources. Further, KCP has been previously disturbed by construction of the existing complex, thus the probability of finding intact prehistoric resources is low (see Chapter 3, Section 3.6.6.1).

4.7.6.2 Historic Resources

Use of the existing warehouse at KCP for mercury storage is not expected to have any impact on historic resources or NRHP eligibility (see Chapter 3, Section 3.6.6.2). DOE has initiated consultation with the Missouri SHPO to support this analysis (see Chapter 5, Section 5.4).

4.7.6.3 American Indian Resources

There would be no impact on American Indian resources at KCP from use of the existing warehouse for mercury storage. Most of the historic American Indian villages in the region (i.e., Osage, Missouri, and the Kansa) were not located in the KCP area but south on the Osage River or north and east along the Mississippi. The 2007 cultural resource assessment indicated a low probability of finding any American Indian sites within the KCP area (see Chapter 3, Section 3.6.6.3).

4.7.6.4 Paleontological Resources

Since KCP is located on alluvium from the Blue River floodplain, which is bordered by outcrops of Pennsylvanian age shale, there is a possibility that fossils may exist (see Chapter 3, Section 3.6.6.4), although no unique paleontological resources are known. However, use of the existing KCP facility for mercury storage would have no impact on these outcrops.

4.7.7 Site Infrastructure

4.7.7.1 Ground Transportation

Facility modifications of the existing Main Manufacturing Building and operations of the facility to support mercury storage at KCP are not expected to appreciably increase demands on the road and rail systems leading to the site. Projected peak traffic volumes and the number of shipments associated with mercury storage operations are presented in Section 4.7.11.

4.7.7.2 Electricity, Fuel, and Water

Utility resource demands and associated assumptions for construction and operation of a new mercury storage facility at KCP would generally be similar to those described in Section 4.3.7.2. However, construction requirements would likely be less than those for GJDS, as activities would be limited to modifying and refurbishing the existing Main Manufacturing Building (Building 1) at KCP to support mercury storage. However, utility demands, such as electrical energy consumption for operation of the mercury storage facility within Building 1 (see Chapter 2, Figure 2–19), could be slightly greater than those for a single, new storage facility due to inefficiency associated with utilizing part of such a large structure to house the mercury storage mission. The projected annual operation electricity requirements to support mercury storage (253 megawatt-hours) would be negligible (0.2 percent increase) when compared with the current annual sitewide electricity usage (see Chapter 3, Section 3.6.7).

Natural gas, with fuel oil backup, is used at KCP. Diesel fuel required (606 liters [160 gallons]) for the operation of the mercury storage facility within Building 1 would be a small percentage (3 percent) of the fuel oil used annually at KCP as a backup fuel source. This volume would be resupplied from local or regional vendors as needed.

Water requirements for facility modifications and operation of a new mercury storage facility within Building 1 also would be negligible compared with KCP's sitewide water usage, which is supplied by the Kansas City municipal system. Water requirements during construction (1,270,000 liters [336,000 gallons]) would temporarily increase site water consumption by 0.2 percent. The annual water demand for mercury storage operations (88,500 liters [23,400 gallons]) would constitute about 0.02 percent of KCP's current water use.

4.7.8 Waste Management

Modification of the existing building at KCP for mercury storage is expected to generate much less than the 271 cubic meters (355 cubic yards) of nonhazardous solid waste and 9,850 liters (2,600 gallons) of nonhazardous sanitary liquid waste projected to be generated during construction of a new facility. Nevertheless, maximum waste-generation volumes are negligible compared with the current waste generation activities at KCP, as described in Chapter 3, Section 3.6.8.1. It is assumed that construction-generated solid waste would be disposed of off site at the Johnson County Mixed Solid Waste Landfill. Portable toilet facilities, serviced by a local or regional contractor, would be used to serve the sanitary needs of the construction workforce.

Operation of a new mercury storage facility within the Main Manufacturing Building is expected to generate an estimated 910 55-gallon (208-liter) drums of hazardous waste over the 40-year period of analysis, as further described in Section 4.3.8. This equates to about 23 55-gallon drums, or approximately 5 cubic meters (6.5 cubic yards) annually. This estimated yearly hazardous waste generation rate is minor (about 6 percent) compared with the 17 metric tons (18.7 tons) of hazardous waste generated and managed each year at KCP (see Chapter 3, Section 3.6.8.1). If existing DOE operations at KCP end, the estimated volume of mercury-contaminated waste generated from mercury storage operations within the Main Manufacturing Building would still be relatively small compared with most RCRA TSD facility operations. KCP is currently a listed hazardous waste large-quantity generator. No changes in KCP's generator status would be required to operate the proposed mercury storage facility.

Facility operations would also generate an estimated 59,000 liters (15,600 gallons) of nonhazardous sanitary waste annually. This yearly generation rate is miniscule (0.02 percent) compared with the estimated 326 million liters (86 million gallons) of sanitary and pretreated industrial wastewater that KCP discharges to the Kansas City municipal sewer system each year (see Chapter 3, Section 3.6.3.1).

DOE and the U.S. General Service Administration continue to investigate and remediate soil and groundwater contamination at several sites across the Bannister Federal Complex. Neither construction nor operation of the proposed mercury storage facility is anticipated to impact resources (e.g., funding, labor, facilities, and equipment) associated with current and/or future site environmental restoration efforts.

4.7.9 Occupational and Public Health and Safety

Mercury would be stored in the existing Bannister Federal Complex, where Honeywell operations occupy about 279,000 square meters (3 million square feet) of an even larger building, which has a height of about 10 meters (33 feet). The mercury storage area itself would be approximately 14,000 square meters (150,000 square feet), a small fraction of the total area. Thus, the building wake is unrelated to the size of the mercury storage area. It is arbitrarily assumed to be of approximately 134 by 134 meters (500 by 500 feet), but would likely be much larger.[22] Most of the risks that pertain to KCP are the same as those discussed in Sections 4.2.9.1 through 4.9.2.5.

4.7.9.1 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites. Consequences to the involved worker are predicted to be negligible because involved workers would never be exposed to airborne concentrations of mercury vapor above the ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. This corresponds to keeping exposures to the involved worker in the SL-I (negligible) range.[23] This would be achieved by adherence to good operating practices, in particular attention to ventilation, inspection, monitoring, and use of PPE, as described in the *Interim Guidance* (DOE 2009c). Therefore, the risks to involved workers would be negligible during normal operations.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.1.2, shows that the predicted long-term average concentration in the building wake at KCP is about 1.0×10^{-5} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and the public would be negligible.

[22] The simple building wake approximation in Appendix D, Table D–28, tends to break down if the building becomes very wide.

[23] For definitions of SLs for various types of exposures, see Section 4.2.9.1.1 and Appendix D, Section D.1.1.1. For a discussion of how risk is assessed, see Sections 4.2.9.1.1 and D.1.1.2.

4.7.9.2 Facility Accidents

Section 4.2.9.1.4 provides a discussion of facility accident risks that applies to all sites. Table 4–3 contains a summary of the likelihood of occurrence of candidate facility accident scenarios initiated by failures of engineered systems, human errors, or external events, and Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible frequency from Table 4–3. The analysis of the scenarios at KCP is similar to that for the same scenarios in Section 4.2.9.1.4. The different dimensions of the buildings affect the building wake calculations, but do not affect conclusions about the magnitude of the risks. However, of all seven candidate sites, KCP is the one that is, without doubt, an urban site. This has the effect of increasing the ambient turbulence intensity in any specific weather condition, thus increasing the predicted rate of dilution and decreasing the predicted distance the plume would travel downwind before diluting below any specific benchmark. The atmospheric dispersion calculations show that, for the outside earthquake spill, the maximum distance downwind to which a concentration greater than AEGL-3 could be exceeded is less than 100 meters (330 feet); for AEGL-2, the corresponding distance is also less than 100 meters (330 feet); and for 0.1 × AEGL-2, it is about 340 meters (1,115 feet). The distance to the closest site boundary from the proposed storage location within KCP is approximately 350 meters (1,150 feet), so consequences and corresponding risks to members of the public would be negligible. Table 4–47 summarizes the results for all accidental spills of elemental mercury on site (without fire).

Table 4–47. Summary of Risks of all Onsite Elemental Mercury Spill Scenarios – Kansas City Plant

Scenario	Frequency	Consequence	Risk
Spills Inside Building[a]			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for all inside spills
Noninvolved worker	FL-II – FL-III	SL-II	N for all inside spills
Member of the public	FL-II – FL-III	SL-II	N for all inside spills
Spills Outside Building			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for outside earthquake spill; N for all other outside spills
Noninvolved worker	FL-II – FL-III	SL-I – SL-II	
Member of the public			
1-metric ton container spill	FL-II	SL-I	N
Single-pallet spill	FL-III	SL-I	N
Earthquake with building collapse[b]	FL-III	SL-I	N

[a] The inside spill scenarios considered are single flask, single pallet, triple pallet, 1-metric-ton container, full spill tray under a pallet, and earthquake with intact building walls.

[b] This scenario encompasses the risk from floods, high winds, and tornadoes.

Key: FL=frequency level; L=low; N=negligible, SL=severity level.

4.7.9.3 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury over a 40-year period of analysis to KCP. These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. The results of the analysis are shown in Table 4–48.

Table 4–48. Frequency Analysis of Truck and Railcar Accidents – Kansas City Plant

Scenario	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires in Dry Weather (per year)	Frequency of Accidents with Fires in Wet Weather (per year)	Frequency of Accidents with Death[a] (per year)
Truck – Scenario 1	754,705	9.7×10^{-3}	1.5×10^{-3}	1.2×10^{-4}	3.8×10^{-6}	4.3×10^{-4}
	–	Moderate – FL-III	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Truck – Scenario 2	1,385,734	1.5×10^{-2}	2.8×10^{-3}	2.2×10^{-4}	7.0×10^{-6}	7.8×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Railcar	250,966	1.6×10^{-3}	7.2×10^{-6}	1.6×10^{-5}	5.1×10^{-7}	1.0×10^{-4}
	–	Moderate – FL-III	Low – FL-II	Low – FL-II	Negligible – FL-I	Moderate – FL-III

[a] Fatality caused by mechanical impact, not by exposure to mercury.
Note: To convert miles to kilometers, multiply by 1.60934.
Key: FL=frequency level.

The above frequencies are for an accident anywhere along any of the transportation routes taken over a 40-year period of analysis to KCP. A crash that occurs in the last mile of the trip was used to estimate the frequency of an onsite crash in the vicinity of the storage building. The frequency of accidents with spills would be low under both truck scenarios and negligible under the Railcar Scenario. The frequency of crashes with fires or death would be negligible under all scenarios.

With respect to transportation accidents involving spills of mercury, the following four scenarios were considered:

- Spill of elemental mercury onto the ground without fire
- Spill of elemental mercury directly into water
- Fire with mercury spill
  - In dry weather
  - In wet weather

4.7.9.3.1 Transportation Accident with Spill of Elemental Mercury onto the Ground

Section 4.2.9.1.5 contains an analysis of spills of elemental mercury onto the ground following a truck or railcar crash without fire. A conservative estimate of the rate of evaporation from the resulting pool and the subsequent atmospheric dispersion (applicable to all sites) shows that a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that individual could only be exposed to such concentrations if the crash occurs along a specific 680-meter (2,230-foot) stretch of any of the routes to KCP. The same reasoning as is used in the generic discussion in Section 4.2.9.1.5 shows that the risk to a member of the public from transportation spills onto the ground without fire en route to KCP would be negligible under Truck Scenario 1 and the Railcar Scenario, but low under Truck Scenario 2.

4.7.9.3.2 Transportation Accident with Spill of Elemental Mercury Directly into Water

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors and humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

Table 4–49 summarizes the risks to human receptors arising from spillages of elemental mercury during transportation to KCP.

Table 4–49. Summary of Transportation Risks to Human Receptors, Spills of Elemental Mercury onto the Ground or into Water, Kansas City Plant

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto the Ground			
Frequency[a]	FL-I	FL-II	FL-I
Consequence	SL-II	SL-II	SL-II
Risk	*Negligible*	*Low*	*Negligible*
Spill into Water			
Frequency[b]	FL-III	FL-III	FL-II
Consequence	SL-I – SL-II	SL-I – SL-II	SL-I – SL-II
Risk[c]	*Negligible to low*	*Negligible to low*	*Negligible to low*

[a] Frequency at which that spill occurs close enough to a specific individual to cause Acute Exposure Guideline Level 2 to be exceeded.

[b] Frequencies of railcar or truck crashes with spills from Table 4–48.

[c] These estimates of risk are subject to large uncertainty.

Key: FL=frequency level; SL=severity level.

4.7.9.3.3 Transportation Accident with Fire

The fire calculations are described in Section 4.2.9.1.5. Table 4–50 shows the results of the calculations of acute-inhalation risks from transportation accidents with fires on transportation routes to KCP. The table encompasses both truck scenarios and the Railcar Scenario.

Note that the risks presented in the above scenario are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

Table 4–50. Summary of Acute-Inhalation Risks to Human Receptors, Accidents with Fires, Transportation Routes to Kansas City Plant

	Both Truck Scenarios with Wooden Pallets	Railcar Scenario with Wooden Pallets
Frequency[a]	FL-III	FL-II
Consequence[b]	SL-II	FL-II
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.

[b] The highest consequence in any weather condition.

Key: FL=frequency level; SL=severity level.

The analyses performed for this EIS show that, under all fire scenarios listed in Table 4–50, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

Table 4–51 summarizes the human health risks associated with all transportation spills.

Table 4–51. Summary of Transportation Risks to Human Receptors, Kansas City Plant

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto ground	Negligible	Low	Negligible
Spill into water	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty
Spill with fire – inhalation, wooden pallets	Low	Low	Low
Spill with fire – dry and wet deposition, wooden pallets	Negligible	Negligible	Negligible

4.7.9.4 Intentional Destructive Acts

The discussion of IDAs is the same for all sites and transportation routes (see Section 4.2.9.1.6).

4.7.10 Ecological Risk

There is a generic analysis of ecological risk in Section 4.2.10.1, which applies without modification to KCP.

4.7.10.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike inorganic compounds formed from divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation are considered to be negligible at all storage sites and along all transportation routes.

4.7.10.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2,

which also makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to ecological receptors could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

4.7.10.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5, and Section 4.2.10.1.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. Table 4–52 summarizes the FL, consequence level, and risk to ecological receptors in the case of a truck crash with pallet fire and no rain (dry deposition) and applies to all candidate storage sites.

Table 4–52. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, Kansas City Plant

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level	Risk[c]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Tables D–12 and D–13.

[b] Applies to both Truck Scenarios 1 and 2.

For the interpretation of Table 4–52, see Section 4.2.10.1.3. The risks of other potential fire scenarios are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–53.
- For railcar crashes with wooden pallet fires and without rain (dry deposition), see Table 4–54.
- The predicted frequency of railcar crashes with pallet fires and rain is negligible, so risks would be negligible and no summary table is presented.

Table 4–53. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, Kansas City Plant

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Table D–16.
[b] Applies to both Truck Scenarios 1 and 2.

Table 4–54. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, Kansas City Plant

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of railcar crashes with fires from Appendix D, Table D–14.

4.7.10.4 Consequences – Intentionally Initiated Fire with Mercury Spill

The consequences of intentionally initiated fires to ecological receptors are the same for all sites (see Section 4.2.10.1.4).

4.7.11 Socioeconomics

Under this alternative, existing space in KCP would be modified for long-term storage of elemental mercury. Employment during renovations is expected to be less than that estimated for constructing a new facility, as described in Section 4.3.11. Appendix C, Table C–1, summarizes the necessary modifications to bring the facility up to specifications to support mercury storage. Operation of the facility is estimated to require approximately eight individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and approximately five individuals thereafter.

Operation of the facility is not expected to generate substantial direct or indirect employment. The largest estimated increase in employment would only increase the ROI workforce by 0.001 percent. Thus, negligible impacts on socioeconomic conditions (i.e., overall employment, population trends, and traffic) in the ROI would result from implementing this alternative.

Construction-related transportation needed to modify the existing facility, including employee vehicle trips and equipment and materials shipments, is not expected to adversely impact traffic conditions on roads leading to the site. It is likely that significantly fewer than the 45 vehicles estimated to construct a new mercury storage facility would be needed to support facility modifications (see Section 4.3.11). Therefore, construction-related transportation is expected to increase the average annual daily traffic count on Bannister Road by no more than 0.2 percent.

Transportation impacts during the operations phase would include employee vehicle trips and shipments of elemental mercury to the site for storage. Appendix C, Section C.1, provides an estimate of the number of shipments by truck. The additional vehicles due to facility operations are not expected to noticeably increase traffic volumes on roads leading to the site. The greatest impact would be during the first 2 years of operations, when it is estimated that approximately 11 vehicles a day could increase the average annual daily traffic count on Bannister Road by less than 0.1 percent. During this time, it is estimated that up to 78 shipments would be made each year. Approximately 96 percent of the additional vehicles would be attributed to employee transportation.

4.7.12 Environmental Justice

An analysis of populations in census block groups found that, of the 671 block groups within the 16-kilometer (10-mile) radius of KCP, 172 contained a disproportionately high number of minority individuals, 2 contained a disproportionately high number of low-income individuals, and 74 contained a disproportionately high number of both minority and low-income individuals. A total of 423 block groups did not contain a disproportionately high number of minority or low-income individuals. Of the 41 census block groups within the 3-kilometer (2-mile) radius of KCP, 16 contained a disproportionately high number of minority individuals and 1 contained a disproportionately high number of both minority and low-income individuals. Twenty-four block groups within this ROI did not contain a disproportionately high number of minority or low-income individuals (see Chapter 3, Section 3.6.11). As discussed in Chapter 3, Section 3.6.1.1, and Section 4.7.1, the surrounding area includes residential, commercial, industrial, and public use lands; there would be no impacts on land use as a result of implementing the KCP alternative. Impacts on air quality under this alternative would be negligible, as discussed in Section 4.7.4.2. No impacts on ecological resources would occur under this alternative, as discussed in Section 4.7.5. There is a low probability of discovering American Indian archaeological sites in the KCP area; thus, there would be negligible impacts on American Indian cultural resources, as discussed in Chapter 3, Section 3.6.6.3, and Section 4.7.6.3. A negligible change in socioeconomic conditions would result under this alternative, as discussed in Section 4.7.11.

An analysis of populations that may be susceptible due to disproportional human health impact factors within the area is presented in Chapter 3, Section 3.6.11. As discussed in Section 4.7.9, implementing the KCP alternative would result in negligible offsite human health risks from mercury emissions during normal operations and facility accidents. As discussed in Section 4.7.9.3, transportation accidents have been identified as posing a negligible-to-low human health risk following dry deposition onto the ground or into water bodies. If a transportation accident were to occur at or near the entrance to the facility, it would be reasonable to conclude that the consequences to human health of that accident would be borne by a disproportionately high number of minority and low-income individuals who reside in areas close to KCP.

4.8 LONG-TERM MERCURY MANAGEMENT AND STORAGE AT SAVANNAH RIVER SITE

Under this alternative, a new mercury storage facility would be constructed at DOE's SRS. SRS occupies approximately 80,290 hectares (198,400 acres) and is located approximately 24 kilometers (15 miles) southeast of Augusta, Georgia, and 19 kilometers (12 miles) south of Aiken, South Carolina. Within this site, the new mercury storage facility would be built in E Area, as further described in Chapter 2, Section 2.4.7.

4.8.1 Land Use and Visual Resources

Negligible impacts on land use and visual resources are expected from construction and operation of a new mercury storage building within E Area of SRS. Construction of this new facility would require the disturbance of approximately 3.1 hectares (7.5 acres) for building construction and laydown areas (see Chapter 2, Section 2.3.1). The proposed mercury storage facility would be located in the north-central portion of E Area. This area has been subject to disturbance from past operations. The completed facility boundary would similarly encompass approximately 3.1 hectares (7.5 acres) within its fenced perimeter, which corresponds to approximately 2.3 percent of the land comprising E Area. The footprint of the mercury storage building would occupy approximately 1.6 hectares (3.9 acres) of this area. Mercury storage operations would be compatible with current DOE waste management and storage operations conducted in this area. The low profile of the new building is not expected to affect the overall viewshed of this area from on- or offsite vantage points. Therefore, mercury storage operations would not result in a change to BLM VRM classifications.

4.8.2 Geology, Soils, and Geologic Hazards

4.8.2.1 Geology and Soils

Construction of a new mercury storage facility in E Area at SRS would generally have the same direct impacts on geology and soils in terms of land area disturbed, depth of excavation, and geologic resource demands as described in Section 4.3.2.1. Geologic resources, including concrete and coarse aggregate (gravel) totaling 8,640 cubic meters (11,300 cubic yards), would be required for construction (see Appendix C, Table C–2) and would be procured from local and/or regional commercial vendors. Trenching may be necessary to install foundation footers or to connect the new mercury storage facility with existing utilities. Locations near existing structures and many open areas within the E Area perimeter have largely been disturbed by site clearing, grading, fill placement, and soil compaction. Excavation in E Area would encounter clayey and silty quartz sand sediments up to 18 meters (60 feet) thick (see Chapter 3, Section 3.7.2). No special construction techniques should be necessary to work in these materials. Nevertheless, a site survey and geotechnical study would be conducted to confirm site geologic characteristics for facility siting and engineering purposes.

Natural and disturbed soils in E Area could be more prone to erosion. However, adherence to standard best management practices for soil erosion and sediment control during construction would serve to minimize soil erosion and loss (see Section 4.3.2.1).

Due to the potential risk of excavating contaminated soils, the construction area would also be surveyed prior to any ground disturbance. Any contamination would be remediated as necessary. During operations, the previously disturbed areas would not be subject to long-term soil erosion and temporarily disturbed areas would be revegetated. There would be no additional impact on geology and soils from operations.

4.8.2.2 Geologic Hazards

The Atlantic Coastal Plain tectonic province, in which SRS is located, is characterized by generally low seismic activity. SRS has been affected by distant earthquakes that have occurred within the state, including the Charleston earthquake of 1886, which is estimated to have produced a peak ground acceleration across SRS of 0.1 *g* and shaking of MMI VII to VIII (see Chapter 3, Section 3.7.2.3). MMI VII shaking can cause moderate damage in well-constructed, ordinary structures but is not expected to damage facilities that have been specially designed or upgraded to withstand the assessed hazards. MMI VIII motion can cause slight damage in specially designed structures and considerable damage in ordinary structures (see Appendix B, Table B–4). The predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.17 *g*. Peak ground motion in this range is only expected to cause slight to moderate damage to ordinary structures and negligible damage to structures designed in accordance with the assessed hazard. This magnitude of ground motion is also supported by the historical record for the area. As further described in Appendix B, Section B.3.2, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. A newly designed and constructed mercury storage facility in E Area would be unlikely to suffer substantial structural damage from the predicted earthquake ground motion at the site. Thus, such ground motion would be unlikely to cause a breach in mercury containers from structural failure.

An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.8.9.2.

4.8.3 Water Resources

4.8.3.1 Surface Water

Facility construction activities are not expected to have any direct impact on surface water features, including Upper Three Runs Creek and its 100-year floodplain immediately to the north and the headwaters to Fourmile Branch located just to the south of E Area. While stormwater runoff from the construction site would be unlikely to reach either stream, appropriate soil erosion and sediment control measures and spill prevention and waste management practices would be employed to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts, as noted in Section 4.3.3.1. All construction and other ground-disturbing activities would be conducted in accordance with SRS's NPDES General Permit for stormwater discharges associated with construction activity (see Chapter 3, Section 3.7.3.1).

Water demands for construction and operation of a new mercury storage facility in E Area would be similar to those described in Section 4.3.3.1. It is anticipated that water for construction and operations would be supplied via E Area's groundwater supply system. Total annual consumption is estimated to be no more than about 88,500 liters (23,375 gallons). Depending on the number of personnel drawn from the existing DOE workforce at SRS, water use by dedicated mercury storage facility staff could be greatly reduced. These construction and operations volumes are relatively small compared with the volume of water currently withdrawn and used by DOE at SRS (see Section 4.8.7.2).

As previously noted in Section 4.3.3.1, design, construction, and operation of the mercury storage facility would incorporate structural controls and practices to prevent the release of elemental mercury and to prevent any spills or other releases, should they occur as a result of abnormal operating conditions, from reaching soils or surfaces where they could be conveyed to surface waters or groundwater. Facility operations would be conducted in accordance with an ICP and SPCC plan, or equivalent plans as mandated by state requirements governing the site, which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

E Area facilities are located outside the 100-year floodplain, and soils across the area are not subject to seasonally high water tables, based on the soils analysis. Nevertheless, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. The potential for sheet flooding and other precipitation effects (e.g., scour and erosion) would be included in the design of foundations, walls, roof structures, and drainage and stormwater management systems for the storage facility. Consequently, the new mercury storage facility would incorporate appropriate stormwater management controls to safely collect and convey stormwater from the facility while minimizing washout, soil erosion, and offsite water quality impacts.

There would be no direct discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via the existing E Area sanitary waste system (see Section 4.8.8).

4.8.3.2 Groundwater

Facility construction is not expected to have any impact on groundwater hydrology or existing contaminant plumes beneath the area due to the depth to groundwater and the shallow depth of excavation. As the facility would be designed and operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.8.4 Meteorology, Air Quality, and Noise

4.8.4.1 Meteorology

Meteorological events can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events were considered in selecting the accident events evaluated in Section 4.8.9.2. As previously detailed and described in Section 4.3.4.1, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including meteorological events. RCRA-permitted facilities, such as the proposed mercury storage facility, must also meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31, and applicable state RCRA requirements to prevent the release of stored wastes. As the SRS region is susceptible to regular occurrence of high winds and occasional hurricanes and tornadoes, the new mercury storage facility in E Area would be designed and constructed as appropriate to minimize the risk from meteorological phenomena.

4.8.4.2 Air Quality

Minor short-term air quality impacts would result from construction of a mercury storage building at SRS. These impacts would include an increase in criteria and toxic air pollutant concentrations from construction equipment emissions (see Appendix C, Section C.2.3). These emissions would occur over a 6-month construction period and are not expected to result in exceedance of air quality standards.

Emissions from operations of the new mercury storage facility would be very small, consisting of emissions from employee vehicles, trucks or trains, semiannual testing of emergency generators, and possibly mercury vapor from any spills or from mercury containers. No localized emissions from space heating are anticipated associated with mercury storage facility operations, as electric heating is anticipated for areas requiring climate control. Compliance with the conformity regulations is discussed in Appendix B, Section B.5.1.2.

Exposures to mercury vapor could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers (those outside the storage facility) or nearby offsite individuals. Appendix D, Section D.4.1, presents a conservative analysis that shows that for a long-term, undetected slow leak inside the proposed mercury storage facility, the predicted long-term average concentration in the building wake never exceeds 80 nanograms per cubic meter. The EPA threshold for chronic exposure to airborne mercury is 300 nanograms per cubic meter, so slow releases of mercury would have a negligible effect on noninvolved workers and the public, with a corresponding negligible risk.

Air quality impacts from transportation of mercury to SRS would be similar to those discussed in Section 4.3.4.2. Truck and rail transport are discussed in more detail in Section 4.8.9.3. Estimated emissions from truck and rail transportation are presented in Tables 4–15 and 4–16.

Annual carbon dioxide emissions would be highest during construction. The second highest year of carbon dioxide emissions would be the year 2013, at approximately 113 metric tons (124 tons) per year, as a result of moving mercury to the site by truck; these annual truck emissions would be greater than rail emissions from shipping mercury. As similarly noted in Section 4.3.4.2, such emissions would minimally add to global and U.S. annual emissions of carbon dioxide. Global climate change is further discussed in Section 4.11.4.2.

4.8.4.3 Noise

Short-term noise impacts at SRS could result from construction of a new mercury storage facility in E Area. These impacts would include some increase in traffic to the site and an increase in noise resulting from construction employee vehicles, equipment delivery, and heavy equipment operation. These impacts would occur during the 6-month construction period. Since the nearest noise-sensitive receptor, a residence, is located more than 9.7 kilometers (6 miles) from the site, the increase in noise levels at this location from construction equipment is expected to be negligible. The estimated average noise level during the daytime (8-hour equivalent sound level) from one item of construction equipment operating at this distance is estimated to be well below background sound levels. The increase in traffic noise levels along South Carolina Highways 19 and 25 from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on Highways 19 and 125.

Short-term noise impacts could occur along South Carolina Highways 19 and 125 as a result of increased truck activity during the period that elemental mercury is transported to the site. The resulting increase in day-night average noise levels along Highways 19 and 125 is expected to be less than 1 dBA. As such, the change in truck traffic is not expected to result in a change in noise levels along these routes or other shipping routes that would be noticeable to the public or result in an increase in annoyance. If the mercury is shipped by rail instead of by truck, some additional rail activity from placing railcars at the site could result in some increase in noise levels near the site.

Operation of the mercury storage facility at SRS is expected to have a negligible impact on noise levels around the site since the noise sources would be limited to a few employee vehicles, occasional delivery trucks, and semiannual testing of the emergency generator.

4.8.5 Ecological Resources

4.8.5.1 Terrestrial Resources

Construction of the proposed new mercury storage facility in E Area would result in ground-disturbing activities. Habitat in the immediate vicinity of E Area consists of disturbed land within a developed setting. Little native vegetation remains within the area of the proposed mercury storage facilities; impacts would be limited to introduced species in an already disturbed landscape. Adherence to best management practices for land cover management (e.g., washing down construction equipment and vehicle tire treads) would serve to reduce the chance of introducing invasive plant species. Impacts on animals from construction would be limited to species adapted to human disturbance. During operations, there would be no additional impacts on terrestrial resources, as temporarily disturbed areas beyond the facility footprint would be revegetated and/or would revert to more-natural conditions.

4.8.5.2 Wetlands and Aquatic Resources

No wetlands or aquatic resources exist within the area of the proposed mercury storage facilities within E Area. Therefore, no impacts on wetlands or aquatic habitats are expected.

4.8.5.3 Threatened and Endangered Species

No threatened or endangered species are known or are expected to exist in the vicinity of the proposed mercury storage facilities within E Area at SRS (see Chapter 3, Section 3.7.5.4). Thus, no impacts on threatened or endangered species are expected from facility modifications, construction, or operations. Consultations have been initiated with the appropriate U.S. Fish and Wildlife Service office and state wildlife agency to support this analysis (see Chapter 5, Section 5.4).

4.8.6 Cultural and Paleontological Resources

4.8.6.1 Prehistoric Resources

No impacts on prehistoric resources are expected from construction or operations of a new mercury storage facility in E Area. The area has been previously disturbed and no such resources have been identified there (see Chapter 3, Section 3.7.6.1).

4.8.6.2 Historic Resources

There would be no impact on historic resources or structures potentially eligible for listing in the NRHP from mercury storage facility construction or operations, as E Area has been previously disturbed and no historic resources have been identified (see Chapter 3, Section 3.7.6.2). DOE has initiated consultation with the South Carolina SHPO to support this analysis (see Chapter 5, Section 5.4).

4.8.6.3 American Indian Resources

No American Indian sites have been identified in E Area. As E Area has been previously disturbed, there is a low probability that resources of interest to American Indian tribes would be affected from proposed construction and operations (see Chapter 3, Section 3.7.6.3). DOE has initiated the consultation process with area and regional tribal nations who may have an interest in the proposed action and alternatives (see Chapter 5, Section 5.4). Nevertheless, DOE has initiated consultation with the Catawba Indian Nation (see Chapter 5, Section 5.4).

4.8.6.4 Paleontological Resources

Construction of a new mercury storage facility is not expected to have any impact on unique paleontological resources, as no noteworthy resources have been identified in E Area (see Chapter 3, Section 3.7.6.4).

4.8.7 Site Infrastructure

4.8.7.1 Ground Transportation

Construction and operations of a new mercury storage facility at SRS are not expected to appreciably increase demands on the road and rail systems leading to the site. Projected peak traffic volumes and the number of shipments associated with mercury storage operations are presented in Section 4.8.11.

4.8.7.2 Electricity, Fuel, and Water

Utility resource demands and associated assumptions for construction and operation of a new mercury storage facility in SRS's E Area would be very similar to those described in Section 4.3.7.2. SRS's current annual electricity consumption is 8 percent of its annual capacity. Under this alternative, the projected annual operational electricity requirements (253 megawatt-hours) of a new mercury storage facility would have a negligible impact (0.07 percent increase) when compared with SRS's sitewide annual electrical energy use. This increase could easily be accommodated by the sitewide and E Area's existing electric power distribution infrastructure (see Chapter 3, Section 3.7.7.2).

Diesel fuel availability at SRS is limited only by the ability to ship it to the site; volume can be increased as needed. Diesel fuel consumption (606 liters [160 gallons]) to support mercury storage operations would be negligible (0.10 percent increase) when compared with the annual sitewide consumption of diesel fuel (see Chapter 3, Section 3.7.7.3).

Water requirements for construction and operation of a new mercury storage facility would be negligible compared with SRS's sitewide water usage and capacity (see Chapter 3, Section 3.7.7.4). Water requirements during construction (1,270,000 liters [336,000 gallons]) would temporarily increase annual sitewide water consumption by about 0.07 percent. The annual water demand for mercury operations (88,500 liters [23,400 gallons]) would constitute about 0.005 percent of the site's current consumption.

4.8.8 Waste Management

Waste generation associated with construction and operations of a new mercury storage facility in SRS's E Area would be similar to that discussed in Section 4.3.8. Facility construction activities would generate an estimated 271 cubic meters (355 cubic yards) of nonhazardous solid waste and 9,850 liters (2,600 gallons) of nonhazardous sanitary liquid waste. These nonhazardous waste streams are minimal (less than 1 percent) compared with SRS's 5-year average generation rate of nonhazardous waste (see Chapter 3, Section 3.7.8.1). It is assumed that construction-generated solid waste would be disposed of at the SRS Construction and Demolition Landfill, as is the current practice at the site. Portable toilet facilities, serviced by a local or regional contractor, would be used to serve the sanitary needs of the construction workforce.

As further described in Section 4.3.8, operation of a new mercury storage facility at SRS is expected to generate an estimated 910 55-gallon (208-liter) drums of hazardous waste over the 40-year period of analysis. This equates to about 23 55-gallon drums or approximately 5 cubic meters (6.5 cubic yards) annually. This hazardous waste volume is minor (about 3 percent) compared with SRS's 5-year average volume of hazardous waste generated sitewide (see Chapter 3, Section 3.7.8.1). As such, no impacts related to the generation of mercury-contaminated waste during the operation of the proposed mercury storage facility are expected.

SRS is currently generating and managing RCRA-regulated mercury-contaminated and other hazardous waste. The hazardous waste is temporarily stored in existing RCRA-permitted hazardous waste storage buildings within the N Area and shipped off site to commercial RCRA-permitted TSD facilities. No changes in SRS's hazardous waste generator status would be required to construct and operate the proposed mercury storage facility.

Facility operations would also generate an estimated 59,000 liters (15,600 gallons) of nonhazardous sanitary wastewater annually. This yearly generation rate is miniscule compared with SRS's sitewide sanitary waste generation and other waste management activities (see Chapter 3, Section 3.7.8.1). Sanitary wastewater would either be discharged to existing sewer systems and/or septic systems that service E Area or to a new, dedicated sewage disposal system permitted by the South Carolina Department of Health and Environmental Control.

DOE continues to manage several ongoing programs and projects at SRS in support of sitewide remediation. Neither construction nor operation of the proposed mercury storage facility is anticipated to impact resources (e.g., funding, labor, facilities, and equipment, etc.) associated with current and/or future site remediation efforts.

Section 3155 of the National Defense Authorization Act for Fiscal Year 2002 (P.L. 107-107) requires a "Plan for Disposition" that is to specify a "means by which all such defense plutonium defense plutonium materials will be removed in a timely manner from the SRS for storage and disposal elsewhere" prior to SRS's receiving surplus defense plutonium waste. The law does not include provisions that would regulate the storage of mercury within the proposed mercury storage facility. As such, the act is not anticipated to impact the construction and/or operation of the mercury storage facility at SRS.

4.8.9 Occupational and Public Health and Safety

If SRS is chosen as the site for mercury storage, a new facility would be built. Most of the risks that pertain to SRS are the same as those discussed in Sections 4.2.9.1 through 4.2.9.5.

4.8.9.1 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites. Consequences to the involved worker are predicted to be negligible because involved workers would never be exposed to airborne concentrations of mercury vapor above ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. This corresponds to keeping exposures to the involved worker in the SL-I (negligible) range.[24] This would be achieved by adherence to good operating practices, in particular attention to ventilation, inspection, monitoring, and use of PPE, as described in the *Interim Guidance* (DOE 2009c). Therefore, the risks to involved workers would be negligible during normal operations.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.1.2, shows that the predicted long-term average concentration in the building wake for new construction is about 2.0×10^{-5} milligrams per cubic meter. This is well below EPA's chronic-inhalation-exposure RfC of 3.0×10^{-4} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and the public would be negligible.

[24] For definitions of SLs for various types of exposures, see Section 4.2.9.1.1 and Appendix D, Section D.1.1.1. For a discussion of how risk is assessed, see Sections 4.2.9.1.1 and D.1.1.2.

4.8.9.2 Facility Accidents

Section 4.2.9.1.4 provides a discussion of facility accident risks that applies to all sites. Table 4–3 contains a summary of the likelihood of occurrence of candidate facility accident scenarios initiated by failures of engineered systems, human errors, or external events, and Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible frequency from Table 4–3. The analysis of the scenarios at SRS is exactly the same as for the same scenarios in Section 4.2.9.1.4, with the exception of a member of the public in the case of an outside earthquake spill. The atmospheric dispersion calculations show that, for this spill, the maximum distance downwind to which a concentration greater than AEGL-3 could be exceeded is less than 100 meters (330 feet); for AEGL-2, the corresponding distance is about 300 meters (980 feet); and for 0.1 × AEGL-2, it is 1.1 kilometers (0.68 miles). However, the distance to the closest site boundary from the proposed mercury storage facility is 8 kilometers (5 miles), so consequences and hence risks to members of the public would be negligible. Table 4–55 summarizes the results for all accidental spills of elemental mercury on site (without fire).

Table 4–55. Summary of Risks of all Onsite Elemental Mercury Spill Scenarios – Savannah River Site

Scenario	Frequency	Consequence	Risk
Spills Inside Building[a]			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for all inside spills
Noninvolved worker	FL-II – FL-III	SL-II	N for all inside spills
Member of the public	FL-II – FL-III	SL-II	N for all inside spills
Spills Outside Building			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for outside earthquake spill; N for all other outside spills
Noninvolved worker	FL-II – FL-III	SL-I – SL-II	
Member of the public			
1-metric ton container spill	FL-II	SL-I	N
Single-pallet spill	FL-III	SL-I	N
Earthquake with building collapse[b]	FL-III	SL-I	N

[a] The inside spill scenarios considered are single flask, single pallet, triple pallet, 1-metric-ton container, full spill tray under a pallet, and earthquake with intact building walls.

[b] This scenario encompasses the risk from floods, high winds, and tornadoes.

Key: FL=frequency level; L=low; N=negligible; SL=severity level.

4.8.9.3 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury over a 40-year period of analysis to SRS. These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. The results of the analysis are shown in Table 4–56.

Table 4–56. Frequency Analysis of Truck and Railcar Accidents – Savannah River Site

Scenario	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires in Dry Weather (per year)	Frequency of Accidents with Fires in Wet Weather (per year)	Frequency of Accidents with Death[a] (per year)
Truck – Scenario 1	869,314	1.1×10^{-2}	1.8×10^{-3}	1.4×10^{-4}	4.4×10^{-6}	4.9×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Truck – Scenario 2	1,682,503	1.7×10^{-2}	3.3×10^{-3}	2.7×10^{-4}	8.6×10^{-6}	9.4×10^{-4}
	–	High –FL-IV	Moderate – FL-III	Moderate –FL-III	Low – FL-II	Moderate – FL-III
Railcar	304,329	1.9×10^{-3}	8.8×10^{-6}	2.0×10^{-5}	6.4×10^{-7}	1.2×10^{-4}
	–	Moderate – FL-III	Low – FL-II	Low – FL-II	Negligible – FL-I	Moderate – FL-III

[a] Fatality caused by mechanical impact, not by exposure to mercury.
Note: To convert miles to kilometers, multiply by 1.60934.
Key: FL=frequency level.

The above frequencies are for an accident anywhere along any of the transportation routes taken over a 40-year period of analysis to SRS. A crash that occurs in the last mile of the trip was used to estimate the frequency of an onsite crash in the vicinity of the storage building. The frequency of accidents with spills would be low under both truck scenarios and negligible under the Railcar Scenario. The frequency of crashes with fires or death would be negligible under all scenarios.

With respect to transportation accidents involving spills of mercury, the following four scenarios were considered:

- Spill of elemental mercury onto the ground without fire
- Spill of elemental mercury directly into water
- Fire with mercury spill
  - In dry weather
  - In wet weather

4.8.9.3.1 Transportation Accident with Spill of Elemental Mercury onto the Ground

Section 4.2.9.1.5 contains an analysis of spills of elemental mercury onto the ground following a truck or railcar crash without fire. A conservative estimate of the rate of evaporation from the resulting pool and the subsequent atmospheric dispersion (applicable to all sites) shows that a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that individual could only be exposed to such concentrations if the crash occurs along a specific 680-meter (2,230-foot) stretch of any of the routes to SRS. The same reasoning as is used in the generic discussion in Section 4.2.9.1.5 shows that the risk to a member of the public from transportation spills onto the ground without fire en route to SRS would be negligible under Truck Scenario 1 and the Railcar Scenario, but low under Truck Scenario 2.

4.8.9.3.2 Transportation Accident with Spill of Elemental Mercury Directly into Water

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors and humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

Table 4–57 summarizes the risks arising from spillages of elemental mercury during transportation to SRS.

Table 4–57. Summary of Transportation Risks to Human Receptors, Spills of Elemental Mercury onto the Ground or into Water, Savannah River Site

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto the Ground			
Frequency[a]	FL-I	FL-II	FL-I
Consequence	SL-II	SL-II	SL-II
Risk	*Negligible*	*Low*	*Negligible*
Spill into Water			
Frequency[b]	FL-III	FL-III	FL-II
Consequence	SL-I – SL-II	SL-I – SL-II	SL-I – SL-II
Risk[c]	*Negligible to low*	*Negligible to low*	*Negligible to low*

[a] Frequency at which spill occurs close enough to a specific individual to cause Acute Exposure Guideline Level 2 to be exceeded.

[b] Frequencies of railcar or truck crashes with spills from Table 4–56.

[c] These estimates of risk are subject to large uncertainty.

Key: FL=frequency level; SL=severity level.

4.8.9.3.3 Transportation Accident with Fire

The fire calculations are described in Section 4.2.9.1.5. Table 4–58 shows the results of the calculations of acute-inhalation risks from transportation accidents with fires on transportation routes to SRS. The table encompasses both truck scenarios and the Railcar Scenario.

Note that the risks presented in the above scenario are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

Table 4–58. Summary of Acute-Inhalation Risks to Human Receptors, Accidents with Fires, Transportation Routes to Savannah River Site

	Both Truck Scenarios with Wooden Pallets	Railcar Scenario with Wooden Pallets
Frequency[a]	FL-III	FL-II
Consequence[b]	SL-II	SL-II
Risk	*Low*	*Low*

a Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.

b The highest consequence in any weather condition.

Key: FL=frequency level; SL=severity level.

The analyses performed for this EIS show that, under all fire scenarios listed in Table 4–58, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

Table 4–59 summarizes the human health risks associated with all transportation spills.

Table 4–59. Summary of Transportation Risks to Human Receptors, Savannah River Site

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto ground	Negligible	Low	Negligible
Spill into water	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty
Spill with fire – inhalation, wooden pallets	Low	Low	Low
Spill with fire – dry and wet deposition, wooden pallets	Negligible	Negligible	Negligible

4.8.9.4 Intentional Destructive Acts

The discussion of IDAs is the same for all sites and transportation routes (see Section 4.2.9.1.6).

4.8.10 Ecological Risk

There is a generic analysis of ecological risk in Section 4.2.10.1, which applies without modification to SRS.

4.8.10.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike inorganic compounds formed from divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation are considered to be negligible at all storage sites and along all transportation routes.

4.8.10.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2,

which also makes the following conclusions regarding the condequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.
- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to ecological receptors could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

4.8.10.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5, and Section 4.2.10.1.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. Table 4–60 summarizes the FL, consequence level, and risk to ecological receptors in the case of a truck crash with pallet fire and no rain (dry deposition) and applies to all candidate storage sites.

Table 4–60. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, Savannah River Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Tables D–12 and D–13.

[b] Applies to both Truck Scenarios 1 and 2.

For the interpretation of Table 4–60, see Section 4.2.10.1.3. The risks of other potential fire scenarios are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–61.
- For railcar crashes with wooden pallet fires and without rain (dry deposition), see Table 4–62.
- The predicted frequency of railcar crashes with pallet fires and rain is negligible, so risks would be negligible and no summary table is presented.

Table 4–61. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, Savannah River Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Table D–16.

[b] Applies to both Truck Scenarios 1 and 2.

Table 4–62. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, Savannah River Site

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of railcar crashes with fires from Appendix D, Table D–14.

4.8.10.4 Consequences – Intentionally Initiated Fire with Mercury Spill

The consequences of intentionally initiated fires to ecological receptors are the same for all sites (see Section 4.2.10.1.14).

4.8.11 Socioeconomics

Under this alternative, a new facility for long-term storage of elemental mercury would be constructed in the SRS E Area. Employment during construction is expected to average 18 people for approximately 6 months. Operation of the facility is estimated to require approximately 8 individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and approximately 5 individuals thereafter, resulting in an increase of the SRS workforce of less than 0.1 percent and an increase in the ROI workforce of 0.003. Neither construction nor operation of a new facility is expected to generate substantial direct or indirect employment. Thus, negligible impacts on socioeconomic conditions (i.e., overall employment, population trends, and traffic) in the ROI would result from implementing this alternative.

Construction-related transportation, including employee vehicle trips and equipment and materials shipments, is not expected to adversely impact traffic conditions on roads leading to the site. It is assumed that there would be approximately 1.5 employees per vehicle, and every vehicle is counted twice to account for round trips. It is estimated that average construction transportation of 45 vehicles a day could increase the average annual daily traffic counts by less than 1 percent, if utilizing Highway 19, to almost 4 percent, if utilizing Secondary Road 64. It is likely that these additional vehicles would use a combination of routes; thus the additional traffic would not be concentrated on one particular route. Fifty-three percent of the vehicles would be attributed to employee transportation.

Transportation impacts during the operations phase would include employee vehicle trips and shipments of elemental mercury to the site for storage. Appendix C, Section C.1, provides an estimate of the number of shipments by truck. The additional vehicles due to facility operations are not expected to noticeably increase traffic volumes on roads leading to the site. The greatest impact would be during the first 2 years of operations, when it is estimated that approximately 11 vehicles a day could increase the average annual daily traffic counts by no more than 0.1 percent, if utilizing Highway 19, to as much as approximately 1 percent, if utilizing Secondary Road 62. During this time, it is estimated that up to 78 shipments would be made each year. Approximately 96 percent of the additional vehicles would be attributed to employee transportation.

4.8.12 Environmental Justice

An analysis of populations in census block groups found that, of the 15 block groups within the 16-kilometer (10-mile) radius of the SRS E Area, 4 contained a disproportionately high number of minority individuals and none contained a disproportionately high number of low-income individuals. No populations have been identified within the 3-kilometer (2-mile) radius surrounding E Area (see Chapter 3, Section 3.7.11). As discussed in Chapter 3, Section 3.7.1.1, and Section 4.8.1, the surrounding area includes urban, residential, industrial, agricultural, and recreational land uses; there would be no offsite impacts on land use as a result of implementing the SRS alternative. Impacts on air quality under this alternative would be minor during construction and negligible during operations, as discussed in Section 4.8.4.2. Impacts on ecological resources are expected to be minimal under this alternative, as discussed in Section 4.8.5. There is a low probability that resources of interest to American Indian tribes occur in E Area at SRS; thus, there would be no impacts on American Indian cultural resources, as discussed in Chapter 3, Section 3.7.6.3, and Section 4.8.6.3. A negligible change in socioeconomic conditions would result under this alternative, as discussed in Section 4.8.11.

An analysis of populations that may be susceptible due to disproportional human health impact factors within the area is presented in Chapter 3, Section 3.7.11. As discussed in Section 4.8.9, implementing the SRS alternative would result in negligible offsite human health risks from mercury emissions during normal operations and facility accidents. As discussed in Section 4.8.9.3, transportation accidents have been identified as posing a negligible-to-low human health risk following dry deposition onto the ground or into water bodies. Three of the four block groups identified that consist of a disproportionately high number of minority individuals are located at or near the site boundary along the potential transportation routes of South Carolina Highway 19 and adjoining U.S. Route 278. If a transportation accident were to occur at or near this site entrance, it would be reasonable to conclude that the consequences to human health of that accident would be borne by a disproportionately high number of minority individuals who reside in this area.

4.9 LONG-TERM MERCURY MANAGEMENT AND STORAGE AT WASTE CONTROL SPECIALISTS, LLC

Under this alternative, elemental mercury would be stored at the WCS site. WCS owns and commercially operates the 541-hectare (1,338-acre) site for the treatment, storage, and landfill disposal of various hazardous and radioactive wastes. The site is located approximately 50 kilometers (31 miles) west of Andrews, Texas, and 13 kilometers (8 miles) east of Eunice, New Mexico. Implementation of this alternative would involve interim use of the Container Storage Building (CSB) located in the existing facility complex at the site until a new facility could be constructed. The new mercury storage facility would be similar to that proposed at the other candidate sites and would be constructed at one of two identified locations (i.e., a north and a south site relative to the developed WCS facilities area) on the WCS site, as further described in Chapter 2, Section 2.4.8. In the following sections, differences in potential impacts between the two elements of the alternative are identified, where appropriate.

4.9.1 Land Use and Visual Resources

Minor impacts on land use and visual resources are expected from construction and operation of a new mercury storage building at WCS. Construction of this new facility would require the disturbance of approximately 3.1 hectares (7.5 acres) for building construction and laydown areas (see Chapter 2, Section 2.3.1). The proposed mercury storage facility would be located on relatively undisturbed land in either the northwestern or southwestern corners of the WCS facilities area and adjacent to the existing built-up facility complex. As an interim measure, elemental mercury could be stored in the existing CSB within the existing WCS facility complex (see Chapter 2, Figure 2–24). The completed facility boundary would similarly encompass approximately 3.1 hectares (7.5 acres) within its fenced perimeter, which corresponds to less than 1 percent of the land comprising the WCS site. The footprint of the mercury storage building would occupy approximately 1.6 hectares (3.9 acres) of this area. Mercury storage operations would be compatible with current WCS waste management and storage operations conducted in this area. No applicable land use plans, policies, or controls have been identified that would restrict storage of elemental mercury at this location (Beverly 2009a). The low profile of the new building is not expected to affect the overall viewshed of this area from on- or offsite vantage points. Therefore, mercury storage operations would not result in a change to BLM VRM classifications.

4.9.2 Geology, Soils, and Geologic Hazards

4.9.2.1 Geology and Soils

Construction of a new mercury storage facility within the WCS perimeter fence would generally have the same direct impacts on geology and soils in terms of land area disturbed, depth of excavation, and geologic resource demands as described in Section 4.3.2.1. Geologic resources, including concrete and coarse aggregate (gravel) totaling 8,640 cubic meters (11,300 cubic yards), would be required for construction (see Appendix C, Table C–2) and would be procured from local and/or regional commercial vendors. Trenching may be necessary to install foundation footers or to connect the new mercury storage facility with existing utilities. Excavation adjacent to WCS would encounter sandy and clayey loam soils and caliche (calcium-cemented soils) developed from the Blackwater Draw Formation, which can be up to 17 meters (55 feet) thick across the site (see Chapter 3, Section 3.8.2). This unit is further underlain by the pebbly and cherty caprock caliche to the north and northwest of the WCS facility complex and by the sands and gravels of the Ogallala-Antlers-Gatuna geologic unit to the south of the facilities area. Due to the depth of excavation even where trenching is required (i.e., up to 1.2 meters [4 feet]) and the locations being considered on the site, no effect on the underlying claystones and sandstones/siltstones is expected. While the presence of caliche hardpans presents a slight limitation for site development, standard excavation activities should be sufficient. Nevertheless, a site survey and geotechnical study would be conducted to confirm site geologic characteristics for facility siting and engineering purposes. This would include an analysis to assess the potential for subsurface dissolution features or site-specific land subsidence.

Natural soils at WCS, especially the eolian sands, could be more prone to erosion. However, adherence to standard best management practices for soil erosion and sediment control during construction would serve to minimize soil erosion and loss (see Section 4.3.2.1). During operations, the previously disturbed areas would not be subject to long-term soil erosion, and temporarily disturbed areas would be revegetated.

Interim use of the existing WCS CSB for mercury storage would have a negligible impact on geology and soils. No exterior modifications would be required to the RCRA-permitted facility, although interior modifications would be performed to upgrade mechanical systems (see Appendix C, Table C–1). Nevertheless, adherence to standard best management practices for soil erosion and sediment control (e.g., use of sediment fencing, staked hay bales, mulching and geotextile matting, and rapid reseeding) in any disturbed areas would serve to minimize any soil erosion and loss. Geologic resource requirements would be minimal.

4.9.2.2 Geologic Hazards

The WCS site lies in the Central Basin Platform region, which has crustal properties that indicate minimum risk due to faulting and seismicity. Seismicity of the immediate WCS site region is relatively low, with historical earthquakes in the region having produced ground shaking up to MMI V (see Appendix B, Table B–4). The predicted peak ground acceleration at the site from an earthquake with an annual probability of occurrence of 1 in 2,500 is 0.12 *g*. Ground motion in this range could cause slight damage to ordinary structures, but is not expected to affect modern structures that have been designed and constructed to withstand the assessed hazard. DOE applies the seismic engineering provisions from the latest building codes as the minimum standard for the design, construction, and upgrade of its facilities. As further described in Appendix B, Section B.3.2, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. The Order also stipulates natural phenomena hazards mitigation for DOE facilities. The new mercury storage facility would be sited and designed to address the risk from geologic hazards. The existing CSB would be evaluated and structural upgrades implemented, as necessary, prior to use. However, neither the existing CSB nor a newly designed and constructed mercury storage facility would be likely to suffer substantial structural damage from the maximum predicted earthquake ground motion at the site. Thus, such ground motion would be unlikely to cause a breach in mercury containers from structural failure. An analysis of potential environmental consequences resulting from an earthquake-induced accident is described in Section 4.9.9.2.

4.9.3 Water Resources

4.9.3.1 Surface Water

Facility construction activities at the WCS site are not expected to have any direct impact on surface-water features. The northern half of the WCS site drains toward an interior playa approximately 2.4 kilometers (1.5 miles) north-northeast of the WCS site, while the southern half of the site and the existing WCS facilities drain toward the ranch house drainage. This drainage feature crosses the WCS property about 0.4 kilometers (0.25 miles) southeast of the existing WCS facilities and flows from east to west (see Chapter 3, Section 3.8.3.1). The new mercury storage facility would be sited to avoid these features and designed to minimize the risk from hydrologic and geologic hazards. Use of and interior modification of the existing CSB would not have any impact on surface-water features. The closest surface-water feature is the ranch house drainage, as discussed above.

Stormwater runoff from the construction site would be unlikely to reach the ranch house drainage or the playa, and appropriate soil erosion and sediment control measures and spill prevention and waste management practices would be employed to minimize suspended sediment, the transport of other deleterious materials, and potential water quality impacts, as noted in Section 4.3.3.1. An NPDES General Permit Notice of Intent would be filed to address stormwater discharges associated with construction activity (see Chapter 5, Section 5.3). Also, development and implementation of a stormwater pollution prevention plan would be required for the construction activity.

Water demands for construction and operation of a new mercury storage facility on the WCS site would be similar to those described in Section 4.3.3.1. It is anticipated that water for construction and operations would be supplied via the existing WCS groundwater supply system. These construction and operations volumes are relatively small compared with the volume of water currently withdrawn and used by WCS on an annual basis (see Section 4.9.7.2). Water requirements to support interior modifications of the CSB would be very small compared with those for construction of the new mercury storage facility (see Section 4.3.3.1). It is anticipated that any water needed would be obtained from the existing WCS facility supply system. During CSB operations, it is expected that any incremental water use would be relatively small compared with existing WCS operations and limited to that required to serve the potable and sanitary needs of the storage facility workforce. Total annual consumption for interim use of the facility is estimated to be a fraction of the 88,500 liters (23,375 gallons) estimated to be required for operation of a new facility sized to store up to 10,000 metric tons (11,000 tons) of mercury. Further, there may be no net increase in water use at WCS, as use of the existing facility for elemental mercury storage would substitute for existing waste management activities, especially if mercury storage staff are drawn from the existing WCS workforce.

As previously noted in Section 4.3.3.1, design, construction, and operation of the mercury storage facility would incorporate structural controls and practices to prevent the release of elemental mercury and to prevent any spills or other releases, should they occur as a result of abnormal operating conditions, from reaching soils or surfaces where they could be conveyed to surface waters or groundwater. As necessary, the CSB would be modified to meet these requirements (see Appendix C, Table C–1). Facility operations would be conducted in accordance with an ICP and SPCC plan, or equivalent plans as mandated by state requirements governing the site and existing operations, which set forth the actions facility personnel would take to respond to fires, explosions, or any accidental release of mercury to air, soil, or surface water at the facility.

A hydraulic study was performed to delineate the 100- and 500-year floodplains for the ranch house drainage south of the WCS facility complex. The existing CSB and other existing WCS facilities are outside the delineated floodplains. Further, the existing topography and soil permeability prevent frequent ponding in the vicinity of the existing facilities and adjacent areas. Drainage from the existing WCS complex is conveyed southeast to the ranch house drainage. DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that DOE facilities be designed, constructed, upgraded as necessary, and operated to protect the public, workers, and environment from natural phenomena hazards, including flooding, and specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020-2002 and 1023-95. Additional surveys and a site-specific flood hazard analysis would be conducted, as necessary, as part of the site selection and design process for a new mercury storage facility.

There would be no direct discharge of effluents to either surface water or groundwater from storage facility operations and no impact on water quality. Only nonhazardous sanitary wastewater (sewage) would be generated and managed via the existing WCS sanitary waste system (see Section 4.9.8).

4.9.3.2 Groundwater

Facility construction is not expected to have any impact on groundwater hydrology due to the depth of excavation relative to the depth of groundwater. Even across the northern and northwestern portions of the WCS site where the new mercury storage facility could be constructed, the depth to the water table is approximately 24 meters (80 feet) (see Chapter 3, Section 3.8.3.2).

Locally, the potential does exist for perched groundwater to be encountered by trenching to depths of no greater than about 1.2 meters (4 feet). In such cases, the excavations may have to be dewatered and the groundwater contained for testing and treatment, if found to be contaminated, prior to discharge. There would be no impact on groundwater from modifications to the CSB.

As the facility would be designed and operated to prevent any spills from reaching the ground, there would be no impact on groundwater from routine operations.

4.9.4 Meteorology, Air Quality, and Noise

4.9.4.1 Meteorology

Meteorological events can result in damage to buildings such as mercury storage warehouses. The frequency and consequences of such events were considered in selecting the accident events evaluated in Section 4.9.9.2. As previously detailed and described in Section 4.3.4.1, DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including meteorological events. RCRA-permitted facilities, such as the proposed mercury storage facility, must also meet applicable design, construction, and operation requirements under Title 40 of the CFR, Section 264.31, and applicable state RCRA requirements to prevent the release of stored wastes. As the WCS site region is susceptible to regular occurrence of high winds, the existing CSB would be upgraded and the new mercury storage facility designed and constructed to withstand the potential for high winds and tornadoes and other meteorological events.

4.9.4.2 Air Quality

Minor short-term air quality impacts would result from construction of a mercury storage building at WCS. These impacts would include an increase in criteria and toxic air pollutant concentrations from construction equipment emissions (see Appendix C, Section C.2.3). These emissions would occur over a 6-month construction period and are not expected to result in exceedance of air quality standards. Negligible, short-term air quality impacts with little or no measurable effect on air quality would result from modification of the existing CSB for interim mercury storage. Criteria and toxic air pollutant emissions from construction equipment (see Appendix C, Section C.2.3) would be limited to those from construction employee vehicles and work trucks, with no heavy equipment use expected.

Emissions from operations of the new mercury storage facility would be very small, consisting of emissions from employee vehicles, trucks or trains, semiannual testing of emergency generators and possibly mercury vapor from any spills or from mercury containers. No localized emissions from space heating are anticipated associated with mercury storage facility operations, as electric heating is anticipated for areas requiring climate control. Compliance with the conformity regulations is discussed in Appendix B, Section B.5.1.2. Emissions and air quality impacts from operation of the CSB for mercury storage would be similar to but less than those described for new facility operations.

Exposures to mercury vapor could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers (those outside the storage facility) or nearby offsite individuals. Appendix D, Section D.4.1, presents a conservative analysis that shows that for a long-term, undetected slow leak inside the proposed mercury storage facility, the predicted long-term average concentration in the building wake never exceeds 80 nanograms per cubic meter. The EPA threshold for chronic exposure to airborne mercury is 300 nanograms per cubic meter, so slow releases of mercury would have a negligible effect on noninvolved workers and the public, with a corresponding negligible risk.

Air quality impacts from transportation of mercury to WCS would be similar to those discussed in Section 4.3.4.2. Truck and rail transport are discussed in more detail in Section 4.9.9.3. Estimated emissions from truck and rail transportation are presented in Tables 4–15 and 4–16.

Annual carbon dioxide emissions would be highest during construction. The second highest year of carbon dioxide emissions would be the year 2013 as a result of moving mercury to the site, when emissions would be approximately 229 metric tons (252 tons) per year, which would be more than rail emissions. As similarly noted in Section 4.3.4.2, such emissions would minimally add to global and U.S. annual emissions of carbon dioxide. Global climate change is further discussed in Section 4.11.4.2.

4.9.4.3 Noise

Short-term noise impacts at WCS could result from construction of a new mercury storage facility. These impacts would include some increase in traffic to the site and an increase in noise resulting from construction employee vehicles, equipment delivery, and heavy equipment operation. These impacts would occur during the 6-month construction period. Since the nearest noise-sensitive receptor, a residence, is located 5.6 kilometers (3.5 miles) from the site, the increase in noise levels at this location from construction equipment is expected to be negligible. The estimated average noise level during the daytime (8-hour equivalent sound level) from four items of construction equipment operating at this distance is estimated to be 13 dBA, which is well below background sound levels. The increase in traffic noise levels along Texas State Highway 176 from construction activity is expected to be less than 1 dBA since the increase in traffic resulting from construction would be much less than the existing traffic on Highway 176. Activities and associated noise impacts from modification of the CSB would be similar to but less than those described above.

Short-term noise impacts could occur along Highway 176 as a result of increased truck activity during the period that elemental mercury is transported to the site. The resulting increase in day-night average noise levels along Highway 176 is expected to be less than 1 dBA. As such, the change in truck traffic is not expected to result in a change in noise levels along this route or other shipping routes that would be noticeable to the public or result in an increase in annoyance. If the mercury is shipped by rail instead of by truck, some additional rail activity from placing railcars at the site could result in some increase in noise levels near the site.

Operation of the new mercury storage facility at WCS is expected to have a negligible impact on noise levels around the site since the noise sources associated with mercury storage would be limited to a few employee vehicles, occasional delivery trucks, and semiannual testing of the emergency generator. Noise impacts from mercury storage facility operations within the CSB would be similar to those discussed for the new mercury storage facility.

4.9.5 Ecological Resources

4.9.5.1 Terrestrial Resources

Habitat in the immediate vicinity of the construction sites consists mainly of shrublands with grassy patches. The vegetation is typical of the surrounding region; common species include shinnery oak mesquite, and soapweed (WCS 2007:8–10, 83). Construction of the new mercury storage facility would result in the loss of 3.1 hectares (7.5 acres) of this land cover. Adherence to best management practices for land cover management (e.g., washing down construction equipment and vehicle tire treads) would serve to reduce the chance of introducing invasive plant species. Impacts on animals from construction would be limited to species adapted to human disturbance. During operations, there would be no additional impacts on terrestrial resources, as temporarily disturbed areas beyond the facility footprint would be revegetated and/or would revert to more-natural conditions.

Since an existing building (i.e., the CSB) would be used for interim mercury storage, no land would be disturbed and no terrestrial resources would be impacted.

4.9.5.2 Wetlands and Aquatic Resources

No wetlands or aquatic resources exist within the proposed locations of the new mercury storage facility at WCS. Therefore, no impacts on wetlands or aquatic habitats are expected.

No land would be disturbed and no wetlands or aquatic resources would be impacted from use of the existing CSB.

4.9.5.3 Threatened and Endangered Species

No threatened or endangered species are known or are expected to exist within the area of the proposed mercury storage facilities at WCS. Thus, no impacts on threatened or endangered species are expected from facility modifications, construction, or normal operations. Consultations have been initiated with the appropriate U.S. Fish and Wildlife Service office and state wildlife agency to support this analysis (see Chapter 5, Section 5.4).

4.9.6 Cultural and Paleontological Resources

4.9.6.1 Prehistoric Resources

No impacts on prehistoric resources are expected from construction of a new mercury storage facility or use of the existing CSB for mercury storage at WCS. A previous survey found an absence of prehistoric occupation or exploitation of the area. The potential to find buried deposits is low (see Chapter 3, Section 3.8.6.1).

4.9.6.2 Historic Resources

There would be no impact on historic resources from mercury storage facility construction or from operations. Surveys conducted found an absence of historic occupation or exploitation of the area (see Chapter 3, Section 3.8.6.1). The potential to find buried deposits is low, and there are no sites currently listed or nominated for listing in the NRHP. DOE has initiated consultation with the Texas SHPO to support this analysis (see Chapter 5, Section 5.4).

4.9.6.3 American Indian Resources

Previous surveys have not identified any American Indian resources on the site (see Chapter 3, Section 3.8.6.2); therefore, there would be no impact from use of the existing CSB or construction and operations of a new mercury storage facility.

4.9.6.4 Paleontological Resources

Construction and operations of a new mercury storage facility are not expected to have any impact on unique paleontological resources, as no such resources have been identified in deposits at WCS (see Chapter 3, Section 3.8.6.3).

4.9.7 Site Infrastructure

4.9.7.1 Ground Transportation

Construction and operations of a new mercury storage facility at WCS or use of the CSB is not expected to appreciably increase demands on the road and rail systems leading to the site. Projected peak traffic volumes and the number of shipments associated with mercury storage operations are presented in Section 4.9.11.

4.9.7.2 Electricity, Fuel, and Water

Utility resource demands and associated assumptions for construction and operation of a new mercury storage facility at WCS would be very similar to those described in Section 4.3.7.2. Under this alternative, the projected annual operational electricity requirements (253 megawatt-hours) of a new mercury storage facility would have a minor impact (7 percent increase) when compared with WCS's current annual electrical energy use. It is expected that this increase could be accommodated by the site's existing electric power distribution infrastructure (see Chapter 3, Section 3.8.7.2).

Fuel availability is limited only by the ability to ship it to the site; volume can be increased as needed. Projected diesel fuel consumption (606 liters [160 gallons]) to support mercury storage operations would be negligible (0.7 percent increase) when compared with WCS's annual consumption of diesel fuel (see Chapter 3, Section 3.8.7.3).

Water requirements for construction and operation of a new mercury storage facility would be minor compared with WCS's sitewide water usage, which is supplied by the Eunice, New Mexico, municipal water system. Water requirements during construction (1,270,000 liters [336,000 gallons]) would temporarily increase annual sitewide water consumption by about 5 percent. The annual water demand for mercury storage operations (88,500 liters [23,400 gallons]) would constitute about 0.4 percent of WCS's current water use.

4.9.8 Waste Management

Both modification and operation of the existing CSB for interim mercury storage and construction and operation of a new mercury storage facility at WCS are expected to have a negligible impact on waste generation and waste management infrastructure. Internal modification of the CSB for interim mercury storage is expected to generate much less than the 271 cubic meters (355 cubic yards) of nonhazardous solid waste and 9,841 liters (2,600 gallons) of nonhazardous sanitary liquid waste projected to be generated during construction of a new facility. Nevertheless, the maximum volumes are negligible compared with the current waste generation and management activities at WCS, as described in Chapter 3, Section 3.8.8. It is assumed that construction-generated solid waste would be disposed of off site at the Lea County Landfill in New Mexico. Portable toilet facilities, serviced by a local or regional contractor, would be used to serve the sanitary needs of the construction workforce.

Operation of the mercury storage facility within either the CSB or a new mercury storage facility is expected to generate an estimated 910 55-gallon (208-liter) drums of hazardous waste over the is 40-year operational period as further described in Section 4.3.8. This equates to about 23 55-gallon drums, or approximately 5 cubic meters (6.5 cubic yards) annually. This estimated yearly hazardous waste generation rate is minor (ranging from about 0.5 to 7 percent) compared with the hazardous waste volumes (which include mercury-contaminated waste) received and managed over the last several years by WCS (see Chapter 3, Section 3.8.8.1). WCS is a listed hazardous waste large-quantity generator. No changes in generator status would be required to operate the proposed mercury storage facility, nor are any substantial effects on WCS's waste management infrastructure expected.

New mercury storage facility operations would also generate an estimated 59,000 liters (15,600 gallons) of nonhazardous sanitary wastewater annually. Nonetheless, operation of the CSB is not expected to result in a substantial increase in sanitary waste generation as the facility is already in operation for other purposes. The projected annual generation of sanitary waste from operation of a new mercury storage facility is minor (about 6 percent) compared with the roughly 1 million liters (270,000 gallons) of wastewater collected and disposed of off site by a commercial sanitary waste contractor each year (see Chapter 3, Section 3.8.7.4).

4.9.9 Occupational and Public Health and Safety

If WCS is chosen as the site for mercury storage, a new facility would be built. Most of the risks that pertain to WCS are the same as those discussed in Sections 4.2.9.1 through 4.2.9.5.

4.9.9.1 Normal Operations

Normal operations are discussed in Appendix D, Section D.4.1. The considerations there are common to all of the proposed storage sites. Consequences to the involved worker are predicted to be negligible because involved workers would never be exposed to airborne concentrations of mercury vapor above ACGIH's 8-hour TWA/TLV of 0.025 milligrams per cubic meter of mercury vapor. This corresponds to keeping exposures to the involved worker in the SL-I (negligible) range.[25] This would be achieved by adherence to good operating practices, in particular attention to ventilation, inspection, monitoring, and use of PPE, as described in the *Interim Guidance* (DOE 2009c). Therefore, the risks to involved workers would be negligible during normal operations.

For people outside the building during normal operations (noninvolved workers and members of the public), a chronic, long-term release is bounded by consideration of a full spill tray under a pallet of 3-L flasks that remains undetected indefinitely (a highly conservative assumption given the expected inspection and monitoring activities within the storage building). The steady state release from this source of mercury vapor is assumed to leak from the building and to be mixed into its turbulent building wake. Appendix D, Section D.4.1.2, shows that the predicted long-term average concentration in the building wake for new construction is about 2.0×10^{-5} milligrams per cubic meter. This is well below EPA's chronic-inhalation-exposure RfC of 3.0×10^{-4} milligrams per cubic meter. Hence, consequences would be in the SL-I range, and the risk to both noninvolved workers and the public would be negligible.

4.9.9.2 Facility Accidents

Section 4.2.9.1.4 provides a discussion of facility accident risks that applies to all sites. Table 4–3 contains a summary of the likelihood of occurrence of candidate facility accident scenarios initiated by failures of engineered systems, human errors, or external events, and Table 4–4 lists the accident scenarios that remain for consequence analysis after eliminating those with negligible frequency from Table 4–3. The analysis of the scenarios at WCS is exactly the same as for the same scenarios in Section 4.2.9.1.4, with the exception of a member of the public in the case of an outside earthquake spill. The atmospheric dispersion calculations show that, for this spill, the maximum distance downwind to which a concentration greater than AEGL-3 could be exceeded is less than 100 meters (330 feet); for AEGL-2, the corresponding distance is about 300 meters (980 feet); and for $0.1 \times$ AEGL-2, it is 1.1 kilometers (0.68 miles). The distance to the closest site boundary from the proposed mercury storage facility is about 70 meters (230 feet), so high consequences would not be exceeded beyond this boundary. The nearest residence is approximately 5.4 kilometers (3.4 miles) away. Therefore, the risk to resident members of the public would be negligible. Table 4–63 summarizes the results for all accidental spills of elemental mercury on site (without fire).

[25] For definitions of SLs for various types of exposures, see Section 4.2.9.1.1 and Appendix D, Section D.1.1.1. For a discussion of how risk is assessed, see Sections 4.2.9.1.1 and D.1.1.2.

Table 4–63. Summary of Risks of all Onsite Elemental Mercury Spill Scenarios – Waste Control Specialists, LLC

Scenario	Frequency	Consequence	Risk
Spills Inside Building[a]			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for all inside spills
Noninvolved worker	FL-II – FL-III	SL-II	N for all inside spills
Member of the public	FL-II – FL-III	SL-II	N for all inside spills
Spills Outside Building			
Involved worker	FL-II – FL-III	SL-I – SL-II	N–L for outside earthquake spill; N for all other outside spills
Noninvolved worker	FL-II – FL-III	SL-I – SL-II	
Member of the public			
1-metric-ton container spill	FL-II	SL-I	N
Single-pallet spill	FL-III	SL-I	N
Earthquake with building collapse[b]	FL-III	SL-I	N

[a] The inside spill scenarios considered are single flask, single pallet, triple pallet, 1-metric-ton container, full spill tray under a pallet, and earthquake with intact building walls.

[b] This scenario encompasses the risk from floods, high winds, and tornadoes.

Key: FL=frequency level; L=low; N=negligible; SL=severity level.

4.9.9.3 Transportation

Appendix D, Section D.2.7, describes the assumptions regarding the transportation of a total of up to 10,000 metric tons (11,000 tons) of elemental mercury over a 40-year period of analysis to WCS. These assumptions, together with knowledge of truck routes and historical frequencies of crashes of various types, can be combined to produce estimates of the frequency at which crashes might occur anywhere along the routes traveled by mercury trucks or railcars. The results of the analysis are shown in Table 4–64.

Table 4–64. Frequency Analysis of Truck and Railcar Accidents – Waste Control Specialists, LLC

Scenario	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires in Dry Weather (per year)	Frequency of Accidents with Fires in Wet Weather (per year)	Frequency of Accidents with Death[a] (per year)
Truck – Scenario 1	1,000,305	1.2×10^{-2}	2.0×10^{-3}	1.6×10^{-4}	5.1×10^{-6}	5.6×10^{-4}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Truck – Scenario 2	1,806,502	1.7×10^{-2}	3.5×10^{-3}	2.9×10^{-4}	9.2×10^{-6}	1.0×10^{-3}
	–	High – FL-IV	Moderate – FL-III	Moderate – FL-III	Low – FL-II	Moderate – FL-III
Railcar	394,112	2.5×10^{-3}	1.1×10^{-5}	2.6×10^{-5}	8.3×10^{-7}	1.6×10^{-4}
	–	Moderate – FL-III	Low – FL-II	Low – FL-II	Negligible – FL-I	Moderate – FL-III

[a] Fatality caused by mechanical impact, not by exposure to mercury.

Note: To convert miles to kilometers, multiply by 1.60934.

Key: FL=frequency level.

The above frequencies are for an accident anywhere along any of the transportation routes taken over a 40-year period of analysis to WCS. A crash that occurs in the last mile of the trip was used to estimate the frequency of an onsite crash in the vicinity of the storage building. The frequency of accidents with spills would be low under both truck scenarios and negligible under the Railcar Scenario. The frequency of crashes with fires or death would be negligible under all scenarios.

With respect to transportation accidents involving spills of mercury, the following four scenarios were considered:

- Spill of elemental mercury onto the ground without fire
- Spill of elemental mercury directly into water
- Fire with mercury spill
  - In dry weather
  - In wet weather

4.9.9.3.1 Transportation Accident with Spill of Elemental Mercury onto the Ground

Section 4.2.9.1.5 contains an analysis of spills of elemental mercury onto the ground following a truck or railcar crash without fire. A conservative estimate of the rate of evaporation from the resulting pool and the subsequent atmospheric dispersion (applicable to all sites) shows that a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than 340 meters (1,115 feet) from a crash. Conservatively, assuming that the individual lives immediately adjacent to the road, that individual could only be exposed to such concentrations if the crash occurs along a specific 680-meter (2,230-foot) stretch of any of the routes to WCS. The same reasoning as is used in the generic discussion in Section 4.2.9.1.5 shows that the risk to a member of the public from transportation spills onto the ground without fire en route to WCS would be negligible under Truck Scenario 1 and the Railcar Scenario, but low under Truck Scenario 2.

4.9.9.3.2 Transportation Accident with Spill of Elemental Mercury Directly into Water

The consequences of the spillage of elemental mercury into a water body are discussed in Appendix D, Section D.5.4.2. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.

- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to humans (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.

- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

Table 4–65 summarizes the risks arising from spillages of elemental mercury during transportation to WCS.

Table 4–65. Summary of Transportation Risks to Human Receptors, Spills of Elemental Mercury onto the Ground or into Water, Waste Control Specialists, LLC

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto the Ground			
Frequency[a]	FL-I	FL-II	FL-I
Consequence	SL-II	SL-II	SL-II
Risk	*Negligible*	*Low*	*Negligible*
Spill into Water			
Frequency[b]	FL-III	FL-III	FL-II
Consequence	SL-I – SL-II	SL-I – SL-II	SL-I – SL-II
Risk[c]	*Negligible to low*	*Negligible to low*	*Negligible to low*

[a] Frequency at which spill occurs close enough to a specific individual to cause Acute Exposure Guideline Level 2 to be exceeded.

[b] Frequencies of railcar or truck crashes with spills from Table 4–64.

[c] These estimates of risk are subject to large uncertainty.

Key: FL=frequency level; SL=severity level.

4.9.9.3.3 Transportation Accident with Fire

The fire calculations are described in Section 4.2.9.1.5. Table 4–66 shows the results of the calculations of acute-inhalation risks from transportation accidents with fires on transportation routes to WCS. The table encompasses both truck scenarios and the Railcar Scenario.

Table 4–66. Summary of Acute-Inhalation Risks to Human Receptors, Accidents with Fires, Transportation Routes to Waste Control Specialists, LLC

	Both Truck Scenarios with Wooden Pallets	Railcar Scenario with Wooden Pallets
Frequency[a]	FL-III	FL-II
Consequence[b]	SL-II	SL-II
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Appendix D, Section D.2.7.

[b] The highest consequence in any weather condition.

Key: FL=frequency level; SL=severity level.

Note that the risks presented in the above scenario are individual risks: they are the answer to the question, "What is the risk to me?" This is not the same as the risk that, somewhere along a transportation route, airborne concentrations would exceed the various SLs. Those risks would in fact be higher.

The analyses performed for this EIS show that, under all fire scenarios listed in Table 4–66, with and without rain, mercury deposited on the ground would never cause the benchmark of 180 milligrams per kilogram to be exceeded. Therefore, the corresponding risks would be negligible.

Table 4–67 summarizes the human health risks associated with all transportation spills.

Table 4–67. Summary of Transportation Risks to Human Receptors, Waste Control Specialists, LLC

	Truck Scenario 1	Truck Scenario 2	Railcar Scenario
Spill onto ground	Negligible	Low	Negligible
Spill into water	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty	Negligible to low within a large range of uncertainty
Spill with fire – inhalation, wooden pallets	Low	Low	Low
Spill with fire – dry and wet deposition, wooden pallets	Negligible	Negligible	Negligible

4.9.9.4 Intentional Destructive Acts

The discussion of IDAs is the same for all sites and transportation routes (see Section 4.2.9.1.6).

4.9.10 Ecological Risk

There is a generic analysis of ecological risk in Section 4.2.10.1, which applies without modification to WCS.

4.9.10.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from containers during storage and handling. Ingestion of soil contaminated with mercury represents the greatest plausible long-term threat from mercury releases. As discussed in Appendix D, deposition of airborne mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike inorganic compounds formed from divalent mercury. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation are considered to be negligible at all storage sites and along all transportation routes.

4.9.10.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. For an assessment of the physical and chemical phenomena that would control how such a spill might affect ecological receptors, see Appendix D, Section D.5.4.2, which also makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to ecological receptors is not possible.
- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors (inorganic compounds of mercury and methylmercury) are slow and would generally allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, transportation to the water body would be slow, again allowing ample time for cleanup.

The foregoing observations might break down if there is spillage into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to ecological risk could be managed so that they are negligible or low. Given this assumption and the fact that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, because of the above-mentioned uncertainty about fast-flowing rivers, this observation should be tempered by noting that the uncertainty regarding this prediction of risk is very large.

4.9.10.3 Transportation Spills with Fires

Ecological risks associated with transportation spills with fires principally arise from ingestion of mercury in soil, wetland sediments, or water bodies. Some of this mercury subsequently is converted to methylmercury; this conversion is taken into account in the analysis in Appendix D, Section D.5, and Section 4.2.10.1.

The following analysis of consequences considers truck and railcar crashes with fires, in each case with wooden pallets. Table 4–68 summarizes the FL, consequence level, and risk to ecological receptors in the case of a truck crash with a pallet fire and no rain (dry deposition) and applies to all candidate storage sites.

Table 4–68. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and No Rain, Waste Control Specialists, LLC

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Tables D–12 and D–13.
[b] Applies to both Truck Scenarios 1 and 2.

For the interpretation of Table 4–68, see Section 4.2.10.1.3. The risks of other potential fire scenarios are summarized as follows:

- For truck crashes with wooden pallet fires and rain (wet deposition), see Table 4–69.
- For railcar crashes with wooden pallet fires and without rain (dry deposition), see Table 4–70.
- The predicted frequency of railcar crashes with pallet fires and rain is negligible, so risks would be negligible and no summary table is presented.

Table 4–69. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Wooden Pallet Fires and Rain, Waste Control Specialists, LLC

Ecological Receptor	Frequency Level of Crash with Fire[a]	Consequence Level	Risk[b]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of truck crashes with spills from Appendix D, Table D–16.
[b] Applies to both Truck Scenarios 1 and 2.

Table 4–70. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Wooden Pallet Fires and No Rain, Waste Control Specialists, LLC

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level	Risk
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] Frequencies of railcar crashes with fires from Appendix D, Table D–14.

4.9.10.4 Consequences – Intentionally Initiated Fire with Mercury Spill

The consequences of intentionally initiated fires to ecological receptors are the same for all sites (see Section 4.2.10.1.4).

4.9.11 Socioeconomics

Under this alternative, a new facility for long-term storage of elemental mercury would be constructed at WCS. Employment during construction is expected to average 18 people for approximately 6 months. Operation of the facility is estimated to require approximately 8 individuals for routine maintenance and support activities during the first 7 years, when higher volumes of shipments are expected, and approximately 5 individuals thereafter, resulting in an increase of the existing WCS workforce of approximately 3 to 5 percent and an increase in the ROI workforce of approximately 0.2 percent. Neither construction nor operation of a new facility is expected to generate substantial direct or indirect employment. Thus, negligible impacts on socioeconomic conditions in the ROI would result from implementing this alternative.

Construction-related transportation, including employee vehicle trips and equipment and materials shipments is not expected to adversely impact traffic conditions on roads leading to the site. It is assumed that there would be approximately 1.5 employees per vehicle, and every vehicle is counted twice to account for round trips. It is estimated that average construction transportation of 45 vehicles a day could increase the average annual daily traffic count on State Highway 176 by less than 2 percent; 53 percent of these vehicles would be attributed to employee transportation.

Transportation impacts during the operations phase would include employee vehicle trips and shipments of elemental mercury to the site for storage. Appendix C, Section C.1, provides an estimate of the number of shipments by truck. The additional vehicles due to facility operations are not expected to noticeably increase traffic volumes on roads leading to the site. The greatest impact would be during the first 2 years of operations, when it is estimated that approximately 11 vehicles a day could increase the average annual daily traffic count on State Highway 176 by less than 0.5 percent. Approximately 96 percent of the additional vehicles would be attributed to employee transportation.

4.9.12 Environmental Justice

An analysis of populations in census block groups found that, of the eight block groups within the 16-kilometer (10-mile) radius of WCS, one contained a disproportionately high number of minority individuals and none contained a disproportionately high number of low-income individuals. There are only two block groups within the 3-kilometer (2-mile) ROI, none of which contained a disproportionately high number of minority or low-income individuals (see Chapter 3, Section 3.8.11). As discussed in Chapter 3, Section 3.8.1.1, and Section 4.9.1, land use in the surrounding area includes industrial activity and ranching, and there would be no offsite impacts on land use as a result of implementing the WCS alternative. Impacts on air quality under this alternative would be minor during construction and negligible during operations, as discussed in Section 4.9.4.2. Impacts on ecological resources are expected to be minimal under this alternative, as discussed in Section 4.9.5. There have been no American Indian resources identified on WCS; thus, there would be no impacts on American Indian cultural resources, as noted in Chapter 3, Section 3.8.6.2, and Section 4.9.6.3. A negligible change in socioeconomic conditions would result under this alternative, as discussed in Section 4.9.11.

An analysis of populations that may be potentially susceptible due to disproportional human health impact factors within the area is presented in Chapter 3, Section 3.8.11. As discussed in Section 4.9.9, implementing the WCS alternative would result in negligible offsite human health risks from mercury emissions during normal operations and facility accidents. As discussed in Section 4.9.9.3, transportation accidents have been identified as posing a negligible-to-low human health risk following dry deposition onto the ground or into water bodies. The block group identified that consists of a disproportionately high number of minority individuals is located approximately 10 kilometers (6 miles) to the west in the city of Eunice. If a transportation accident were to occur at or near the site entrance, it would be reasonable to conclude that the consequences to human health of that accident would not be borne by a disproportionately high number of minority individuals since the identified block group lies beyond the potentially impacted area of approximately 1.6 kilometers (1 mile), as discussed in Chapter 3, Section 3.2.11.

4.10 CLOSURE

At the end of their useful lives, proposed mercury storage facilities would be subject to closure. This would occur under all the action alternatives. Under the No Action Alternative, existing mercury storage facilities could also be subject to closure.

The DOE mercury storage facilities would be closed in a manner that (1) minimizes the need for further maintenance and (2) controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, and contaminated runoff to the ground or surface waters or to the atmosphere from the facility (40 CFR 264.11). All hazardous waste and hazardous waste residues would be removed from the facility, and remaining containers and any soil containing or contaminated with hazardous waste or hazardous waste residues would be decontaminated or removed (40 CFR 264.178).

Closure would be executed in accordance with a detailed closure plan prepared by the facility operator (i.e., by DOE or DOE's authorized contractor). This plan would be subject to review and approval by EPA or the state's environmental protection agency responsible for permitting the long-term elemental mercury storage facility. The closure plan would also contain a credible site-specific cost estimate for these actions to allow DOE to allocate adequate funding such that closure activities could be conducted in a timely manner.

Closure activities would involve removing any remaining elemental mercury in storage and transporting it to suitable TSD facilities, as appropriate. In addition, the closure plan would include a detailed description of the steps needed to remove or decontaminate all hazardous waste residues and contaminated containment system components, equipment, structures, and soils during closure (40 CFR 264.112(b)(4)). For example, storage facilities would be inspected for residual mercury contamination. Affected surfaces would then be cleaned with a mercury-absorbing cleaner, as appropriate. Any contaminated materials would be isolated and contained. Workers performing such inspections, testing, and cleanup activities would wear appropriate personal protective gear, including disposable coveralls and air filtration systems.

Contaminated debris or soils, contaminated PPE, and other contaminated materials used for cleanup would be packaged prior to transport off site to a commercial hazardous waste management facility for mercury recovery, recycling, and/or disposal.

It is not possible to project the volume of mercury-contaminated material that may be generated from closure activities. It is likely, however, that much less waste would be generated during closure than during normal facility operations.

Closure activities are expected to occur mostly inside the storage facilities, except for the transport of wastes, and are expected to result in negligible air and water emissions. The cleaning procedure would be designed to minimize the release of any material to the air or water (i.e., mercury or cleaning agent). Therefore, air and water quality impacts from such activities are expected to be minor and human health risks to be low. Because the shipment of wastes resulting from closure should be limited to a few truck trips, impacts on traffic and transportation are expected to be negligible. As there would be little air or water emissions and no land disturbance, no impacts are expected on land use and visual resources, geology and soils, water resources, air quality and noise, ecological resources, cultural and paleontological resources, site infrastructure, or socioeconomics.

Further analysis of alternatives for future use of mercury storage facilities is not possible at this time. Future plans for facility reuse or other disposition would be the subject of additional NEPA analysis, as appropriate.

4.11 CUMULATIVE IMPACTS

The cumulative impacts analysis has been conducted in accordance with the Council on Environmental Quality (CEQ) regulations that implement NEPA and the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997).

4.11.1 Methodology and Analytical Baseline

The CEQ regulations implementing NEPA define cumulative effects as "impacts on the environment which result from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). The regulations further explain that "cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." The cumulative impacts assessment is based on both geographic and time considerations. Both site (see Section 4.11.3) and global commons (see Section 4.11.4) cumulative impacts are addressed.

The methodologies used to analyze cumulative impacts of the alternatives evaluated in this *Mercury Storage EIS* are described in more detail in Appendix B, Section B.12. The ROIs used in the cumulative impacts analysis were generally assumed to be within a 16-kilometer (10-mile) radius of each facility location. The general approach to the analysis involves the following process:

- Baseline impacts from past and present actions were identified (i.e., these are the baseline conditions described in Chapter 3).
- The potential impacts produced by the management and storage alternatives were identified (as described in Sections 4.3 through 4.9).
- Reasonably foreseeable future actions were identified.
- Cumulative impacts of the proposed action at the candidate mercury storage sites were estimated.

The analysis of constructing and operating a mercury storage facility(ies) at each site determined that impacts on the various resource areas ranged from none, to negligible, to minor. No resource area at any of the seven candidate storage sites evaluated under the action alternatives was predicted to be impacted at a level greater than minor. In keeping with CEQ regulations (40 CFR 1508.7), those resource areas that were predicted to be impacted in a minor way were evaluated for their potential to contribute to cumulative impacts within the ROI. Where impacts were predicted not to occur or were negligible, cumulative impacts were not analyzed since there would be either no, or only a very small incremental increase in impacts on the resource within the ROI. Thus, cumulative impacts are not addressed for any of the alternative sites for geology and soils, water resources, cultural and paleontological resources, waste management, occupational and public health and safety, socioeconomics, or environmental justice.

Two additional criteria used to determine whether project impacts could contribute to cumulative impacts within the ROI were land disturbance associated with new construction and air quality impacts resulting from mercury emissions. Thus, the following discussion of cumulative impacts addresses mercury emissions for all sites, land use impacts for sites where new construction is required, and resource areas for those sites where impacts were predicted to be minor.

4.11.2 Potential Cumulative Actions

Actions that may contribute to cumulative impacts include on- and offsite projects conducted by government agencies, businesses, or individuals that are within the 16-kilometer (10-mile) ROI considered in this *Mercury Storage EIS*. Information on present and future actions was gathered based on a review of local (i.e., city and county) and Federal Government information, as well as any known plans in the private sector. Additionally, NEPA documents were reviewed to determine if current or proposed projects could affect the cumulative impacts analysis. The potential actions listed in Table 4–71 are those that may contribute to cumulative impacts on or within the ROI of the seven candidate sites evaluated under the action alternatives. Potential contributions to cumulative impacts at non-DOE mercury storage sites under the No Action Alternative were not evaluated because potential changes at existing mercury storage sites are highly speculative. DOE's Y–12 was not evaluated since, under the No Action Alternative, no change is expected to occur at the site relative to mercury management and storage. In general, those actions that are speculative, not yet well defined, or are expected to have a negligible contribution to cumulative impacts are not included in the cumulative impact estimates.

4.11.3 Cumulative Impacts by Site

Cumulative impacts are described for each site under consideration for mercury storage.

4.11.3.1 Grand Junction Disposal Site

The cumulative impacts of locating a mercury storage facility at GJDS on land use, visual resources, air quality, and infrastructure were evaluated and predicted to be negligible. Since there were either no or negligible impacts associated with locating a storage facility at GJDS on geology and soils, water resources, ecological resources, cultural and paleontological resources, waste management, occupational and public heath and safety, socioeconomics, and environmental justice, these resources were not evaluated with respect to their contribution to cumulative impacts.

Table 4–71. Actions That May Contribute to Cumulative Impacts

Location	Description	Reference
Grand Junction Disposal Site		
Onsite DOE action	Open portion of disposal cell will close in 2023	Geiser 2009
Delta County, Colorado	Construction of Solid Waste Disposal Facility	Rice 2009
Hanford Site		
Onsite DOE actions	Central Plateau closure River Corridor Cleanup Project Continuing decommissioning of eight surplus production reactors and their support facilities in the 100 Areas Decommissioning of the N Reactor and its support facilities Actions involving the development and use of borrow pits Continued operation and development of additional disposal cells at the Environmental Restoration Disposal Facility near the 200-West Area Operation of the Waste Treatment Plant Development of an integrated disposal facility Closure of the high-level radioactive waste tanks, decommissioning of the Fast Flux Test Facility, and other actions specified in the *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*	DOE 2009b
	Waste management operations at the Central Waste Complex	DOE 2009d
Onsite Non-DOE actions	Management of the Hanford Reach National Monument and Saddle Mountain National Wildlife Refuge Operations of the US Ecology Commercial Low-Level Radioactive Waste Disposal Facility near the 200-East Area	DOE 2009b
Franklin County, Washington	No major projects are planned for the portion of Franklin County, Washington, within the 16-kilometer ROI	Wendt 2009
Hawthorne Army Depot		
Onsite DoD actions	Long-term management of the defense stockpile of elemental mercury	DLA 2004a
	Ongoing operations of the Defense Environmental Restoration Program	DoD 2009
	Construction and operations of 30-megawatt geothermal facility	DoD 2008; The Humboldt Sun 2009
Offsite action	Construction and operations of transmission line	Hawthorne 2009
Mineral County, Nevada	No major projects are planned within the 16-kilometer ROI	Hartman 2009b
Idaho National Laboratory		
Onsite DOE actions	Construction and operations of Integrated Waste Treatment Unit	INL 2009
	Idaho Cleanup Project	CH2M-WG Idaho 2009a, 2009b, 2009c
Bingham County, Idaho	No major projects are planned within the 16-kilometer ROI	Mecham 2009

Table 4–71. Actions That May Contribute to Cumulative Impacts *(continued)*

Location	Description	Reference
Kansas City Plant		
Offsite action	Plans within the 16-kilometer ROI include 44 nonresidential, 46 residential, and 27 capital improvement projects	Lebofsky 2009
Offsite action	U.S. Route 71 expansion near Grandview, Missouri	Hicks 2009
Savannah River Site		
Onsite DOE actions	Continued transformation of nuclear weapons complex to be smaller, more-responsive, efficient, and secure	DOE 2008b:Table 3.16-4
	Construction and operations of MOX Fuel Fabrication Facility	DOE and NNSA 2009
	Construction and operations of Pit Disassembly and Conversion Facility	DOE 2008b:6.4, 6.5
	Construction and operations of Biomass Cogeneration Facility	DOE 2008c
	High-level waste tank closure	DOE 2002
	Interim remedial action for the E Area low-level waste facility	Sauerborn 2009
Offsite action	Expansion of Vogtle Electric Generating Plant	NRC 2009; Owens 2009
Waste Control Specialists, LLC, Site		
Offsite actions	Widening of Texas State Highway 176	Beverly 2009b
	Construction and operation of Louisiana Energy Services National Enrichment Facility Operation of Wallac Quarry Operation of Lea County Landfill Operation of Sundance Services, Inc. (oilfield services company) Operation of DD Landfarm	WCS 2009

Note: To convert kilometers to miles, multiply by 0.6214.
Key: DoD=U.S. Department of Defense; DOE=U.S. Department of Energy; MOX=mixed oxide; ROI=region of influence.

4.11.3.1.1 Land Use

A mercury storage facility at GJDS would require 3.1 hectares (7.5 acres) of land, with most construction taking place within the developed portion of the site. The only major project planned within the 16-kilometer (10-mile) ROI is a landfill to be constructed in Delta County, Colorado. The landfill is to occupy 45 hectares (110 acres) south of GJDS near the Delta County line. Since construction of the mercury storage facility would be compatible with existing land use at GJDS, would largely take place on previously disturbed land, and would represent a relatively small portion of the planned development within a 16-kilometer (10-mile) radius, the mercury storage facility's contribution to cumulative impacts on land use would be negligible.

4.11.3.1.2 Visual Resources

Construction of a new mercury storage facility at GJDS would result in a minor change to the visual environment. However, the overall BLM VRM Class IV rating of the site would not change. The new Delta County Landfill would be built on undisturbed land and would therefore change the visual appearance of the landfill site; however, these two projects are not within sight of each other. Thus, considering the minor change in the appearance of the GJDS and the distance between it and the proposed landfill, the mercury storage facility's contribution to cumulative impacts on visual resources within the ROI would be negligible.

4.11.3.1.3 Air Quality

As noted in Section 4.4.4.2, construction of the mercury storage facility at GJDS would result in minor short-term impacts on air quality. Emissions would occur over a 6-month construction period and are not expected to result in exceedance of the ambient air quality standards. Due to the short duration of the construction phase of the project, the distance between GJDS and the proposed Delta County Landfill, as well as the likely difference in timing of the projects, cumulative impacts on air quality are unlikely.

As described in Section 4.3.9.1, exposures to the public from small amounts of mercury vapor emitted from storage containers or residual contamination during operation of a mercury storage facility would be expected to have a negligible effect on public health. Mercury inhalation exposure to the public is primarily from exposure to elemental mercury, less than 50 percent of which can be attributed to local sources. Thus, it is regional and background sources that account for the majority of total mercury exposure, except where there are large nearby sources. Inhalation exposures are insignificant when compared with ingestion routes. The primary source of mercury emissions in the United States is coal-fired utility boilers (33 percent of all emissions). Other sources include burning hazardous wastes (19 percent), commercial/industrial boilers (18 percent), medical waste incinerators (10 percent), chlorine production (4.5 percent), and broken mercury products (1 percent). An estimated breakdown of national emissions of mercury is presented in Volume II of the *Mercury Study Report to Congress* (EPA 1997b:5-2). Less than half of the mercury deposition within the United States is estimated to come from sources within the country (EPA 1997b:5-3; 1997c:3-42; 1997e:5-2; 2009c:1; NADP 2005:11). Existing sources of mercury emissions in Mesa County, Colorado, include an electric utility plant and various landfills (EPA 2009d). The Delta County Landfill would be a potential future mercury emission source. For most of the public, inhalation exposures of elemental mercury are insignificant when compared with ingestion of methylmercury (EPA 1997b:5-2).

Transportation of mercury to the storage facility would also result in minor short-term air quality impacts, as is the case for construction; these impacts are not likely to overlap in place and time with operations of the Delta County Landfill. Thus, considering the low levels of emissions, the distance between the two facilities, and potential differences in delivery routes and timing of deliveries, cumulative impacts would be negligible.

4.11.3.1.4 Infrastructure

Construction and operation of a mercury storage facility are not expected to appreciably increase demands on the transportation systems leading to the GJDS. Fuel and water requirements during construction and operation of the storage facility would be minimal and would not impact regional supplies. Both would be delivered by truck on an as-needed basis. Demands for these resources at the Delta County Landfill, while unknown at this time, also are not expected to impact local or regional supplies. Thus, cumulative impacts on fuel and water supplies are not expected.

Electricity demand during construction would be minimal and would likely be supplied by a diesel-fired generator. However, during operation of the facility, electric power requirements would increase the site's annual electrical energy consumption to 268 megawatt-hours. The increase would be nearly 2.5 times the site's existing capacity. As a result, the electrical distribution infrastructure would need to be upgraded to provide adequate electricity for mercury storage facility operations. However, even considering the as-yet-unknown electrical requirement of the Delta County Landfill, the increase in electric power usage within the ROI from these two projects is not expected to have a cumulative impact on the ability of Public Service Company of Colorado to supply power.

4.11.3.2 Hanford Site

The cumulative impacts of locating a mercury storage facility at Hanford on land use and air quality were evaluated and predicted to be negligible. Since there were either no or negligible impacts associated with locating a storage facility at Hanford on visual resources, geology and soils, water resources, ecological resources, cultural and paleontological resources, infrastructure, waste management, occupational and public heath and safety, socioeconomics, and environmental justice, these resources were not evaluated with respect to their contribution to cumulative impacts.

4.11.3.2.1 Land Use

A mercury storage facility would require 3.1 hectares (7.5 acres) of land within the 200-West Area, an area designated as Industrial-Exclusive (see Chapter 3, Section 3.3.1.1). Construction would take place within a 22-hectare (54-acre) disturbed area just to the south of CWC. As noted in Table 4–71, numerous projects with the potential to disturb a large area of land could take place at Hanford. Although Hanford is larger than the 16-kilometer (10-mile) ROI evaluated in this EIS, the cumulative impacts analysis presented within the *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* estimated that nearly 1,100 hectares (2,720 acres) of the site could be affected by past, present, and reasonably foreseeable future actions (DOE 2009b:T-6). Thus, since the mercury storage facility would be built within a disturbed area, would be compatible with existing land use, and would represent a very small percentage of potential Hanford land disturbance, the mercury storage facility's contribution to cumulative impacts on land use would be negligible.

One area of potential conflict with possible future development within the 200-West Area involves the area immediately to the west of CWC. Under certain alternatives considered in the *TC & WM EIS* (DOE 2009b), this area would be used for certain facilities and an expansion of CWC. Although this area slightly overlaps the area selected for a mercury storage facility, both are large enough to easily accommodate proposed development.

4.11.3.2.2 Air Quality

As noted in Section 4.4.4.2, construction of the mercury storage facility at Hanford would result in minor short-term impacts on air quality. Emissions would occur over a 6-month construction period and are not expected to result in exceedance of the ambient air quality standards. Due to the short duration of the project, peak air pollutant concentrations from this and other Hanford projects would likely occur at different times. Thus, minor increases in air pollutants during construction of the mercury storage facility would be unlikely to contribute to cumulative air quality impacts. Emissions from tank closure and waste management activities at Hanford would result in elevated concentrations of carbon monoxide and particulate matter within the ROI (DOE 2009b).

Exposures to the public from small amounts of mercury vapor emitted from storage containers or residual contamination during operation of a mercury storage facility are expected to have a negligible effect on public health. Sources of mercury inhalation exposure to the public are discussed in Section 4.11.3.1.3. Existing sources of mercury emissions in Benton County, Washington, include a manufacturing plant and a landfill (EPA 2009d).

Transportation would also result in minor short-term air quality impacts, as is the case for construction impacts; these impacts are not likely to overlap in place and time with other projects and activities within the ROI. Since transportation-related air quality impacts associated with mercury storage and other activities within the ROI would be short term and are not expected to substantially change existing baseline conditions, their contribution to cumulative impacts would be negligible.

4.11.3.3 Hawthorne Army Depot

The cumulative impact of locating a mercury storage facility at the Hawthorne Army Depot on air quality was evaluated and predicted to be negligible. Since there were either no or negligible impacts associated with locating a storage facility at the Hawthorne Army Depot on land use, visual resources, geology and soils, water resources, ecological resources, cultural and paleontological resources, infrastructure, waste management, occupational and public heath and safety, socioeconomics, and environmental justice, these resources were not evaluated with respect to their contribution to cumulative impacts.

Negligible short-term air quality impacts would result from modification of existing structures for mercury storage in the Central Magazine Area. However, the proposed storage location is immediately adjacent to the area that will store DNSC mercury. The analysis of the impacts of storing DNSC mercury concluded that modifications to existing facilities would be negligible (DLA 2004a). Thus, considering that the Hawthorne Army Depot is in a rural area with few nearby sources of air pollution and few air quality issues, and that the modification of existing facilities to accommodate the storage of mercury for both the proposed DOE and DNSC projects would have negligible impacts, cumulative air quality impacts would be negligible.

Exposures to the public from small amounts of mercury vapor emitted from storage containers or residual contamination during operation of a mercury storage facility are expected to have a negligible effect on public health. Sources of mercury inhalation exposure to the public are discussed in Section 4.11.3.1.3. There are no existing sources of mercury emissions reported in Mineral County, Nevada (EPA 2009d); however, the storage of DNSC mercury would be a potential future source of public exposure to elemental mercury. Still, the analysis of the impacts of storing DNSC mercury concluded that there would be negligible cumulative impacts on public health associated with storing DNSC mercury at Hawthorne Army Depot (DLA 2004a). Thus, considering the levels of mercury projected to be emitted from both storage projects, and that no other existing sources of mercury emissions are reported for Mineral County, it is unlikely that cumulative air quality impacts would result.

As described in Section 4.5.4.2, air quality impacts from transporting mercury to a storage facility at the Hawthorne Army Depot were predicted to be minor and of short duration. Also, they are not likely to overlap in place and time with other activities within the ROI. For example, although shipments associated with the storage of mercury analyzed in this EIS would take place over the 40-year period of analysis, those associated with DNSC mercury would occur over a period of a few months (DLA 2004a). Other projects listed in Table 4–71 are also expected to have short-term transportation impacts on air quality. Since transportation-related air quality impacts associated with mercury storage and other activities within the ROI are not expected to substantially differ from existing baseline conditions, cumulative impacts would be negligible.

4.11.3.4 Idaho National Laboratory

The cumulative impacts of locating a mercury storage facility at INL on land use and air quality were evaluated and predicted to be negligible. Since there were either no or negligible impacts associated with locating a storage facility at INL on visual resources, geology and soils, water resources, ecological resources, cultural and paleontological resources, infrastructure, waste management, occupational and public heath and safety, socioeconomics, and environmental justice, these resources were not evaluated with respect to their contribution to cumulative impacts.

4.11.3.4.1 Land Use – Idaho Nuclear Technology and Engineering Center

A mercury storage facility at INTEC, which is located within the Central Core Area of INL, would require 3.1 hectares (7.5 acres) of land. The Integrated Waste Treatment Unit, which is being constructed at INTEC as part of the Idaho Cleanup Project, is the only other major project being undertaken at INL.

Since both the proposed mercury storage facility and the Integrated Waste Treatment Unit would encompass limited acreage and would be compatible with existing land use at INL, their contributions to cumulative impacts on land use would be negligible.

4.11.3.4.2 Land Use – Radioactive Waste Management Complex

There would be no cumulative impacts on land use at INL if RWMC is the location selected for mercury storage. This is the case since an existing structure would be used in place of building a new facility.

4.11.3.4.3 Air Quality

As noted in Section 4.6.4.2, construction of the mercury storage facility at INTEC would result in minor short-term impacts on air quality, while those associated with modifying existing storage modules at RWMC would be negligible. Emissions at INTEC would occur over a 6-month construction period and are not expected to result in exceedance of ambient air quality standards. Due to the short duration of construction, peak air pollutant concentrations would likely occur at different times than those of the Integrated Waste Treatment Unit. Thus, increases in air emissions during construction of the mercury storage facility would be unlikely to contribute to cumulative air quality impacts.

Exposures to the public from small amounts of mercury vapor emitted from storage containers or residual contamination during operation of a mercury storage facility are expected to have a negligible effect on public health. Sources of mercury inhalation exposure to the public are discussed in Section 4.11.3.1.3. Existing sources of mercury emissions in Bingham, Butte, and Jefferson Counties in Idaho include a food processing plant, INL, and various landfills (EPA 2009d).

Air quality impacts from transporting mercury to a storage facility at either INTEC or RWMC would be minor, of short duration, and are not likely to overlap in place and time with those associated with the Integrated Waste Treatment Unit. Since transportation-related air quality impacts associated with mercury storage and the Integrated Waste Treatment Unit would be short term and are not expected to substantially change existing baseline conditions, their contribution to cumulative impacts would be negligible.

4.11.3.5 Kansas City Plant

The cumulative impacts of locating a mercury storage facility at KCP on air quality were evaluated and predicted to be negligible. Since there were either no or negligible impacts associated with locating a storage facility at KCP on land use, visual resources, geology and soils, water resources, ecological resources, cultural and paleontological resources, infrastructure, waste management, occupational and public heath and safety, socioeconomics, and environmental justice, these resources were not evaluated with respect to their contribution to cumulative impacts.

As addressed in Section 4.7.4.2, negligible short-term air quality impacts with little or no measurable effect on air quality standards would result from modification of the existing Main Manufacturing Building at KCP. Also, exposures to the public from small amounts of mercury vapor emitted from storage containers or residual contamination during operation of a mercury storage facility are expected to have a negligible effect on public health. Sources of mercury inhalation exposure to the public are discussed in Section 4.11.3.1.3. Existing sources of mercury emissions in Jackson County, Missouri, and Wyandotte County, Kansas, include electric utility plants, several manufacturing plants, a water treatment plant, and various landfills (EPA 2009d).

The transportation of mercury to a storage facility at KCP was predicted to have minor impacts on air quality; these impacts are not likely to overlap in place and time with the many other activities within the ROI (see Table 4–71). Due to the very large volume of traffic within the ROI, the limited air emissions from site-related traffic are not expected to substantially change baseline conditions; thus, their cumulative contributions to impacts on air quality would be negligible.

4.11.3.6 Savannah River Site

The cumulative impacts of locating a mercury storage facility at SRS on land use and air quality were evaluated and predicted to be negligible. Since there were either no or negligible impacts associated with locating a storage facility at SRS on visual resources, geology and soils, water resources, ecological resources, cultural and paleontological resources, infrastructure, waste management, occupational and public heath and safety, socioeconomics, and environmental justice, these resources were not evaluated with respect to their contribution to cumulative impacts.

4.11.3.6.1 Land Use

A mercury storage facility would require 3.1 hectares (7.5 acres) of land. This disturbance would take place within E Area, which is located within the Industrial Core Management Area of SRS. As noted in Table 4–71, numerous projects, including the interim remedial action at the E Area low-level waste facility, are planned within the ROI both on and off SRS. These projects would generally take place within disturbed areas or be located adjacent to existing facilities. Since the mercury storage facility would represent a small percentage of potential future land disturbance within the ROI and would be compatible with existing land use, its contribution to cumulative impacts on land use would be negligible.

4.11.3.6.2 Air Quality

As noted in Section 4.8.4.2, construction of the mercury storage facility at SRS would result in minor short-term impacts on air quality. Emissions would occur over a 6-month construction period and are not expected to result in exceedance of the ambient air quality standards. Due to the short duration of the project, peak air pollutant concentrations from this and other projects within the ROI would likely occur at different times. Thus, minor increases in air pollutants during construction of the mercury storage facility would be unlikely to contribute to cumulative air quality impacts. Existing contributions of SRS activities to concentrations of particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers within the ROI approach the 24-hour average standard (see Chapter 3, Table 3–15).

Exposures to the public from small amounts of mercury vapor emitted from storage containers or residual contamination during operation of a mercury storage facility are expected to have a negligible effect on public health. Sources of mercury inhalation exposure to the public are discussed in Section 4.11.3.1.3. Existing sources of mercury emissions in Aiken, Allendale, and Barnwell Counties, South Carolina, and Burke and Richmond Counties, Georgia, include electric utility plants, several manufacturing plants, SRS, and various landfills (EPA 2009d).

Transportation of mercury to a storage facility at SRS would result in minor short-term air quality impacts. As is the case for construction, impacts are not likely to overlap in place and time with other projects and activities within the ROI. Since transportation-related air quality impacts associated with mercury storage and other activities within the ROI would be of short duration and are not expected to substantially change existing baseline conditions, their contribution to cumulative impacts would be negligible.

4.11.3.7 Waste Control Specialists, LLC, Site

The cumulative impacts of locating a mercury storage facility at WCS on land use, visual resources, air quality, and ecological resources were evaluated and predicted to be negligible. Since there were either no or negligible impacts associated with locating a storage facility at WCS on geology and soils, water resources, cultural and paleontological resources, infrastructure, waste management, occupational and public heath and safety, socioeconomics, and environmental justice, these resources were not evaluated with respect to their contribution to cumulative impacts.

4.11.3.7.1 Land Use

A mercury storage facility at WCS, which would be constructed within an undeveloped portion of the site, would require 3.1 hectares (7.5 acres) of land. As noted in Table 4–71, there are a number of projects planned and under way within the ROI that would disturb a relatively large area of land within the ROI. Much of this development is concentrated along the State Highway 176 corridor (including widening of the highway itself) in the immediate vicinity of WCS. Although the mercury storage facility would add to the developing nature of the ROI, due to the limited area of disturbance, its contribution to cumulative impacts on land use would be negligible.

There would be no cumulative impacts on land use at WCS from use of the existing CSB for interim mercury storage.

4.11.3.7.2 Visual Resources

The overall BLM VRM Class IV rating of the site would not change, but the facility would result in a minor change to the local visual environment. Although the mercury storage facility would add to the changing viewscape of the ROI, due to its location adjacent to existing facilities and relatively small size, its contribution to cumulative impacts on visual resources would be negligible.

4.11.3.7.3 Air Quality

As noted in Section 4.9.4.2, construction of the mercury storage facility at WCS would result in minor short-term impacts on air quality. Emissions would occur over a 6-month construction period and are not expected to result in exceedance of the ambient air quality standards. Due to the short duration of the project, peak air pollutant concentrations from this and other projects within the ROI would likely occur at different times. Thus, minor increases in air emissions during construction of the mercury storage facility would be unlikely to contribute to cumulative air quality impacts.

Exposures to the public from small amounts of mercury vapor emitted from storage containers or residual contamination during operation of a mercury storage facility are expected to have a negligible effect on public health. Sources of mercury inhalation exposure to the public are discussed in Section 4.11.3.1.3. Existing sources of mercury emissions in Andrews County, Texas, and Lea County, New Mexico, include WCS and various landfills (EPA 2009d).

Transportation of mercury to a storage facility at WCS would also result in minor short-term air quality impacts; as is the case for construction, these impacts are not likely to overlap in place and time with other projects and activities within the ROI. Since transportation-related air quality impacts associated with mercury storage and other activities within the ROI would be short term and are not expected to substantially change existing baseline conditions, their contribution to cumulative impacts would be negligible.

Transportation impacts associated with use of the CSB would be similar to those described above for new facility construction.

4.11.3.7.4 Ecological Resources

A mercury storage facility could be built either to the north or south of the existing developed portion (facilities area) of WCS. Neither of these areas has been disturbed by current site development, and each exhibits terrestrial resources common to the area (see Chapter 3, Section 3.8.5). Construction of a mercury storage facility would result in the loss of 3.1 hectares (7.5 acres) of habitat. As noted in Table 4–71, numerous projects are planned, or have been built, within the ROI, with most development along the State Highway 176 corridor. While the total acreage involved is not available, all of these projects have disturbed native habitat. Although mercury storage facility construction would remove a small area of habitat, its contribution to cumulative impacts on terrestrial resources would be negligible. Due to the lack of occurrence of (or disturbance to) wetlands, aquatic resources, or threatened or endangered species within the potential development sites, the new facility would not contribute to cumulative impacts on those resources.

4.11.4 Global Commons Cumulative Impacts

Cumulative effects may also occur on a global scale. Both ozone depletion and global climate change are addressed below as they relate to the proposed mercury storage facility.

4.11.4.1 Ozone Depletion

The *Mercury Storage EIS* alternatives are not expected to use or discharge substantial quantities of any ozone-depleting compounds. Construction and operations activities would be accomplished using materials and equipment formulated to be compliant with laws and regulations to reduce the use of ozone-depleting compounds. Any release of ozone-depleting compounds would be incidental to the conduct of the *Mercury Storage EIS* activities. Emissions of ozone-depleting compounds would be very small and would represent a negligible contribution to the destruction of the Earth's protective ozone layer.

4.11.4.2 Global Climate Change

The "natural greenhouse effect" is the process by which part of terrestrial radiation is absorbed by gases in the atmosphere, warming the Earth's surface and atmosphere. This greenhouse effect and the Earth's radiation balance are affected largely by water vapor, carbon dioxide, and trace gases, which absorb infrared radiation and are referred to as greenhouse gases. Other greenhouse gases include nitrous oxide, halocarbons, and methane.

There is consensus among scientists, including those on the Intergovernmental Panel on Climate Change (IPCC), that increases in atmospheric concentrations of certain pollutants can produce changes in the Earth's atmospheric energy balance and thereby influence global climate. These pollutants are commonly referred to as "greenhouse gases," and this warming effect is referred to as "global warming." Water vapor (1 percent of the atmosphere) is the most common and dominant greenhouse gas; only small amounts of water vapor are produced as the result of human activities. The principal greenhouse gases resulting from human activities are carbon dioxide, methane, nitrous oxide, and halocarbons. Halocarbons include chlorofluorocarbons; hydrofluorocarbons, which are replacing chlorofluorocarbons as refrigerants; and perfluorocarbons, which are a byproduct of aluminum smelting. Other gases of concern include sulfur hexafluoride, which is widely used in insulation for electrical equipment. These gases are released in different quantities and have different potencies in their contributions to global warming (IPCC 2007; Justus and Fletcher 2006).

Sources of anthropogenic carbon dioxide include combustion of fossil fuels such as natural gas, oil, gasoline, and coal. It is estimated that carbon dioxide atmospheric levels have risen by more than 35 percent since the preindustrial period (since 1750) as a result of human activities. Emissions of other greenhouse gases have also risen. Annual global emissions of carbon dioxide were estimated to be 26.4 billion metric tons (29.1 billion tons) per year from 2000 through 2005 from fossil fuel use worldwide (IPCC 2007:3). Carbon dioxide is the most important anthropogenic greenhouse gas and is therefore of primary concern in this EIS.

The IPCC concluded that warming of the Earth's climate system is unequivocal, and that most of the observed increase in global average temperatures is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. The IPCC reports potential impacts from warming of the climate system, including expansion of sea water volume; decreases in mountain glaciers and snow cover resulting in sea level rise; changes in arctic temperatures and ice; changes in precipitation, ocean salinity, and wind patterns; and changes in extreme weather (IPCC 2007:3–8).

The release of anthropogenic greenhouse gases and their potential contribution to global warming are inherently cumulative phenomena. Cumulative impacts of the emission of carbon dioxide and other greenhouse gases from *Mercury Storage EIS* alternatives and other activities at the candidate sites and throughout the region would contribute to changes related to global climate discussed above. As described in this chapter (see Tables 4–15 and 4–16) and Appendix C, Section C.2, the *Mercury Storage EIS* alternatives could produce various quantities of carbon dioxide from construction and operation. Specifically, the emission estimates for the *Mercury Storage EIS* alternatives account for facility-specific fuel-burning sources from construction activity and mobile source emissions from mercury shipments. Emissions from employee vehicles and indirect emissions from electricity use were not estimated.

Greenhouse gas emissions projected from the proposed mercury storage facility are relatively small compared with the 26.4 billion metric tons (29.1 billion tons) of carbon dioxide emitted worldwide from fossil fuel use (IPCC 2007:3) and the 5.98 billion metric tons (6.59 billion tons) (EPA 2008:ES-5) of estimated U.S. carbon dioxide emissions in 2006. However, emissions from the storage facility(ies), in combination with past and future emissions from all other sources, would contribute incrementally to the climate change impacts described above. Although the cumulative emissions of greenhouse gases and the impacts on global climate and the resulting environmental, economic, and social consequences could be significant, at present there is no methodology that would allow DOE to estimate the specific impacts (if any) this increment of climate change would produce in the vicinity of the storage facility(ies) or elsewhere.

4.12 MITIGATION MEASURES

This section summarizes the mitigation measures that could be used to avoid or reduce environmental impacts resulting from implementation of the alternatives, as described in the preceding sections. As specified in CEQ's NEPA regulations (40 CFR 1508.20), mitigation includes the following:

- Avoiding impacts altogether by not taking a certain action or parts of an action
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation
- Rectifying impacts by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating impacts over time by preserving and maintaining the affected environment during duration of the action
- Compensating for impacts by replacing or providing substitute resources or environments

Following the completion of an EIS and its associated Record of Decision (ROD), DOE is required to prepare a mitigation action plan that addresses any mitigation commitments expressed in the ROD (10 CFR 1021.331). If the ROD contains no mitigation commitments, a mitigation action plan is not required. The mitigation action plan would explain how certain measures would be planned and implemented to mitigate any adverse environmental impacts identified in the ROD. The mitigation action plan would be prepared before DOE would take any action requiring mitigation.

As described throughout this chapter, the impacts of construction and normal operations of the DOE-designated mercury storage facility(ies) would be negligible to minor and would not require mitigation to reduce impacts to acceptable levels. Activities associated with the establishment of a new mercury storage facility would follow standard procedures for minimizing construction impacts on such resources as air quality and surface water, as well as operational impacts on public health and safety, including accident prevention. These practices are required by Federal and state licensing and permitting requirements, as noted throughout this chapter and further discussed in Chapter 5. Further, DOE has considered mitigation in the formulation of the alternatives as currently proposed, which serve to prevent or reduce short- and/or long-term environmental impacts. Specifically, site location, design, and construction of the proposed new mercury storage facility would be conducted in accordance with the standards specified under Title 40 of the CFR, Part 264, for hazardous waste TSD facilities. These include but are not limited to the location and performance standards for new RCRA-permitted facilities under Title 40 of the CFR, Section 264.18 that address seismic considerations, floodplains, and other natural hazards.

Nonetheless, mitigation measures could be used to further reduce potential mercury vapor emissions from mercury storage facility operations. Although mercury vapor emissions during normal operations would be below all applicable standards, emissions could be further reduced by using mercury vapor filters and by lowering the temperature of the air in the storage building through the use of air conditioning. Filters would actively remove mercury vapor as air passes through the filters, and air conditioning would reduce mercury vapor emissions because cooler temperatures result in less mercury vaporization. Although mercury vapor filters could be used to further reduce mercury emissions, these filters would require expensive changes in facility design, as well as changes in operations and maintenance procedures. They would also generate additional hazardous waste (e.g., spent filters) requiring disposal. Although air conditioning could be used to further reduce mercury vapor emissions, air conditioning equipment would be expensive both to install and to operate (e.g., maintenance and energy costs) and would consume electrical energy that may be generated by burning greenhouse-gas-generating fossil fuels.

4.13 RESOURCES

This section describes any unavoidable adverse environmental impacts that could result from implementation of the alternatives; irreversible and irretrievable commitments of resources; and the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. Unavoidable adverse environmental impacts are impacts that would occur after implementation of all feasible mitigation measures. A resource commitment is considered irreversible when direct and indirect impacts from its use limit future use options. Irreversible commitments apply primarily to nonrenewable resources, such as cultural resources, and also to those resources that are renewable only over long periods of time, such as soil productivity. A resource commitment is considered irretrievable when the use or consumption of the resource is neither renewable nor recoverable for future use. Irretrievable commitment applies to the loss of production, harvest, or natural resources. The relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity addresses issues associated with the condition and maintenance of existing environmental resources used to support the proposed action and the function of these resources after their use.

4.13.1 Unavoidable Adverse Environmental Impacts

Implementing any of the action alternatives considered in the EIS for the long-term storage of elemental mercury would result in unavoidable adverse impacts on the human environment. In general, these impacts are expected to be negligible overall and would arise from incremental impacts attributed to the construction and normal operations of new and/or modified mercury storage facilities at any of the seven candidate sites.

As further described in this chapter, construction of a new mercury storage facility at any site would result in land disturbance, generation of fugitive dust and noise, soil erosion, consumption of utilities and natural resources, and increased vehicle traffic that would be unavoidable, even with the application of best management and conservation practices. These activities would generally occur in or adjacent to previously disturbed areas with existing complementary land uses. Construction activities are expected to have negligible impacts overall and would be temporary in nature (i.e., lasting up to 6 months). The completed mercury storage facility would occupy up to 3.1 hectares (7.5 acres) of land over the long term (assumed, for purposes of analysis, to be up to 40 years). Activities performed to modify or upgrade existing facilities for long- term storage of elemental mercury would also result in some unavoidable adverse impacts that would generally be similar to but less than those noted above for construction of a new storage facility.

Operations of new or modified facilities at any of the seven candidate sites would have minimal unavoidable adverse impacts on air quality associated with semiannual testing of diesel fuel–fired emergency generators. Emissions would also be generated from employee vehicle trips, relatively infrequent delivery vehicle trips, and truck trips for transporting elemental mercury to the facility. The associated emissions would not measurably degrade ambient air quality or jeopardize impact compliance with air quality standards around any candidate site.

Also unavoidable would be the generation of small amounts of hazardous and industrial waste associated with normal facility operations. Any waste generated during operations would be collected, packaged, and eventually removed for suitable recycling or disposal in accordance with applicable EPA and/or state regulations. Sanitary wastewater would also be generated and disposed of through onsite sewage disposal systems or municipal sanitary sewer systems, as appropriate for each site.

Under the No Action Alternative, operation of non-DOE mercury storage facilities and Y–12 would also result in some unavoidable adverse impacts in terms of air emissions, consumption of utility resources, and waste generation. However, at some storage locations, mercury storage may necessitate that the owners provide for expanded storage, resulting in additional construction and operational environmental impacts (see Section 4.2).

Future closure of mercury storage facilities (see Section 4.10) would result in the one-time generation of waste material. Such waste would be collected, packaged as appropriate, and removed for suitable recycling or disposal in accordance with applicable EPA and/or state regulations.

4.13.2 Irreversible and Irretrievable Commitment of Resources

This section summarizes the major irreversible and irretrievable commitments of resources that have been identified under each alternative considered in this *Mercury Storage EIS*. Implementation of any of the alternatives considered for long-term storage of elemental mercury, including the No Action Alternative, would entail the commitment of land, energy (e.g., electricity, fossil fuels), water, construction materials (e.g., steel, concrete), geologic resources, equipment, human labor, and capital. In general, the commitments of energy, materials, labor, and capital would be irreversible and, once committed, these resources would be unavailable for other purposes. Capital would be committed permanently. In addition, the generation of waste would indirectly entail the irreversible and irretrievable commitment of resources due to the land required for landfill space, utilities consumed to operate disposal facilities, and human labor.

Key resource commitments for construction and operation of a new mercury storage facility are presented in Appendix C, Tables C–2 and C–4. The No Action Alternative would entail the least commitment of land, material, and energy resources based on the analyses presented in this chapter.

4.13.2.1 Land Use

Operation of modified existing facilities or proposed new facilities for mercury storage would require the commitment of land to the prescribed use over the 40-year period of analysis considered in this EIS. Thus, the commitment of land is irreversible in the short term, but not necessarily irreversible over the long term. Over the long term, the land that would be occupied by either existing or proposed facilities could ultimately be returned to open space uses if buildings, roads, and other structures were removed and the land revegetated. Alternatively, the facilities could be modified for use in other DOE programs.

4.13.2.2 Energy and Water

Energy expended directly or indirectly to support long-term storage of mercury would be in the form of electricity to operate equipment and fossil fuels to operate equipment and vehicles. Electricity and fuels would be purchased from commercial sources. Consumption of electricity and fossil fuels would be an irretrievable commitment of nonrenewable resources. Water consumed for construction and operations would constitute an irreversible commitment and would not be available for other uses. Water would be obtained via each site's existing water supply system, as described in this chapter. However, these resources are readily available, and the amounts projected to be required are not expected to deplete available supplies.

4.13.2.3 Materials and Geologic Resources

The irreversible and irretrievable commitment of materials, equipment, and other resources comprises those used in the modification or new construction of mercury storage facilities at the candidate sites. This includes materials that cannot be recovered or recycled, materials that are contaminated and cannot be effectively decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Principal construction materials would include steel, concrete (a product of cement, sand, gravel, and other minerals), asphalt, and gravel, although other materials such as wood, plastics, and other metals would also be used (see Appendix C, Section C.2.3). For practical purposes, materials including concrete and steel and other materials incorporated into the framework of existing or new facilities would be unrecoverable and irretrievably lost. Certain materials and equipment used during operation of the storage facilities could be recycled when the facilities are closed. All materials and commodities would be procured from commercial vendors in the regions surrounding each candidate site, and all are commonly available materials that are not expected to be in short supply in the affected regions.

4.13.2.4 Waste

Mercury storage operations at any candidate site would generate nonrecyclable waste streams, such as solid waste, sanitary wastewater, and potentially hazardous (mercury-contaminated) waste. The treatment and disposal of any solid waste would cause irreversible and irretrievable commitments of landfill space, energy, and materials. Hazardous waste disposal would require an irreversible and irretrievable commitment of land. This space would be unavailable for wastes from other sources. Sanitary wastewater generated and discharged to treatment systems and/or to the land would eventually be recycled through the ecosphere and would not entail a permanent commitment or impairment of resources.

4.13.3 Relationship Between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

Under each action alternative, adverse impacts from short-term use of resources would be balanced by long-term benefits and enhancement of long-term productivity associated with the reduction of elemental mercury in the environment. Each of the action alternatives would entail similar relationships between local, short-term uses of the environment and the maintenance and enhancement of long-term productivity. However, there would be differences in the relative magnitude of the short-term uses based on differences in location, including use of existing and/or new storage facilities, utility and transportation infrastructure availability, and labor availability and utilization. Regardless, upon completion of mercury storage activities at any of the candidate locations, land and facilities could be returned to other uses, including long-term productive uses (see Section 4.13.2.1).

Under the No Action Alternative, environmental resources have already been committed to activities Y–12 and, possibly, at some existing source locations. There could be environmental impacts at non-DOE storage sites in the short term associated with the need to provide for new or increased storage requirements. Such activities could adversely affect the long-term productivity of the environment.

4.14 REFERENCES

ATSDR (Agency For Toxic Substances and Disease Registry), 2009a, *Health Consultation Proposed Mercury Clean-Up Level For The East Fork Poplar Creek Flood Plain Soil, Oak Ridge, Tennessee*, U.S. Department of Health and Human Services, Public Health Service, accessed through http://www.atsdr.cdc.gov/HAC/pha/efork2/oak_p1.html, November 12.

ATSDR (Agency For Toxic Substances and Disease Registry), 2009b, *Public Health Consultation: Y–12 Weapons Plant Chemical Releases into East Fork Poplar Creek, Oak Ridge, Tennessee*, U.S. Department of Health and Human Services, Public Health Service, accessed through http://www.atsdr.cdc.gov/hac/pha/efork1/y12_p1.html, November 12.

Beverly, M., 2009a, County Manager, Lea County, Lovington, New Mexico, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, September 24.

Beverly, M., 2009b, County Manager, Lea County, Lovington, New Mexico, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Future Plans in the Waste Control Specialists Site Region," July 29.

CDC (Centers for Disease Control and Prevention), 2009, *Documentation for Immediately Dangerous to Life or Health Concentrations*, and *1988 OSHA PEL Project Documentation*, accessed through http://www.cdc.gov/niosh/database.html, June 11.

CEQ (Council on Environmental Quality), 1997, *Considering Cumulative Effects Under the National Environmental Policy Act*, Executive Office of the President, Washington, D.C., January.

CH2M-WG Idaho, 2009a, *Safely Delivering the Idaho Cleanup Project*, accessed through https://idahocleanupproject.com/, December 1.

CH2M-WG Idaho, 2009b, *Idaho Cleanup Project, Idaho Nuclear Technology and Engineering Center (INTEC)*, accessed through https://idahocleanupproject.com/Progress/INTEC/tabid/127/Default.aspx, December 1.

CH2M-WG Idaho, 2009c, *Idaho Cleanup Project, Radioactive Waste Management Complex (RWMC)*, accessed through https://idahocleanupproject.com/Progress/RWMC/tabid/130/Default.aspx, December 1.

DLA (Defense Logistics Agency), 2004a, *Final Mercury Management Environmental Impact Statement*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DLA (Defense Logistics Agency), 2004b, *Human Health and Ecological Risk Assessment Report for the "Mercury Management EIS,"* Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DoD (U.S. Department of Defense), 2008, "Army Launches New Energy Initiative, Test Projects at Posts," accessed through http://www.army.mil/-newsreleases/2008/10/06/13073-army-launches-new-energy-initiatives-test-projects-at-posts/, October 6.

DoD (U.S. Department of Defense), 2009, *Defense Environmental Restoration Program*, Environmental Command, accessed through http://aec.army.mil/usaec/cleanup/derp00.html, August 28.

DOE (U.S. Department of Energy), 2000, *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, D.C., December.

DOE (U.S. Department of Energy), 2002, *Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement*, DOE/EIS-0303, Savannah River Operations Office, accessed through http://www.gc.energy.gov/NEPS/finalEIS-0303.htm, May.

DOE (U.S. Department of Energy), 2004, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, 2nd ed., Office of NEPA Policy and Compliance, December.

DOE (U.S. Department of Energy), 2008a, *Idaho National Laboratory Site Environmental Report, Calendar Year 2007*, DOE/ID-12082(07), Idaho Operations Office, Environmental Surveillance, Education and Research Program, Idaho Falls, Idaho, September.

DOE (U.S. Department of Energy), 2008b, *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*, DOE/EIS-0236-S4, National Nuclear Security Administration, Washington, D.C., October.

DOE (U.S. Department of Energy), 2008c, *Environmental Assessment for Biomass Cogeneration and Heating Facilities at the Savannah River Site*, DOE/EA-1605, Savannah River Operations Office, Aiken, South Carolina, August.

DOE (U.S. Department of Energy), 2009a, *Idaho National Laboratory Cultural Resource Management Plan*, DOE/ID-10997, Rev. 3, Idaho Operations Office, accessed through http://www.inl.gov/technicalpublications/Documents/4192201.pdf.

DOE (U.S. Department of Energy), 2009b, *Draft Tank Closure and Waste Management Environmental Impact Statement of the Hanford Site, Richland, Washington*, DOE/EIS-0391, Office of River Protection, October.

DOE (U.S. Department of Energy), 2009c, *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury*, November 13.

DOE (U.S. Department of Energy), 2009d, *Solid Waste Integrated Forecast Technical (SWIFT) Report 2008.0: FY2008 to FY2035, Central Waste Complex*, accessed through http://www.hanford.gov/swift/Onsite/cwc.htm, December 1.

DOE and Mesa County (U.S. Department of Energy and Mesa County Board of Commissioners), 1996, Memorandum of Understanding Between the United States Department of Energy and the Mesa County Board of Commissioners Regarding Utilization of the Cheney Repository, April 24.

DOE and NNSA (U.S. Department of Energy and National Nuclear Security Administration), 2009, *Mixed Oxide Fuel Fabrication Facility*, accessed through http://www.moxproject.com/images/factsheets/mfff.pdf, October 10.

EPA (U.S. Environmental Protection Agency), 1997a, *Mercury Study Report to Congress*, Vol. V, *Health Effects of Mercury and Mercury Compounds*, EP9-452/R-97-007, Office of Air Quality Planning and Standards and Office of Research and Development, accessed through http://epa.gov/mercury/report.htm, December.

EPA (U.S. Environmental Protection Agency), 1997b, *Mercury Study Report to Congress*, Vol. II, *An Inventory of Anthropogenic Mercury Emissions in the United States*, EPA-452/R-97-004, Office of Air Quality Planning and Standards and Office of Research and Development, accessed through http://epa.gov/mercury/report.htm, December.

EPA (U.S. Environmental Protection Agency), 1997c, *Mercury Study Report to Congress*, Vol. IV, *An Assessment of Exposure to Mercury in the United States*, EPA-452/R-97-006, Office of Air Quality Planning and Standards and Office of Research and Development, accessed through http://epa.gov/mercury/report.htm, December.

EPA (U.S. Environmental Protection Agency), 1997d, *Mercury Study Report to Congress*, Vol. III, *Fate and Transport of Mercury in the Environment*, EPA-452/R-97-005, Office of Air Quality Planning and Standards and Office of Research and Development, accessed through http://epa.gov/mercury/report.htm, December.

EPA (U.S. Environmental Protection Agency), 1997e, *Mercury Study Report to Congress*, Vol. VII, *Characterization of Human Health and Wildlife Risks from Mercury Exposure in the United States*, EPA-452/R-97-009, Office of Air Quality Planning and Standards and Office of Research and Development, accessed through http://epa.gov/mercury/report.htm, December.

EPA (U.S. Environmental Protection Agency), 2003, *User's Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model*, EPA420-R-03-010, Assessment and Standards Division, Office of Transportation and Air Quality, August.

EPA (U.S. Environmental Protection Agency), 2007, *Mercury Storage Cost Estimates*, Office of Pollution Prevention and Toxics and Office of Solid Waste and Emergency Response, Washington, D.C., November.

EPA (U.S. Environmental Protection Agency), 2008, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2006*, accessed through http://www.epa.gov/climatechange/emissions/usinventoryreport.html, April 15.

EPA (U.S. Environmental Protection Agency), 2009a, *Mercury Vapor Results*, AEGL Program, accessed through http://www.epa.gov/oppt/aegl/pubs/rest184.htm, February 13.

EPA (U.S. Environmental Protection Agency), 2009b, *Emission Factors for Locomotives*, EPA-420-F-09-025, Office of Transportation and Air Quality, accessed through http://epa.gov/oms/locomotives.htm, April.

EPA (U.S. Environmental Protection Agency), 2009c, *Basic Information, Mercury*, accessed through http://www.epa.gov/mercury/about.htm, November 11.

EPA (U.S. Environmental Protection Agency), 2009d, *Facility Emissions Report – Hazardous Air Pollutants* (Search Parameters: Mercury Compounds, 2002, Colorado, Idaho, Kansas, Missouri, Nevada, New Mexico, South Carolina, Texas, and Washington), accessed through http://www.epa.gov/air/data/ntiemis.html, November 13.

EPA (U.S. Environmental Protection Agency), 2009e, *Integrated Risk Information System, Mercury, Elemental* (CASRN 7439-97-6), accessed through http://www.epa.gov/NCEA/iris/subst/0370.htm, November 18.

Geiser, D.W., 2009, *Response to Expression of Interest: Facility for the Long-Term Management and Storage Elemental Mercury*, U.S. Department of Energy, Office of Legacy Management, Washington, D.C., April 24.

GreenFacts, 2009, *Scientific Facts on Mercury*, accessed through http://www.greenfacts.org/en/mercury/l-3/mercury-1.htm, December 17.

Hartman, S., 2009a, Mineral County Planning Commission, Hawthorne, Nevada, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, September 24.

Hartman, S., 2009b, Mineral County Planning Commission, Hawthorne, Nevada, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Future Plans in the Hawthorne Army Depot Region," July 30.

Hawthorne (Hawthorne Army Depot), 2009, *"Mercury Storage EIS" Data Call Response.*

Hicks, J., 2009, Cass County, Missouri, Planning and Zoning Department, Harrisonville, Missouri, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Future Plans in the Kansas City Plant Region," July 30.

INL (Idaho National Laboratory), 2009, *"Mercury Storage EIS" Data Call Response*.

IPCC (Intergovernmental Panel on Climate Change), 2007, *A Report of Working Group I of the Intergovernmental Panel on Climate Change, Summary for Policymakers*, Cambridge, United Kingdom, and New York, New York.

Justus, J.R., and S.R. Fletcher, 2006, *CRS Issue Brief for Congress: Global Climate Change*, IB89005 Congressional Research Service, Library of Congress, accessed through http://www.ncseonline.org/nle/crsreports/06apr/IB89005.pdf, May 12.

Lebofsky, S., 2009, City Planning and Development Department, Kansas City, Missouri, personal communication (email) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Projects Within 10 Miles of the Bannister Federal Complex," July 31.

Mecham, W., 2009, Bingham County, Blackfoot, Idaho, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Future Plans in the Idaho National Laboratory Region," July 30.

Munger, F., 2005, *Mercury Drops in Oak Ridge*, Knoxville News-Sentinel, Knoxville, Tennessee, June.

NADP (National Atmospheric Deposition Program), 2005, *Locations of Monitoring Stations in the Mercury Trends Network*, accessed through http://nadp.sws.uiuc.edu/AMN/MappingLocations.pdf, November 23.

Neef, T., 2009, Kansas City Planning and Development, Kansas City, Missouri, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, September 24.

NRC (U.S. Nuclear Regulatory Commission), 2009, "NRC Issues Early Site Permit, Work Authorization for Vogtle Site in Georgia," accessed through http://www.nrc.gov/reading-rm/doc-collections/news/2009/09-141.html, August 26.

ORNL (Oak Ridge National Laboratory), 2009, *East Fork Poplar Creek, Signs of Recovery*, accessed through http://www.ornl.gov/info/ornlreview/rev27-3/text/envside1.htm, November 12.

OSHA (Occupational Safety and Health Administration), 2002, *Occupational Safety and Health Guideline for Mercury Vapor*, U.S. Department of Labor, accessed through http://www.osha.gov/SLTC/healthguidelines/mercuryvapor/recognition.html.

Owens, W., 2009, Planning, Permits, and Inspections, Burke County, Waynesboro, Georgia, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Future Plans in the Grand Junction Disposal Site Region," July 30.

Rice, D., 2009, Senior Planner, Delta County, Delta, Colorado, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Future Plans in the Grand Junction Disposal Site Region," August 3.

Sauerborn, P., 2009, "Interim Action Proposed Plan for the E-Area Low-Level Waste Facility (Slit Trench Disposal Units 1 and 2) Available for Public Comment," *Environmental Bulletin*, Vol. 20, No. 12, Savannah River Nuclear Solutions, LLC, accessed through http://www.srs.gov/general/pubs/envbul/documents/v20n12.pdf, June 1.

Shim, J.S., H-N. Hsieh, and D. Watts, 2002, *Mercury Vapor Monitoring at Somerville Depot*, New Jersey, Center for Environmental Engineering and Science, New Jersey Institute of Technology, University Heights, Newark, New Jersey, December.

Tetra Tech (Tetra Tech EM, Inc.), 2007, *Process Hazard Analysis for the Receipt and Storage of Mercury at Hawthorne Army Depot Hawthorne, Nevada*, Hawthorne, Nevada, April 27.

The Humboldt Sun, 2009, "After Late 20th Century Bust, Geothermal is Making a Comeback," accessed through http://www.nevadageothermal.com/i/pdf/April_17_2009_Geothermal.pdf, April 17.

WCS (Waste Control Specialists, LLC), 2007, *Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste,* Appendix 2.9.1: "Ecological Assessment, Attachment 2, Ecological Assessment of the Low-Level Waste Repository," March 16.

WCS (Waste Control Specialists, LLC), 2009, "*Mercury Storage EIS*" *Data Call Response*, Attachment B.

Wendt, G., 2009, Franklin County Planning and Building Department, Pasco, Washington, personal communication (telephone conversation) with S. Robinson, Science Applications International Corporation, Germantown, Maryland, "Future Plans in the Hanford Site Region," July 30.

Code of Federal Regulations

10 CFR 1021.331, U.S. Department of Energy, "National Environmental Policy Act Implementing Procedures: Mitigation Action Plans."

40 CFR 264, U.S. Environmental Protection Agency, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities."

40 CFR 1508.7, Council on Environmental Quality, "Terminology and Index: Cumulative Impact."

40 CFR 1508.20, Council on Environmental Quality, "Terminology and Index: Mitigation."

U.S. Department of Energy Guides, Orders, and Standards

DOE Guide 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*, March 28, 2000.

DOE Order 420.1B, *Facility Safety*, December 22, 2005.

DOE Standard 1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, January 2002.

DOE Standard 1023-95, *Natural Phenomena Hazards Assessment Criteria*, April 2002.

DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, March 30, 2006.

U.S. Public Laws

P.L. 110-414, Mercury Export Ban Act of 2008.

P.L. 107-107, National Defense Reauthorization Act for Fiscal Year 2002, December 28, 2001.

CHAPTER 5
ENVIRONMENTAL LAWS, REGULATIONS, PERMITS, AND OTHER POTENTIALLY APPLICABLE REQUIREMENTS

Chapter 5 presents the laws, regulations, permits and other requirements that could potentially apply to the proposed action. The proposed action would be implemented in accordance with all applicable Federal, state, and local laws and regulations and in full compliance with U.S. Department of Energy policies, orders, procedures, and guidance documents. Consultations are being conducted with Federal and state agencies and American Indian tribal governments in accordance with applicable requirements.

5.1 INTRODUCTION

In compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, Council on Environmental Quality (CEQ) NEPA regulations (40 CFR 1500–1508), and U.S. Department of Energy (DOE) NEPA implementing procedures (10 CFR 1021), DOE must consider applicable environmental regulations and any permitting or licensing requirements (including permit applications for new permits or permit modifications for existing permits) when evaluating alternatives for implementing the proposed action. The Notice of Intent announcing the preparation of this environmental impact statement (EIS) issued on July 2, 2009 (74 FR 31723), identifies that one of the issues to be considered is the compliance with all applicable Federal, state, and local statutes and regulations and required Federal and state environmental permits, consultations, and notifications. This chapter includes a range of potentially applicable Federal laws, regulations, and laws from seven different states where the potential candidate sites being evaluated are located. However, the state statutes typically mirror the Federal statutes in that they are required to be at a minimum equally as stringent.

This chapter identifies major requirements that could be applicable to the proposed action, which is to designate and operate a facility for the long-term management and storage of elemental mercury generated within the United States. Table 5–1 lists laws, regulations, and other requirements that potentially are applicable to designating and operating a DOE mercury storage facility. Section 5.2 describes the laws, regulations, and other applicable requirements that set environmental protection requirements that could apply to the DOE facility. Section 5.3 discusses potentially applicable permits. Section 5.4 describes applicable consultations.

Table 5–1. Environmental Laws, Regulations, and Other Potentially Applicable Requirements

Title	Citations
Air Quality and Noise	
Clean Air Act of 1970	42 U.S.C. 7401 et seq.
Noise Control Act of 1972	42 U.S.C. 4901 et seq.
EPA regulations: "National Emission Standards for Hazardous Air Pollutants"	40 CFR 61
EPA regulations: "National Emission Standards for Hazardous Air Pollutants for Source Categories"	40 CFR 63
Water Resources	
Clean Water Act of 1972	33 U.S.C. 1251 et seq.
Safe Drinking Water Act of 1974	42 U.S.C. 300f et seq.
Executive Order 11988: *Floodplain Management* (as amended by Executive Order 12148)	42 FR 26951 (May 24, 1977)
Executive Order 11990*: Protection of Wetlands* (as amended by Executive Order 12608)	42 FR 26961 (May 24, 1977)
EPA regulations: "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System" Permit Programs	40 CFR 122
EPA regulations: "Procedures for Decision-Making" (Permitting)	40 CFR 124
Waste Management, Pollution Prevention, Energy Conservation	
Mercury Export Ban Act of 2008	Public Law No. 110-414
Toxic Substances Control Act of 1976	15 U.S.C. 2601 et seq.
Solid Waste Disposal Act of 1965, as amended (commonly referred to as the "Resource Conservation and Recovery Act")	42 U.S.C. 6901 et seq.
Federal Facility Compliance Act of 1992	42 U.S.C. 6961 et seq.
Pollution Prevention Act of 1990	42 U.S.C. 13101 et seq.
Executive Order 12088: *Federal Compliance with Pollution Control Standards* (as amended by Executive Order 12580; revoked in part by Executive Order 13148)	43 FR 47707 (October 17, 1978)
Executive Order 13148: *Greening the Government Through Leadership in Environmental Management* (revoked by Executive Order 13423).	65 FR 24595 (April 26, 2000)
Executive Order 13423: *Strengthening Federal Environmental, Energy, and Transportation Management*	72 FR 3919 (January 26, 2007)
EPA regulations: "Identification and Listing of Hazardous Waste"	40 CFR 261
EPA regulations: "Standards Applicable to Generators of Hazardous Waste"	40 CFR 262
EPA regulations: "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"	40 CFR 264
EPA regulations: "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"	40 CFR 265
EPA regulations: "Land Disposal Restrictions"	40 CFR 268
EPA regulations: "EPA Administered Permit Programs: The Hazardous Waste Permit Program"	40 CFR 270
EPA regulations: "Requirements for Authorization of State Hazardous Waste Programs"	40 CFR 271
DOE Order: *Departmental Energy, Renewable Energy, and Transportation Management*	DOE Order 430.2B

Title	Citations
Emergency Planning and Response	
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)	42 U.S.C. 9601 et seq.
Emergency Planning and Community Right-to-Know Act of 1986 (Superfund Amendments and Reauthorization Act of 1986, Title III)	42 U.S.C. 11001 et seq.
Executive Order 12580*: Superfund Implementation* (as amended by Executive Orders 12777, 13016, 13286, and 13308)	52 FR 2923 (January 29, 1987)
EPA regulations: "National Oil and Hazardous Substances Pollution Contingency Plan"	40 CFR 300
EPA regulations: "Designation, Reportable Quantities, and Notification"	40 CFR 302
EPA regulations: "Hazardous Chemical Reporting: Community Right-to-Know"	40 CFR 370
EPA regulations: "Toxic Chemical Release Reporting: Community Right-to-Know"	40 CFR 372
DOE Order: *Comprehensive Emergency Management System*	DOE Order 151.1C
Ecological Resources	
Fish and Wildlife Coordination Act	16.U.S.C. 661 et seq.
Bald and Golden Eagle Protection Act of 1972	16 U.S.C. 668–668d
Migratory Bird Treaty Act of 1918	16 U.S.C. 703 et seq.
Endangered Species Act of 1973	16 U.S.C. 1531 et seq.
Executive Order 11990: *Protection of Wetlands* (as amended by Executive Order 12608)	42 FR 26961 (May 25, 1977)
Executive Order 13112*: Invasive Species* (as amended by Executive Order 13286)	64 FR 6183 (February 8, 1999)
Cultural Resources	
American Antiquities Act of 1906	16 U.S.C. 431 et seq.
Archaeological and Historic Preservation Act of 1974	16 U.S.C. 469–469c
Archaeological Resources Protection Act of 1979	16 U.S.C. 470aa-mm
National Historic Preservation Act of 1966	16 U.S.C. 470 et seq.
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. 3001 et seq.
American Indian Religious Freedom Act of 1978	42 U.S.C. 1996 et seq.
Executive Order 11593: *Protection and Enhancement of the Cultural Environment*	36 FR 8921 (May 15, 1971)
Executive Order 13007: *Indian Sacred Sites*	61 FR 26771 (May 29, 1996)
Executive Order 13175: *Consultation and Coordination with Indian Tribal Governments*	65 FR 67249 (November 9, 2000)
Executive Order 13287: *Preserve America*	68 FR 10635 (March 5, 2003)
ACHP regulations: "Protection of Historic Properties"	36 CFR 800
DOE Policy: *DOE Management of Cultural Resources*	DOE Policy 141.1
DOE Order: *DOE American Indian Tribal Government Interactions and Policy*	DOE Order 144.1

Title	Citations
Worker Safety and Health	
Occupational Safety and Health Act of 1970	29 U.S.C. 651 et seq.
Executive Order 12699: *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction* (as amended by Executive Order 13286)	55 FR 835 (January 9, 1990)
DOE regulations: "Worker Safety and Health Program"	10 CFR 851
DOL regulations: "Occupational Safety and Health Standards"	29 CFR 1910
DOE Policy: *Safety Management Functions, Responsibilities, and Authorities Policy*	DOE Policy 411.1
DOE Order: *Worker Protection Program for DOE (Including NNSA) Federal Employees*	DOE Order 440.1B
Transportation	
Hazardous Materials Transportation Act of 1975	49 U.S.C. 1801 et seq.
DOT regulations: "Hazardous Materials Program Definitions and General Procedures"	49 CFR 105
DOT regulations: "Hazardous Materials Program Procedures"	49 CFR 107
DOT regulations: "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans"	49 CFR 172
DOT regulations: "Specifications for Packagings"	49 CFR 178
DOT regulations: "Continuing Qualification and Maintenance of Packagings"	49 CFR 180
DOE Order: *Packaging and Transportation Safety*	DOE Order 460.1B
Quality Assurance	
DOE Order: *Quality Assurance*	DOE Order 414.1C
DOE Order: *Conduct of Operations Requirements for DOE Facilities*	DOE Order 5480.19 Change 2
Other Laws, Regulations, and Potentially Applicable Requirements	
Farmland Protection Policy Act of 1981	7 U.S.C. 4201 et seq.
National Environmental Policy Act of 1969	42 U.S.C. 4321 et seq.
Executive Order 11514: *Protection and Enhancement of Environmental Quality* (as amended by Executive Orders 11541 and 11991)	35 FR 4247 (March 7, 1970)
Executive Order 12898: *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (as amended by Executive Order 12948)	59 FR 7629 (February 16, 1994)
Executive Order 13045: *Protection of Children from Environmental Health Risks and Safety Risks* (as amended by Executive Orders 13229 and 13296)	62 FR 19885 (April 23, 1997)
Executive Order 13514: *Federal Leadership in Environmental, Energy, and Economic Performance*	74 FR 52117 (October 8, 2009)
DOE regulations: "National Environmental Policy Act Implementing Procedures"	10 CFR 1021
DOE Policy: *Land and Facility Use Planning*	DOE Policy 430.1
DOE Policy: *Identifying, Implementing, and Complying with Environment, Safety, and Health Requirements*	DOE Policy 450.2A
DOE Order: *Environmental Protection Program*	DOE Order 450.1A

Key: ACHP=Advisory Council on Historic Preservation; CEQ=Council on Environmental Quality; CFR=*Code of Federal Regulations*; DOE=U.S. Department of Energy; DOL=U.S. Department of Labor; DOT=U.S. Department of Transportation; EPA=U.S. Environmental Protection Agency; FR=*Federal Register*; NEPA=National Environmental Policy Act; NNSA=National Nuclear Security Administration; U.S.C.=*United States Code*.

5.2 LAWS, REGULATIONS, AND OTHER POTENTIALLY APPLICABLE REQUIREMENTS

This section describes Federal laws, regulations, and other potentially applicable requirements as they relate generally to Federal actions, specifically to elemental mercury management and storage, and to the construction and operation of a long-term management and storage facility for elemental mercury. Mercury is addressed in numerous U.S. Environmental Protection Agency (EPA) regulations, including regulations pertaining to air quality, water quality, hazardous waste management, and pollution prevention.

5.2.1 The Mercury Export Ban Act of 2008

On October 14, 2008, President George W. Bush signed into law Senate Bill 906, the Mercury Export Ban Act of 2008 (the Act), Public Law No. 110-414. The overarching purpose of the Act is "to prohibit the sale, distribution, transfer, and export of elemental mercury."

Section 3 of the Act amends the Toxic Substances Control Act (TSCA) to prohibit any Federal agency from selling, distributing, conveying, or transferring to any other Federal, state, or local agency, or any private entity or individual, any elemental mercury under the control or jurisdiction of the Federal agency, effective beginning on the date of enactment of this Act. The Act sets forth two exceptions to this prohibition: (1) "a transfer between Federal agencies of elemental mercury for the sole purpose of facilitating storage of mercury to carry out this Act; or" (2) "a conveyance, sale, distribution, or transfer of coal."

Section 4 amends TSCA to prohibit the export of elemental mercury from the United States effective January 1, 2013. Section 4 also establishes certain reporting requirements and provides an essential use exemption.

Section 5, entitled "Long-Term Storage," directs DOE to designate a facility(ies) for the long-term management and storage of elemental mercury generated within the United States. DOE's facility(ies) must be operational by January 1, 2013, and ready to accept custody of elemental mercury delivered to such a facility. The Act also requires DOE to assess fees based upon the *pro rata* costs of long-term management and storage of the elemental mercury. The Act establishes October 1, 2012, as the date on which DOE must make public the fee schedule. Section 5(d)(1) further provides that the elemental mercury stored at the facility is subject to the requirements of the Solid Waste Disposal Act (SWDA), including the hazardous waste management requirements under Subtitle C of the Act; however, the Act provides that the elemental mercury stored at the DOE facility "shall not be subject to the storage prohibition of section 3004(j) of the SWDA."

DOE's designation of a facility(ies) for the purpose of long-term management and storage of elemental mercury is a Federal action that is governed by NEPA and is the basis for DOE's preparation of this EIS.

5.2.2 Air Quality and Noise

Clean Air Act of 1970, as amended (42 U.S.C. 7401 et seq.). The Clean Air Act is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Section 118 of the Clean Air Act requires that each Federal agency with jurisdiction over any property or facility engaged in any activity that might result in the discharge of air pollutants to comply with "all Federal, state, interstate, and local requirements" related to the control and abatement of air pollution.

The Clean Air Act requires: (1) EPA to establish National Ambient Air Quality Standards as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 U.S.C. 7409); (2) the establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 U.S.C. 7411); (3) the evaluation of specific emission increases to prevent a significant deterioration in air quality (42 U.S.C. 7470 et seq.); and (4) specific standards for releases of hazardous air pollutants (including mercury) (42 U.S.C. 7412). Air emissions standards are established in Title 40 of the *Code of Federal Regulations* (CFR), Parts 50 through 99. These standards are implemented through state implementation plans developed by each State with EPA approval. The Clean Air Act requires owners or operators of emission sources to meet standards and obtain permits to satisfy these standards.

The Clean Air Act regulates 188 air toxics, also known as "hazardous air pollutants." Mercury is listed as a hazardous air pollutant and regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAPs) Program found in Title 40 of the CFR, Parts 61 and 63. While numerous regulations have been instituted in the last 10 years governing emissions into air, most have been aimed at point sources and stationary sources (e.g., iron/steel foundries, chlor-alkali plants, boilers/process heaters).

Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq.). Section 4 of the Noise Control Act directs all Federal agencies to carry out, "to the fullest extent within their authority," programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare. All alternatives will require compliance with this Act.

"National Emission Standards for Hazardous Air Pollutants" (40 CFR 61). NESHAPs are Federal regulations establishing emission standards for categories or subcategories of major sources and area sources of hazardous air pollutants. These standards require the maximum degree of emission reduction that has been determined to be achievable with the available technology.

"National Emission Standards for Hazardous Air Pollutants for Source Categories" (40 CFR 63). These regulations require EPA to publish and regularly update (at least every 8 years) a listing of all categories and subcategories of major and area sources that emit hazardous air pollutants. Currently, the proposed action is not regulated under these requirements.

5.2.3 Water Resources

Clean Water Act of 1972, as amended (33 U.S.C. 1251 et seq.). The Clean Water Act, which amended the Federal Water Pollution Control Act, is intended to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The Clean Water Act prohibits the "discharge of toxic pollutants (including mercury) in toxic amounts" to navigable waters of the United States. Under the Clean Water Act, states generally set water quality standards for their rivers, streams, lakes, and wetlands. These standards identify levels for pollutants, including mercury, that must be met to protect human health, fish, and wildlife. Section 307(a) designates mercury as a toxic pollutant.

No person may discharge pollutants, including mercury, into navigable waters without a permit. Under the Clean Water Act, either EPA or authorized states issue permits, which include limits that ensure the water quality standards are met. Section 313 of the Clean Water Act requires the Federal Government to comply with Federal, state, and local requirements (including obtaining and maintaining a permit) if an activity might cause a discharge or runoff of pollutants to surface waters. EPA and individual states also issue information to the public on waters contaminated with mercury and on the harmful effects of mercury, identify the mercury sources and reductions needed to achieve water quality standards, and warn people about eating fish containing high levels of methylmercury (White 2006).

The Clean Water Act also provides guidelines and limitations for effluent discharges from point source and non–point source discharges and establishes the National Pollutant Discharge Elimination System (NPDES) Permit Program. The NPDES Permit Program is administered by EPA, pursuant to regulations in Title 40 of the CFR, Part 122 and may be delegated to states. Sections 401 through 405 of the Water Quality Act of 1987 added Section 402(p) to the Clean Water Act, which requires EPA to establish regulations for permits for stormwater discharges associated with industrial activities. Stormwater provisions of the NPDES Permit Program are set forth in Title 40 of the CFR, Section 122.26. Title 40 of the CFR, Part 124, also contains EPA procedures for issuing, modifying, revoking, and reissuing, or terminating all Resource Conservation and Recovery Act (RCRA), NPDES, and other types of permits.

Safe Drinking Water Act of 1974, as amended (42 U.S.C. 300f et seq.). The primary objective of the Safe Drinking Water Act is to protect the quality of public drinking water supplies and sources of drinking water. The implementing regulations, administered by EPA unless delegated to the states, establish standards applicable to public water systems. These regulations include maximum contaminant levels in public water systems. The EPA regulations implementing the Safe Drinking Water Act are found in Title 40 of the CFR, Parts 100–149, with maximum contamination levels for mercury in drinking water (listed as 0.002 milligrams per liter) in Section 141.62. Other programs established by the Safe Drinking Water Act include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program.

All federally funded projects that might have the potential to affect and especially to contaminate a sole-source aquifer must undergo a review by EPA to ensure that the project will have no detrimental effects on or endanger in any way the sole-source aquifer. A principal or sole-source aquifer is defined as an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. Often these areas have no alternative drinking water source(s) or supply. Sole-source aquifer designation is one tool to protect drinking water supplies and thus prevent contamination. The designation protects an area's groundwater resource by requiring review of proposed projects within the designated area.

Floodplain Management **(Executive Order 11988).** This Executive Order requires Federal agencies to establish procedures to ensure that any Federal action undertaken in a floodplain considers the potential effects of flood hazards and floodplain management and avoids floodplain impacts to the extent practicable.

Protection of Wetlands **(Executive Order 11990).** This Executive Order requires Federal agencies to avoid any short- or long-term adverse impacts on wetlands wherever there is a practicable alternative. DOE will provide the opportunity for public review and comment of any alternative that would call for construction in wetlands.

National Pollutant Discharge Elimination System, Permit Programs (40 CFR 122). NPDES is the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits; and imposing and enforcing pretreatment requirements in accordance with the Clean Water Act. NPDES Permit Program regulations require that a permit be obtained for the discharge of "pollutants" from any "point source" into "waters of the United States."

"Procedures for Decision-Making," Permitting (40 CFR 124). These regulations establish EPA's procedures for issuing, modifying, revoking and reissuing, or terminating all RCRA, Underground Injection Control, Prevention of Significant Deterioration (PSD) (under the Clean Air Act), and NPDES permits. Additionally, these regulations allow for the combining of the permitting process (including public hearings) for a given facility that holds (or is applying for) two or more permits under the listed programs. These regulations also allow for the coordination and joint permit processing between EPA and authorized states when different permits will be issued by EPA and the state.

5.2.4 Waste Management, Pollution Prevention, and Energy Conservation

Toxic Substances Control Act of 1976 (415 U.S.C. 2601 et seq.). TSCA regulates the manufacture, processing, distribution, and use of certain chemicals, including polychlorinated biphenyls, asbestos, radon, lead-based paint, and most recently, excess elemental mercury. TSCA provides EPA with the authority to require testing of chemical substances entering the environment and to regulate them as necessary. The law complements and expands existing toxic substance laws such as Section 112 of the Clean Air Act and Section 307 of the Clean Water Act. Specific to this EIS, the Mercury Export Ban Act of 2008 amends TSCA to prohibit Federal agencies from selling elemental mercury to any other Federal agency, any State or local government agency, or any private individual or entity; prohibits the export of elemental mercury from the United States beginning in 2013 (subject to potential essential use exemptions); and directs DOE to designate a facility(ies) (to be operational by January 1, 2013) for the long-term management and storage of elemental mercury generated within the United States.

Solid Waste Disposal Act of 1965, as amended (commonly referred to as the "Resource Conservation and Recovery Act") (42 U.S.C. 6901 et seq.). SWDA (as amended), also called RCRA, governs the generation, transportation, treatment, storage, and disposal of hazardous and nonhazardous waste. Under RCRA, EPA defines and identifies hazardous waste; establishes standards for generators of hazardous waste and the transportation, treatment, storage, and disposal of hazardous waste; and requires permits for persons engaged in hazardous waste activities. Section 3001 delineates the criteria for identification or listing of hazardous waste. Section 3002 establishes the standards applicable to generators of hazardous waste, which includes recordkeeping and reporting; use of proper containers; labeling, handling, and storage of hazardous waste containers; and certified waste minimization programs. Section 3004 establishes the standards applicable to hazardous waste treatment, storage, and disposal (TSD) facilities. Hazardous waste TSD facility standards include, but are not limited to recordkeeping and reporting; monitoring, inspecting, and maintaining compliance with the hazardous waste manifest system; standards for location, design, and construction; personnel training; and maintaining up-to-date contingency plans. Section 3004 also prohibits the land disposal of containerized liquid hazardous waste or free liquids contained in hazardous waste, and establishes the prohibition of land disposal of certain specified hazardous wastes. Section 3005 requires the owner/operator of a TSD facility to have a permit issued under RCRA. The effective period of an RCRA permit is a fixed term, not to exceed 10 years. Section 3006 of the Act (42 U.S.C. 6926) allows states to establish and administer these permit programs with EPA approval; state programs may be broader or more stringent than the Federal program.

The Mercury Export Ban Act of 2008 stipulates that elemental mercury managed and stored at a DOE-designated facility(ies) is subject to the requirements of SWDA, including the hazardous waste provisions, except as provided in Section 5(g)(2) (discussed below).

RCRA Section 1004(33) defines the term "storage," when used in connection with hazardous waste, to mean the containment of hazardous waste, either on a temporary basis or for a period of years, in such a manner as not to constitute disposal of such hazardous waste. RCRA Section 3004(j) ("Storage of Hazardous Waste Prohibited from Land Disposal") states that, in the case of any hazardous waste that is prohibited from one or more methods of land disposal under this section (mercury-bearing hazardous wastes are subject to land disposal restrictions), the storage of such hazardous waste is prohibited unless such storage is solely for the purpose of the accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment, or disposal. However, Section 5(g)(2) of the Mercury Export Ban Act provides that the elemental mercury that DOE is storing on a long-term basis shall not be subject to the storage prohibition of Section 3004(j) (42 U.S.C. 6924(j)).

Federal Facility Compliance Act of 1992 (42 U.S.C. 6961 et seq.). The Federal Facility Compliance Act enacted on October 6, 1992, amended RCRA to eliminate sovereign immunity for Federal facilities such that all Federal agencies are subject to all substantive and procedural requirements of Federal, state, and local solid and hazardous waste laws.

Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq.). The Pollution Prevention Act establishes a national policy for waste management and pollution control. Source reduction is given first preference, followed by environmentally safe recycling, with disposal or releases to the environment as a last resort. Oil pollution prevention regulations (40 CFR 112) establish procedures to prevent the discharge of oil and require the preparation and implementation of spill prevention, control, and countermeasures plans.

Federal Compliance with Pollution Control Standards **(Executive Order 12088).** This Executive Order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, the Noise Control Act, the Clean Water Act, the Safe Drinking Water Act, TSCA, and RCRA. Section 1-4 of this Executive Order was revoked by Executive Order 13148.

Greening the Government Through Leadership in Environmental Management **(Executive Order 13148)**. This Executive Order revokes Executive Orders 12843, 12856, 12969; the Executive Memorandum on Environmentally Beneficial Landscaping of April 26, 1994; and Section 1–4, ‘‘Pollution Control Plan,’’ of Executive Order 12088. This Executive Order was revoked by Executive Order 13423.

Strengthening Federal Environmental, Energy, and Transportation Management **(Executive Order 13423).** This Executive Order is a compilation of several previous Executive Orders and revokes either in full or in part or supersedes Executive Orders 12856, 12902, 13101, 13123, and 13148. This Executive Order requires Federal agencies to conduct their environmental, transportation, and energy-related activities in an environmentally, economically, and fiscally sound, integrated, continuously improving, efficient, and sustainable manner. Measurable goals are delineated within established timeframes for Federal agencies to implement this Executive Order. The following are a few examples of Federal agency goals set forth in this Executive Order:

- To improve energy efficiency by 3 percent annually through the end of fiscal year (FY) 2015 or by 30 percent by the end of FY 2015

- To reduce water consumption through life-cycle cost-effective measures by 2 percent annually through the end of FY 2015 or by 16 percent by the end of FY 2015

- To ensure that Federal agencies (a) reduce the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of by the agencies; (b) increase diversion of solid waste as appropriate; and (c) maintain cost-effective waste prevention and recycling programs at their facilities

- To ensure that new construction and major renovation of agency buildings comply with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings as set forth in the Federal Leadership in High Performance and Sustainable Buildings Memorandum of 2006

Hazardous Waste Identification Regulations (40 CFR 261). Classification of solid waste as hazardous waste is based on exhibited hazardous waste characteristics and/or on inclusion of the waste on a list of hazardous wastes developed by EPA. Once a waste has been identified as hazardous, it must comply with all applicable Federal and authorized state regulations regarding its management. Elemental mercury that is a solid waste would be classified as hazardous under RCRA if it exhibits the characteristic of toxicity using the Toxicity Characteristic Leaching Procedure (Waste Code D009) (40 CFR 261.24), or if it is a listed hazardous waste, i.e., a commercial chemical product, manufacturing chemical intermediate, or off-specification commercial chemical product (Waste Code U151 - mercury) (40 CFR 261.33(f)). Generators have an option to determine whether a solid waste is hazardous waste based upon generator acceptable knowledge. The elemental mercury received at the proposed facility will be packaged, transported, received, and managed in long-term storage in accordance with all applicable Federal and authorized state RCRA regulations. Additionally, the guidance document, *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury (Interim Guidance)* (DOE 2009), provides supplemental information for the variety of potential generators regarding documentation, packaging, and transportation.

Hazardous Waste Generator Regulations (40 CFR 262). These regulations define three categories of hazardous waste generators based on the volume of hazardous waste generated and delineate the varying requirements based on the category of hazardous waste generation. A conditionally exempt small quantity generator (CESQG) produces 100 kilograms or less of hazardous waste per calendar month and is exempt from the requirements of Title 40 of the CFR, Parts 262 through 270, if it complies with the requirements in Section 261.5. Additionally, a CESQG does not have an onsite accumulation time limit, unlike the other two categories of hazardous waste generators. A small quantity generator is defined as such if it produces between 100 and 1,000 kilograms of hazardous waste per calendar month and is subject to modified regulations found in Title 40 of the CFR, Part 262. Generally, small quantity generators must comply with some, but not all of the regulations that apply to large quantity generators. A hazardous waste generator that produces 1,000 kilograms or more of hazardous waste per calendar month, or more than 1 kilogram of acutely hazardous waste, is classified as a large quantity generator and is subject to full regulations of Title 40 of the CFR, Part 262.

Owner/Operator of Hazardous Waste Treatment, Storage, and Disposal Facilities Regulations (40 CFR 264 and 270). The owner or operator of a facility that treats, stores, or disposes of hazardous waste is required to obtain and maintain through closure an RCRA permit issued by EPA, a duly authorized state agency, or in some cases both Federal and state agencies. These permits include the conditions and requirements that the TSD facility must meet. Title 40 of the CFR, Part 264, also delineates strict regulations for RCRA-permitted hazardous waste TSD facilities. Areas addressed in these regulations include, but are not limited to requirements regarding air emissions, groundwater monitoring, permits and permitting (including recordkeeping and reporting), corrective action and cleanup, and closure. The mercury storage facility(ies) will be an RCRA-permitted hazardous waste TSD facility(ies); therefore, air emission management, monitoring, and operational and control standards could apply.

Owner/Operator of Hazardous Waste Treatment, Storage, and Disposal Facilities Interim Status Regulations (40 CFR 265). The regulations provide requirements for the operation and management of a hazardous waste TSD facility (which are for the most part the same stringent requirements as a fully RCRA-permitted facility) during the timeframe of interim status and until certification of final closure (or until postclosure actions are completed as applicable) if the TSD facility has fully complied with requirements for interim status under Section 3005(e) of RCRA (also called SWDA) (including submission of an RCRA permit application).

Section 5(d)(1) of the Mercury Export Ban Act states, "A designated facility in existence on or before January 1, 2013, is authorized to operate under interim status pursuant to section 3005(e) of the SWDA until a final decision on a permit application is made pursuant to section 3005(c) of the SWDA. Not later than January 1, 2015, the Administrator of the EPA (or an authorized State) shall issue a final decision on the permit application."

"Land Disposal Restrictions" (40 CFR 268). EPA's land disposal program has three major components, which address hazardous waste: disposal, dilution, and storage. The purpose of the land disposal restrictions provisions is to minimize hazards from the land disposal of hazardous wastes by setting treatment standards that must be achieved prior to land disposal. The dilution prohibition basically prohibits dilution as a "treatment" method, and the storage prohibition states that hazardous waste may not be stored indefinitely in lieu of treatment. Hazardous waste may be stored, subject to the land disposal program, only for the purpose of accumulating quantities necessary for proper recovery, treatment, or disposal. EPA has established treatment standards for both D009 and U151 wastes (i.e., wastes containing mercury) (40 CFR 268.40). High mercury waste (waste containing greater than 260 milligrams per kilogram total mercury) must undergo "retorting" or "roasting" in a thermal processing unit that volatilizes the mercury for recovery. Currently, the high-purity elemental mercury resulting from retorting can not be disposed of via land disposal.

EPA and Authorized State Hazardous Waste Permit Program (40 CFR 270–271). These sections delineate EPA's and authorized states' permit regulations or the Hazardous Waste Permit Program under Subtitle C of SWDA. They apply to EPA and to authorized states to the extent provided in Title 40 of the CFR, Part 271. The regulations cover basic EPA and authorized state permitting requirements, such as application requirements, standard permit conditions, and monitoring and reporting requirements. The RCRA permit application/approval process can take anywhere from 1 to 4 years.

Title 40 of the CFR, Parts 260–283, delineate EPA requirements and regulations implementing RCRA. Table 5–2 identifies specific regulatory citations applicable to the mercury storage activities.

Table 5–2. Hazardous Waste Treatment, Storage, and Disposal Facility Requirements

Section of RCRA	Coverage	Final Regulation
Subtitle C	Overview and definitions	40 CFR 260
3001	Identification and listing of hazardous waste	40 CFR 261
3002	Standards for hazardous waste generators	40 CFR 262
3004	Standards for HWM facilities	40 CFR 264–267
3005	Permit requirements for HWM facilities	40 CFR 124 and 270
3006	Guidelines for state programs	40 CFR 271

Key: CFR=*Code of Federal Regulations*; HWM=hazardous waste management; RCRA=Resource Conservation and Recovery Act.

Generally, the candidate locations that have an existing hazardous waste TSD facility permit would have to prepare permit modifications, and candidate locations without an existing RCRA TSD facility permit would require a full Part A and Part B RCRA permit application, public review/comment, and permit approval process. There will be some uncertainty and variability in the permitting process.

***Departmental Energy, Renewable Energy, and Transportation Management* (DOE Order 430.2B).** This Order defines the requirements and responsibilities for managing DOE's energy, buildings, and fleets.

5.2.5 Emergency Planning and Response

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601 et seq.) (also known as Superfund). This Act authorizes EPA to require responsible site owners, operators, arrangers, and transporters to clean up releases of hazardous substances. This Act also provides authority for Federal and state governments to respond directly to hazardous substance incidents. The Act requires reporting spills to the National Response Center. Any non–federally permitted release of 1 pound (0.45 kilograms) or more of mercury into the environment in a 24-hour period must be reported immediately to the National Response Center (40 CFR 302.4).

EPA is required to evaluate all facilities that treat, store, or dispose of CERCLA wastes (40 CFR 300.440). There is a potential that some of the elemental mercury shipments may be classified as Superfund waste. The purpose of the CERCLA Off-Site Rule is to avoid CERCLA wastes contributing to current or future environmental problems, by directing CERCLA wastes to offsite waste management units determined by EPA to be environmentally sound and therefore "acceptable." Prior to receiving elemental mercury from a Superfund site, EPA would need to evaluate the selected long-term storage site in accordance with the Off-Site Rule.

Emergency Planning and Community Right-to-Know Act of 1986 (U.S.C. 11001 et seq.) (also known as the Superfund Amendments and Reauthorization Act of 1986, Title III). This Act requires emergency planning and notice to communities and government agencies of the presence and release of specific chemicals. Facilities are required to provide various information (such as inventories of specific chemicals used or stored and releases that occur from these sites) to the state emergency response commission and to the local emergency planning committee to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. EPA implements this Act under regulations found in Title 40 of the CFR, Parts 355, 370, and 372. These regulations would apply to the proposed action and to all of the action alternatives set forth in this EIS.

***Superfund Implementation* (Executive Order 12580).** This Executive Order delegates to the heads of executive departments and agencies the responsibility of undertaking remedial actions for releases or threatened releases that are not on the National Priorities List, and removal actions, other than emergencies, where the release is from any facility under the jurisdiction or control of executive departments and agencies.

"National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300). The National Oil and Hazardous Substances Pollution Contingency Plan is required by Section 105 of CERCLA and Section 311(d) of the Clean Water Act and provides for communication; preparedness; and efficient, coordinated, and effective response actions to discharges of oil and releases of hazardous substances, pollutants, and contaminants. These regulations apply to releases of hazardous substances, and pollutants or contaminants into the environment that could present an imminent and substantial danger to public health or welfare and discharges of oil into or on navigable waters of the United States.

"Designation, Reportable Quantities, and Notification" (40 CFR 302). These regulations designate under Section 102(a) of CERCLA the hazardous substances, pollutants, and contaminants; reportable quantities; and notification requirements for releases of these substances and reportable quantities for hazardous substances designated in Section 311 of the Clean Water Act.

"Hazardous Chemical Reporting: Community Right-to-Know" (40 CFR 370). These regulations establish the reporting requirements for providing the public with information regarding the hazardous chemicals in their communities and aids in the development of state and local emergency response plans.

"Toxic Chemical Release Reporting: Community Right-to-Know" (40 CFR 372). These regulations establish the submission of information relating to the release of toxic chemicals under Section 313 of Title III of the Superfund Amendments and Reauthorization Act. This information is intended in part to inform the public and communities about releases of toxic chemicals from "covered" facilities in their communities; to assist in research; and to aid in development of regulations, guidelines, and standards.

***Comprehensive Emergency Management System* (DOE Order 151.1C).** This Order establishes DOE's policy and assigns roles and responsibilities for the DOE Emergency Management System.

5.2.6 Ecological Resources

Bald and Golden Eagle Protection Act of 1972, as amended (16 U.S.C. 668–668d). The Bald and Golden Eagle Protection Act, as amended, makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States (Section 668, 668c). A permit must be obtained from the U.S. Department of the Interior (DOI) to relocate a nest that interferes with resource development or recovery operations. This requirement would apply to eagles that might inhabit any of the mercury storage facility locations.

Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 et seq.). The Migratory Bird Treaty Act, as amended, is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. This Act stipulates that it is unlawful at any time, by any means, or in any manner, to "kill any migratory bird." DOE would be required to consult with the U.S. Fish and Wildlife Service regarding impacts on migratory birds and to avoid or minimize these effects in accordance with the U.S. Fish and Wildlife Service mitigation policy.

Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The intent of the Endangered Species Act is to prevent the further decline of endangered and threatened species and to restore these species and their habitats. Section 7 requires Federal agencies having reason to believe that a prospective action may affect an endangered or threatened species or its habitat to consult with the U.S. Fish and Wildlife Service of DOI or the National Marine Fisheries Service of the U.S. Department of Commerce to ensure that the action does not jeopardize the species or destroy its habitat (50 CFR 17). If, despite reasonable and prudent measures to avoid or minimize such impacts, the species or its habitat would be jeopardized by the action, a review process is specified to determine whether the action may proceed. If a threatened or endangered species were identified at any of the mercury storage facility locations, consultations with the aforementioned agencies would be required.

Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 et seq.). The Fish and Wildlife Coordination Act promotes additional planning and cooperation between Federal, state, public, and private agencies for the conservation and rehabilitation of the country's fish and wildlife and authorizes DOI to provide assistance. This Act requires consultation with the U.S. Fish and Wildlife Service if there is construction, modification, or control of bodies of water. If such a body of water would be affected by any of the potential mercury storage alternatives, evaluation and potential consultation would be required. Impoundments with a surface area less than 10 acres (4.05 hectares) are exempt.

***Protection of Wetlands* (Executive Order 11990).** This Executive Order requires Federal agencies to avoid short-term and long-term impacts on wetlands if a practical alternative exists.

***Invasive Species* (Executive Order 13112).** This Executive Order requires Federal agencies to prevent the introduction of invasive (nonnative) species or to monitor and control invasive species, to provide for restoration of native species, to conduct research, to promote educational activities, and to exercise care in taking actions that could promote the introduction or spread of invasive species.

5.2.7 Cultural Resources

American Antiquities Act of 1906, as amended (16 U.S.C. 431–433). This Act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally controlled lands from appropriation, excavation, injury, and destruction without permission. Under this Act, the President of the United States is authorized to declare historic landmarks, prehistoric and historic structures, and other objects of historic or scientific interest that are situated on lands controlled or owned by the Federal Government to be national monuments. Currently, none of the candidate mercury storage facility locations have any known artifacts or resources that would necessitate compliance under this Act (see discussion in Chapter 4).

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996 et seq.). This Act reaffirms American Indian religious freedom under the first amendment and establishes U.S. policy to protect and preserve the inherent and constitutional right of American Indians to believe, express, and exercise their traditional religions. This Act requires that Federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religions.

Archaeological and Historic Preservation Act of 1974, as amended (16 U.S.C. 469–469c). This Act protects sites that have prehistoric and historic importance. It provides for the preservation of historical and archaeological data, including relics and specimens, that might otherwise be irreplaceably lost or destroyed as a result of a Federal construction project or federally licensed activity or program. Mercury storage and management activities would require compliance with this Act if, during construction, maintenance, or closure activities, any prehistoric or historic resources were found.

Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470 et seq.). This Act requires a permit for any excavation or removal of archaeological resources from Federal or American Indian tribal lands. Excavations must be undertaken for the purpose of furthering archaeological knowledge in the public interest, and resources removed are to remain the property of the United States. The law requires that, whenever any Federal agency finds that its activities may cause irreparable loss or destruction of significant scientific, prehistoric, or archaeological data, the agency must notify DOI. DOI may request that a department or agency undertake the recovery, protection, and preservation of such data. Consent must be obtained from the American Indian tribe or the Federal agency having authority over the land on which a resource is located before issuance of a permit; the permit must contain terms and conditions requested by the tribe or Federal agency. If such a discovery were made during activities associated with any of the potential mercury storage alternatives, all applicable notifications, permit applications, and other required steps would be taken.

National Historic Preservation Act of 1996, as amended (16 U.S.C. 470 et seq.). The National Historic Preservation Act declares that sites with significant national historic value should be placed on the National Register of Historic Places, which is maintained by the Secretary of the Interior. Sections 106 and 110 require that historic properties be appropriately considered in planning Federal initiatives and actions. Section 110 sets out broad Federal agency responsibilities with respect to historic properties. It is a proactive mechanism with emphasis on ongoing management of historic preservation sites and activities at Federal facilities. No permits or certifications are required under this Act. Section 106 requires the head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking to ensure compliance with the provisions of the Act. It compels Federal agencies to "take into account" the effect of their projects on historical and archaeological resources and to give the Advisory Council on Historic Preservation the opportunity to comment on such effects. Section 106 mandates consultation during Federal actions if the undertaking has the potential to have an effect on a historic property. This consultation normally involves the State Historic Preservation Officers and may include other organizations and individuals, such as local governments and American Indian tribes. If an adverse effect is found, the consultation often ends with the execution of a memorandum of agreement that states how the adverse effects will be resolved. Revisions to the regulations implementing Section 106, found in Title 30 of the CFR, Part 800, became effective on June 17, 1999 (64 FR 27043). These revisions introduced new flexibility and options for agencies to use to meet their obligations to comply with this Act. DOE will comply in full with the requirements of this Act for any action relating to the designation of the mercury storage facility.

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq.). This Act establishes a means for American Indians to request the return or "repatriation" of human remains and other cultural items presently held by Federal agencies or federally assisted museums or institutions. The Act also contains provisions regarding the intentional excavation and removal of, inadvertent discovery of, and illegal trafficking in American Indian human remains and cultural items. Major actions under this law include: (a) Establishing a review committee with monitoring and policy-making responsibilities; (b) developing regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (c) providing oversight of museum programs designed to meet the inventory requirements and deadlines of this law; and (d) developing procedures to handle unexpected discoveries of graves or grave goods during activities on Federal or tribal lands. All Federal agencies that manage land and/or are responsible for archaeological collections from their lands or generated by their activities must comply with this Act. Regulations implementing this Act are found in Title 43 of the CFR, Part 10.

***Protection and Enhancement of the Cultural Environment* (Executive Order 11593).** This Executive Order directs Federal agencies to locate, inventory, and nominate properties under their jurisdiction or control to the National Register of Historic Places, if those properties qualify. This process requires DOE to provide the Advisory Council on Historic Preservation the opportunity to comment on the possible impacts of the proposed activity on any potentially eligible or listed resources. Compliance with this Executive Order is discussed under the National Historic Preservation Act of 1996, as amended.

***Indian Sacred Sites* (Executive Order 13007).** This Executive Order requires Federal agencies that manage lands, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, to (1) accommodate access to and ceremonial use of American Indian sacred sites by American Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Federal agencies shall maintain the confidentiality of such sites, as appropriate.

***Consultation and Coordination with Indian Tribal Governments* (Executive Order 13175).** This Executive Order requires Federal agencies to establish regular and meaningful consultations with tribal officials and to collaborate with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States' government-to-government relationships with American Indian tribes, and to reduce the imposition of unfunded mandates on American Indian tribes.

***Preserve America* (Executive Order 13287).** This Executive Order requires Federal agencies, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, to protect and enhance the care and management of cultural and natural heritage assets in their care.

"Protection of Historic Properties" (36 CFR 800). These regulations require Federal agencies to take into account the effects of their undertakings on historic properties, establish procedures to meet these responsibilities, and establish processes for Federal agencies to accommodate historic preservation and their undertakings through consultation among agency officials and other interested/affected parties. The goal of this consultation process is to identify historic properties potentially affected by the undertaking; assess its effects; and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties.

***DOE Management of Cultural Resources* (DOE Policy 141.1).** The purpose of this DOE Policy is to ensure that DOE programs and field elements integrate cultural resources management into their missions and activities.

***DOE American Indian Tribal Government Interactions and Policy* (DOE Order 144.1).** This Order communicates DOE, programmatic, and field responsibilities for interacting with American Indian governments and transmits DOE's American Indian and Alaska Native tribal government policy and its guiding principles, the framework for implementation of the policy.

5.2.8 Worker Safety and Health

Occupational Safety and Health Act of 1970 (29 U.S.C. 651 et seq.). The Occupational Safety and Health Act established standards for safe and healthful working conditions in places of employment throughout the United States. This Act is administered and enforced by the Occupational Safety and Health Administration (OSHA), an agency within the U.S. Department of Labor. Although OSHA and EPA both have a mandate to reduce exposures to toxic substances, including mercury, OSHA's jurisdiction is limited to safety and health conditions that exist in the workplace environment. Under this Act, it is the duty of each employer to furnish employees with a place of employment free of recognized hazards likely to cause death or serious physical harm. Employees have a duty to comply with the occupational safety and health standards and rules, regulations, and orders issued under this Act.

Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction **(Executive Order 12699).** This Executive Order delineates requirements for earthquake safety measures in new Federal buildings. The purposes of these requirements are to reduce risks to the lives of occupants of buildings owned by the Federal Government and to persons who would be affected by the failures of Federal buildings in earthquakes, to improve the capability of essential Federal buildings to function during or after an earthquake, and to reduce earthquake losses of public buildings, all in a cost-effective manner.

Each Federal agency responsible for the design and construction of each new Federal building shall ensure that the building is designed and constructed in accordance with appropriate seismic design and construction standards. This requirement pertains to all building projects for which development of detailed plans and specifications is initiated subsequent to the issuance of the Executive Order. The proposed actions/alternatives that would require new building construction would have to comply with this Executive Order.

"Worker Safety and Health Program" (10 CFR 851). This regulation establishes DOE's nonradiological worker safety and health programs; just as OSHA does for the private industry. This part of Title 10 ensures DOE contractor workers have safe and healthful workplaces in which hazards are abated, controlled, or otherwise mitigated in a manner that provides reasonable assurance that workers are protected from the hazards associated with their jobs. It establishes management responsibilities, workers' rights, required safety and health standards, and worker training on the hazards of their jobs as well as hazard controls.

In June 2005, the DOE Assistant Secretary for Environment, Safety, and Health published in the *Safety and Health Bulletin*, "Safe Management of Mercury (Hg)" (DOE 2005), which provides information regarding the safe handling of mercury and mercury compounds during operations at DOE facilities.

"Occupational Safety and Health Standards" (29 CFR 1910). OSHA regulations establish specific standards instructing employers what must be done to achieve a safe and healthful working environment. OSHA standards limit the concentration of elemental mercury in workplace air to 0.1 milligrams per cubic meter (29 CFR 1910.1000).

DOE and other Federal Government agencies are not governed by OSHA regulations nor do they undergo compliance audits by OSHA personnel. However, they are required, under Title 29 of the *United States Code*, Section 668, to establish their own occupational safety and health programs for their places of employment that are consistent with OSHA standards (see above).

Safety Management Functions, Responsibilities, and Authorities Policy **(DOE Policy 411.1).** This Policy defines DOE's safety management functions, responsibilities, and authorities to ensure that work is performed safely and efficiently.

Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees **(DOE Order 440.1B).** This Order establishes the framework for an effective worker protection program that will reduce or prevent injuries, illnesses, and accidental losses by providing DOE, including National Nuclear Security Administration, workers with a safe and healthful workplace.

5.2.9 Transportation

Hazardous Materials Transportation Act of 1975 (49 U.S.C. 1801 et seq.). Transportation of hazardous materials and substances is regulated by the U.S. Department of Transportation (DOT). The Hazardous Materials Transportation Act of 1975 requires DOT to delineate standardized national regulations for transportation of hazardous materials.

DOT regulations (49 CFR 105, 107, 171–180) establish definitions and general program procedures and requirements of the hazardous materials regulations program. DOT hazardous material regulations establish standards for packaging, marking and labeling, and placarding of packages; and monitoring, routing, and accident reporting and manifesting of in-transit shipments. Requirements for transport by rail, air, and public highway are included. Mercury is listed on the DOT Hazardous Materials Table (49 CFR 172) as a hazardous material regulated fully under DOT only when it is transported by air or vessel, or if it is being offered in a single container at or above its reportable quantity of 1 pound (0.45 kilograms). The elemental mercury would be shipped in single containers, each containing a quantity of mercury above the 1 pound (0.45 kilograms) reportable quantity; therefore, shipment must be compliant with these regulations.

***Packaging and Transportation Safety* (DOE Order 460.1B).** This Order establishes the safety requirements for the proper packaging and transportation of DOE offsite shipments and onsite transfers of hazardous materials.

5.2.10 Quality Assurance

***Quality Assurance* (DOE Order 414.1C).** This DOE Order ensures that the quality of DOE products and services meets or exceeds the customers' expectations. The objective is to achieve quality assurance for all work based upon the following principles: (1) that quality is assured and maintained through a single, integrated, effective quality assurance program (i.e., management system); (2) that management support for planning, organization, resources, direction, and control is essential to quality assurance; (3) that performance and quality improvement require thorough, rigorous assessment and corrective action; (4) that workers are responsible for achieving and maintaining quality; and (5) that environmental, safety, and health risks and impacts associated with work processes can be minimized while maximizing reliability and performance of work products.

***Conduct of Operations Requirements for DOE Facilities* (DOE Order 5480.19 [Change 2]).** The purpose of this Order is to provide requirements and guidelines for departmental branches and divisions to use in developing directives, plans, and/or procedures relating to the conduct of operations at DOE facilities. The implementation of these requirements and guidelines should result in improved quality and uniformity of operations.

5.2.11 Other Requirements

Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 et seq.). This Act requires the avoidance of any adverse effects on prime and unique farmlands. Its purpose is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses and to ensure that Federal programs are administered in a manner that, to the extent practical, will be compatible with state and local government and private programs and policies to protect farmland.

National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.). NEPA establishes a national policy in an effort to increase awareness of the environmental consequences of human actions on the environment and consideration of environmental impacts during the preliminary planning and design prior to the decisionmaking stages of a project. It requires Federal agencies to prepare a detailed EIS for any major Federal action with potentially significant environmental impacts. Federal agencies are regulated under the CEQ regulations (40 CFR 1500 et seq.) for implementing the procedural requirements of NEPA.

***Protection and Enhancement of Environmental Quality* (Executive Order 11514).** This Executive Order (implemented by Title 40 of the CFR, Parts 1500 through 1508) requires Federal agencies to continually monitor and control their activities to meet the following objectives: (1) protect and enhance the quality of the environment and (2) develop procedures to ensure the fullest practicable provision of timely public information and understanding of the Federal plans and programs that may have potential environmental impacts so that views of interested parties can be obtained.

***Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Executive Order 12898).** This Executive Order requires each Federal agency to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The environmental justice sections of Chapter 4 provide the compliance information pertaining to this Order.

***Protection of Children from Environmental Health Risks and Safety Risks* (Executive Order 13045).** This Executive Order requires each Federal agency to make it a high priority to identify and assess environmental, health, and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental, health, or safety risks. Appendix D explains that the mercury exposure limits are protective of children and other sensitive individuals.

***Federal Leadership in Environmental, Energy, and Economic Performance* (Executive Order 13514).** The overarching purpose of this Executive Order (effective date October 5, 2009) is to establish an integrated strategy towards sustainability in the Federal Government and to make reduction of greenhouse gas emissions a priority for Federal agencies. It requires Federal agencies to (1) increase energy efficiency; (2) measure, report, and reduce greenhouse gas emissions; (3) conserve and protect water resources through efficiency, reuse, and stormwater management; (4) eliminate waste, recycle, and prevent pollution; (5) leverage agency acquisitions to foster markets for sustainable technologies and environmentally preferable materials, products, and services; (6) design, construct, maintain, and operate high performance sustainable buildings in sustainable locations; (7) strengthen the vitality and livability of the communities in which Federal facilities are located; and (8) inform Federal employees about and involve them in the achievement of these goals. In an effort to achieve these goals and continue mission support, Federal agencies are required to (1) prioritize actions based on a full accounting of both economic and social benefits and costs; and (2) drive continuous improvement by annually evaluating performance, extending or expanding projects that have net benefits, and reassessing or discontinuing underperforming projects. Lastly, Federal agencies are required to ensure transparency in implementing this Order by disclosing results associated with the actions taken pursuant to this Order by placing information on publicly available Federal websites.

"National Environmental Policy Act Implementing Procedures" (10 CFR 1021). Title 10 of the CFR, Part 1021, sets forth DOE's NEPA implementing procedures, which supplement and are used in conjunction with the CEQ regulations in Title 40 of the CFR, Parts 1500 through 1508.

***Land and Facility Use Planning* (DOE Policy 430.1).** This Policy states that DOE will manage all of its land and facilities as valuable national resources with stewardship based on the principles of ecosystem management and sustainable development. DOE will integrate mission, economic, ecologic, social, and cultural factors in a comprehensive plan for each site that will guide land and facility use decisions. Each comprehensive plan will consider the site's larger regional context and will be developed with stakeholder participation.

To achieve its full potential, each DOE site is given, under the life-cycle asset management approach, the responsibility of tailoring the process to local conditions and many existing activities that impact the planning for DOE's land and facility assets. These include, but are not limited to, the NEPA process, site planning and asset management, public participation, economic development under community re-use organizations, privatization of assets, site strategic planning, environmental justice, cultural asset management, historic preservation, and natural resource management.

***Environmental Protection Program* (DOE Order 450.1A).** This Order implements sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations and meet or exceed compliance with applicable environmental, public health, and resource protection requirements in a cost-effective manner.

***Identifying, Implementing and Complying with Environment, Safety, and Health Requirements* (DOE Policy 450.2A).** This Policy sets forth the framework for identifying, implementing, and complying with environment, safety, and health requirements so that work is performed in the DOE complex in a manner that ensures adequate protection of workers, the public, and the environment. This Policy reaffirms the commitments in the *Environment, Safety and Health Policy for the Department of Energy Complex* (DOE Policy 450.1), including the commitments to excellence and continuous improvement in all DOE operations.

5.3 PERMITS AND NOTIFICATIONS

This section summarizes the general requirements for either permit modification or permit application for each of the candidate elemental mercury storage facility locations, noting that there is a degree of uncertainty in the permitting process. Regulatory agencies responsible for applicable permitting at proposed sites are also identified. Table 5–3 summarizes the existing and potential new environmental permits for air, water, and hazardous waste for each of the seven site alternatives. Sections 5.3.1 through 5.3.7 provide more details on the permits and notifications generally required for each candidate location.

Six of the seven candidate sites currently have existing air permits, NPDES permits, and construction stormwater discharge permits. Only Grand Junction Disposal Site (GJDS) could require a new air permit, NPDES permit, and construction stormwater discharge permit. Regulatory notification to either EPA or the authorized state regulatory compliance divisions of the intent to provide long-term storage and management of elemental mercury and any TSD facility design changes, modifications, etc. would be required for the other candidate locations. Communication and coordination with all applicable regulatory agencies including site specific discussions and facility specific permitting requirements (application for new permits or modification to existing permits) will be required for the long-term management and storage of elemental mercury at the selected site.

Because of the requirement that the elemental mercury storage facility(ies) operate under a permit pursuant to Section 3005 of SWDA, hazardous waste TSD facility requirements and all associated permitting will be necessary. Five of the seven candidate sites currently have existing hazardous waste permits. Only GJDS and Kansas City Plant (KCP) would require a new hazardous waste TSD facility permit. The other candidate locations would require hazardous waste TSD facility permit modifications.

Table 5–3. Environmental Permit Summary

Permits	GJDS Colorado	Hanford Site Washington	HAD Nevada	INL Idaho	KCP Missouri	SRS South Carolina	WCS Texas
Air							
Existing Permit(s)	No	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State
New Permit Application	Yes, State	No	No	Determined After Review	No	Determined After Review	No
Permit Modification	N/A	Potential	Potential	Potential	Potential	Potential	No
Regulatory Notification	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State
Water							
National Pollutant Discharge Elimination System							
Existing Permit(s)	No	Yes, State	Yes, State	Yes, EPA	Yes, State	Yes, State	Yes, State
New Permit Application	Yes, State	No	No	No	No	No	No
Permit Modification	N/A	No	No	No	No	No	No
Regulatory Notification	Yes, State	Yes, State	Yes, State	Yes, EPA	Yes, State	Yes, State	Yes, State
General Construction Stormwater Permit							
Existing General Stormwater Permit(s)	No	Yes, State	Yes, State	Yes, EPA	Yes, State	Yes, State	Yes, State
New Permit Application	Yes, State	No	No	No	No	No	No
Permit Modification	N/A	Yes, State	Yes, State	Yes, EPA	Yes, State	Yes, State	No
Regulatory Notification	Yes, State	Yes, State	Yes, State	Yes, EPA	Yes, State	Yes, State	Yes, State
Hazardous Waste Permit							
Existing Permit(s)	No	Yes, State TSD Facility	Yes, State TSD Facility	Yes, State TSD Facility	Yes, State 90-Day Storage	Yes, State TSD Facility	Yes, State TSD Facility
New Permit Application	Yes, State	No	No	No	Yes, State	No	No
Permit Modification	N/A	Yes, State	Yes, State	Yes, State	N/A	Yes, State	Yes, State
Regulatory Notification	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State	Yes, State

Key: EPA=U.S. Environmental Protection Agency; GJDS=Grand Junction Disposal Site; HAD=Hawthorne Army Depot; INL=Idaho National Laboratory; KCP=Kansas City Plant; N/A=not applicable; SRS=Savannah River Site; TSD=treatment, storage, and disposal; WCS=Waste Control Specialists, LLC.

5.3.1 Grand Junction Disposal Site, Colorado

Currently, there are no environmental permits and none are required for the ongoing activities associated with this facility; however, this site does have a U.S. Nuclear Regulatory Commission (NRC) general license for custody and long-term care of residual radioactive material (10 CFR 40.27). As discussed in Chapter 1, Section 1.7.1, DOE and the Mesa County Board of Commissioners (Mesa County) entered into a Memorandum of Understanding (1996 MOU) (DOE and Mesa County 1996) to provide meaningful consultation with and participation of Mesa County in DOE's use of GJDS. Mesa County's position is that the use of GJDS is restricted per the 1996 MOU and that DOE is obligated to honor this agreement. DOE currently is evaluating the applicability of the 1996 MOU to determine whether it would affect the viability of this site as a reasonable alternative. After the cell is closed, DOE will begin long-term custodial care in accordance with the NRC general license requirements, as codified in Title 10 of the CFR, Section 40.27. Actions, activities, and compliance requirements occurring at GJDS are delineated in the NRC general license. Specific notification, communication, and coordination of activities that occur at GJDS between DOE and Mesa County are addressed in the 1996 MOU. GJDS is in compliance with the requirements specified in the NRC general license and with the terms and conditions specified in the 1996 MOU. Historically speaking, GJDS has been in regulatory compliance since construction of the cell was completed in 1994.

Mesa County land use regulations require that a storage facility or a warehouse be located in an industrial or commercial zoned district. The current land use of GJDS is Agricultural Forestry Transitional. Therefore, a certificate of designation and a conditional use permit could be required through Mesa County before this site would be developed for mercury storage.

Colorado Department of Public Health and Environment (CDPHE) – Air Pollution Control Division

General Construction Permit (GP03). Land development activities that are less than 25 contiguous acres and less than 6 months in duration are exempt from permitting and do not need to report air emissions to the division. For these projects, operators must use appropriate control measures to minimize the release of fugitive dust from the site. Land development refers to all land-clearing activities including, but not limited to, land preparation, such as excavating or grading for residential, commercial, or industrial development or oil and gas exploration and production. If construction activities were to last longer than 6 months and disturb greater than 25 contiguous acres, a general construction permit from the CDPHE would be required.

CDPHE, Hazardous Materials and Waste Management Division

Notification of Regulated Waste Activity. Persons who own or operate a facility for the treatment, storage, or disposal of regulated hazardous waste; transport hazardous waste; handle used oil; or handle large quantities of universal waste must notify CDPHE of these activities and obtain an EPA identification number—a number issued by CDPHE and EPA to identify a facility for hazardous waste management and tracking purposes. The notification includes the location and general description of the activities and type(s) of hazardous wastes handled by the facility.

TSD Facility Permit. Owners and operators of existing or new hazardous waste management units must have permits for the active life of the unit, including the closure period. The decision to issue a permit for treatment, storage, or disposal of hazardous waste is made by the Hazardous Materials and Waste Management Division of CDPHE after a thorough evaluation of the two-part application and input from the public.

There are a number of steps that are taken prior to the issuance or denial of a hazardous waste permit. Not all steps require public participation, but they can add to the timelines of the final action of the permit. Additionally, Mesa County could also potentially require a conditional use permit.

CDPHE, Water Quality Control Division, Stormwater Program

General Permit for Stormwater Discharges Associated with Heavy Industrial Activity-Hazardous Waste Treatment, Storage, and Disposal Facilities and Construction Activities. A stormwater discharge permit is required for hazardous waste TSD facilities (including those operating under interim status). In accordance with Colorado regulations, industries with Standard Industrial Classification

No. 4953, "Hazardous Waste Treatment, Storage or Disposal Facilities," require permit type H, which is the "Heavy Industry General Permit (Permit No. COR-020000), Appendix A." At least 30 days prior to the anticipated date of discharge, the owner (or operator if the owner does not operate the facility) of the facility shall submit an application as provided by the CDPHE Water Quality Control Division. Submittal of a stormwater management plan is required for heavy industry applicants. Additionally, the plan must be implemented and kept at the facility for state review at any time. Stormwater discharge activities are covered and regulated under the Colorado Discharge Permit System. Permits require an annual report, monitoring and sampling, and preparation and maintenance of best management plans.

A stormwater discharge permit is also required for any construction activity, including clearing, grading, and excavating that results in the disturbance of 5 or more acres of total land area, and disturbance of less than 5 acres of total land that is part of a larger common plan of development that will ultimately disturb 5 acres or more of total land.

5.3.2 Hanford Site, Washington

The Hanford Site has numerous active environmental permits issued by the Washington State Department of Ecology (Ecology) and the Benton County Clean Air Authority, which enforces regulations pertaining to detrimental effects, fugitive dust, incineration products, odor, opacity, asbestos, and sulfur oxide emissions.

Washington State Department of Ecology (Ecology)

General Regulations for Air Pollution Sources, *Washington Administrative Code* (WAC) 173-400. Washington State has an extensive set of regulations governing toxic air pollutants (TAPs) (WAC 173-460). These regulations are similar to the EPA Clean Air Act amendments regarding hazardous air pollutants. In contrast to the Federal program, which applies to new and existing emission sources, the TAP rules apply only to new sources of TAPs, including any modification of an existing source where the modification will increase TAP emissions. The TAP rules are implemented under the New Source Review (NSR) Program, and the regulatory standard for TAPs is "best available control technology." An NSR permit delineates what construction (new or modification) is permitted, the emission levels that must be met, and operational time limits for the source of emissions. Washington State lists elemental mercury as a TAP, identifies controls for new TAP sources, and specifies for elemental mercury an acceptable source impact level of 0.09 micrograms per cubic meter, a small-quantity emission rate of 0.0118 pounds per 24-hour average, and a *de minimis* emission value of 0.000591 for elemental mercury averaged over a 24-hour period (WAC 173-460-150). Note that an NSR permit is not required if the TAP emission is below the *de minimis* value prior to any emission control equipment.

Notification of Modification/New Toxic Air Pollutant, WAC 173-400-100. The owner or operator of each source listed (including TSD facilities) shall register the source with Ecology. Both the construction of a new source and/or modification of a stationary source that increases the amount of any air contaminant emitted by such source or that results in the emission of any air contaminant not previously emitted must notify and register with Ecology.

Ecology, Dangerous (Hazardous) Waste TSD Facility Regulations, Dangerous Waste Regulations, WAC 173-303

Notice of Intent Modification/Expansion/New Non–DOE Source Generator to Existing Hazardous Waste TSD Facility Permit (WAC 173-303-280). General requirements for dangerous waste management facilities. The requirements of WAC 173-303-280 through 173-303-395 apply to all owners and operators of facilities that store, treat, or dispose of dangerous wastes and that must be permitted under the requirements of this chapter (WAC 173-303).

Hanford Federal TSD Facility Permit. The DOE Hanford Site Washington State TSD facility permit (No. WA7890008967) allows Hanford to treat, store, and dispose of hazardous waste. The Washington Hazardous Waste Management Act grants Ecology the authority to regulate the disposal of hazardous wastes in Washington and to implement waste reduction and prevention programs. Ecology has adopted extensive regulations that are found in Chapter 173-303 of the WAC. Washington State has received authority from EPA to implement the full RCRA program within the state's borders.

Ecology, Water Quality Programs, Chapters 173-220 & 226 WAC NPDES Permit Program, WAC 173–220, and Waste Discharge General Permit Program, WAC 173-226. *Notification/Modification of Existing Permits: WAC 173-220-150, "Other Terms and Conditions."* In addition to the requirements of WAC 173-220-130 and 173-220-140, each issued permit shall require that: (a) all discharges authorized by the permit shall be consistent with the terms and conditions of the permit; (b) any facility expansions, production increases, or process modifications that would result in new or increased discharges of pollutants causing effluent limitations in the permit to be exceeded must be reported to the department by submission of a new application or supplement thereto; or, if such discharge does not violate effluent limitations specified in the permit, by submission to the department of notice of such new or increased discharges of pollutants.

Permits, Point Source Pollution, Individual or General Permits. *WAC 173-226-080, "Other Terms and Conditions."* In addition to the requirements of WAC 173-226-070, 173-226-090, and 173-226-180, each general permit shall require that: (a) all discharges authorized by the general permit shall be consistent with the terms and conditions of the permit; (b) any facility expansions, production increases, or process modifications that would result in new or increased discharges of pollutants causing effluent limitations in the general permit to be exceeded or beyond that which was reported in the application for coverage must be reported to the department by submission of a new application or supplement thereto.

5.3.3 Hawthorne Army Depot, Nevada

The Hawthorne Army Depot operates under an air permit for various sources, including boilers, processors, diesel-powered generators, and conventional ordnance disposal, and a separate permit for plasma ordnance disposal operations. The Hawthorne Army Depot is a large-quantity generator of hazardous waste and has an RCRA permit for storage of hazardous waste. Stormwater discharges from the Hawthorne Army Depot are covered by an NPDES general permit.

The Defense Logistics Agency's *Final Mercury Management Environmental Impact Statement* (DLA 2004) and subsequent Record of Decision (69 FR 23733) concluded that the long-term storage of U.S. Department of Defense commodity mercury would be at the Hawthorne Army Depot. The mercury is stored and handled as a commodity.

As of 2006, Nevada enacted mercury-specific legislation in the Air Emissions Control Program, the Nevada Clean Air Mercury Rule, and the Chemical Accident Prevention Program (CAPP) (specifically aimed at storage requirements that went into effect September 18, 2006). In September 2006, the Nevada Division of Environmental Protection (NDEP) expanded CAPP to cover storage facilities that handle large quantities of mercury. NDEP added mercury to the list of highly hazardous substances, which are regulated under CAPP.

As part of the CAPP hazardous substance regulations, Senate Bill No. 118 was proposed in the 2007 legislative session to promulgate regulations for handling and storing mercury in quantities greater than or equal to 200,000 pounds (100 tons) by adding language to *Nevada Revised Statutes* (NRS), Section 459.3818. Section 459.3818 (1)(c) proposed provisions to protect the health, safety, and welfare of the residents of Nevada from the effects of handling and storing quantities of mercury meeting or exceeding 200,000 pounds (100 tons). The State of Nevada adopted this State Environmental Commission regulation effective October 31, 2007.

Nevada Administrative Code (NAC), Section 459.9533, is a regulation relating to hazardous materials that designates mercury as a highly hazardous substance.

NDEP, Bureau of Air Quality Planning, CAPP, NRS 459.380–459.3874.

Determination of Applicability of CAPP (especially as it relates to mercury)

NAC 459.95321. The owner or operator shall determine for each process (e.g., mercury storage) within the boundary of his facility if the process is subject to CAPP.

NAC 459.95323, "Criteria for Determination." A process is subject to CAPP if the process contains a highly hazardous substance in a quantity equal to or greater than the amount set forth in Subsection 1 of NAC 459.9533 under the column labeled "Threshold Quantity."

NAC 459.9533, "Tabulated Values for Threshold Quality, Two Release Quantity and Toxic Endpoints, Classification of Substance as Explosive." This section includes a table that sets forth the list of highly hazardous substances and the parameters associated with carrying out CAPP. The parameters associated with mercury are reproduced below.

Mercury:
Chemical Abstracts Service Number = 439-97-6
Threshold Quantity = 200,000 pounds
Two Release Quantity = 5,000 pounds
Toxicity or Flammability = Toxicity
Toxic Endpoint (milligrams per liter) = 0.0021

The owner or operator of a facility that has a process subject to Mercury CAPP shall comply with the following requirements:

1. Register annually with NDEP.
2. Pay the annual fees pursuant to NAC 459.95334.
3. Develop a mercury management system.
4. Conduct a mercury hazard assessment.
5. Develop and implement a mercury spill prevention program.
6. Develop and implement a mercury emergency response program.
7. Provide information to NDEP in advance of an inspection.
8. Submit to NDEP a Revalidation of Mercury Process Hazard Analysis (pursuant to NAC 459.9549).

NDEP, Bureau of Air Quality Planning, Air Pollution Control - NAC 445B.001–445B.395. All necessary permits and procedures are in place. No further action would be needed if the Hawthorne Army Depot is chosen as the mercury storage facility site.

NDEP, "Facilities for Management of Hazardous Waste: General Provisions," NAC 444.842–8482.

TSD Permit Notice of Intent/Modification - NAC 444.8458, *"Stationing New or Expanding Facility for Management of Hazardous Waste: Certificate of Designation; Prerequisite for Permit; Application; Issuance; Exempt Facilities."* A person who proposes to construct or operate a new or expanding facility for the management of hazardous waste must obtain a certificate of designation from the Administrator of the Nevada Department of Health and Human Services before the submission of a Class 3 modification, required pursuant to Title 40 of the CFR, Part 124, Subparts A and B, and Title 40 of the CFR, Part 270, Subparts A through F.

Annual Report to State. The owner or operator must submit an annual report to the state regarding the quantity of the highly hazardous substances present on site, specifically, the maximum quantity on site between June 1 of the previous year and May 31 of the current year (NAC 459.95348).

Highly Hazardous Substances, NAC 459.952–459.9542.

NDEP, Water Pollution Control Program, 445A.226–445A.348. No action would be needed if the Hawthorne Army Depot is chosen as the mercury storage facility site.

5.3.4 Idaho National Laboratory, Idaho

Idaho National Laboratory (INL) has numerous environmental permits, including one RCRA permit with a number of permitted TSD facilities and two Title 5 air permits (DOE 2008). In general, the Idaho Department of Environmental Quality is an EPA-authorized state agency. However, regulation of radionuclide emissions at DOE facilities, as prescribed in Title 40 of the CFR, Part 61, Subpart H, has not been delegated to Idaho and is administered by EPA.

Idaho Department of Environmental Quality, Rules for the Control of Air Pollution in Idaho, the Idaho Administrative Procedure Act (IDAPA) 58.01.01.

Air, IDAPA 58.01.01, Section 581. Construction or modifications of facilities that fall under this classification are subject to a preconstruction review and permitting under the program. Under EPA regulations, the State of Idaho has been delegated authority under the Clean Air Act to maintain the Primary and Secondary National Ambient Air Quality Standards (40 CFR 52, Subpart N), to issue PSD permits (40 CFR 52.683), to enforce performance standards for new stationary sources, and to issue permits to operate. The State of Idaho also administers a permit program that regulates sources that are too small to qualify as a major source under PSD regulations. The State of Idaho has regulatory authority for the NESHAP Subpart M program – Asbestos. To date, State of Idaho does not have authority delegated from EPA to administer the NESHAP Subpart H Program (radionuclide emissions), that authority remains with EPA (40 CFR 61.90–61.97).

Notice to Modify/Review Mercury Insignificant Emission Criteria. The Idaho Air Quality Program is primarily administered through the permitting process. Potential sources of air pollutants are evaluated against regulatory criteria to determine if the source is specifically exempt from permitting requirements and if the source’s emissions are significant or insignificant. If emissions are determined to be significant, several actions may occur: (1) permitting determinations may be made to demonstrate that the project or process is either below emission thresholds or listed as exempted source categories in State of Idaho regulations allowing self-exemption or (2) an application for a permit to construct may be submitted. If emissions are deemed major under PSD regulations, then a PSD analysis must be completed. If not deemed significant per PSD regulations, an application for only a permit to construct without the additional PSD modeling and analyses is needed. All permits to construct are applied for using State of Idaho air regulations and guidelines.

Idaho Department of Environmental Quality, “Rules and Standards for Hazardous Waste,” IDAPA 58.01.05.

The State of Idaho is authorized by EPA to administer its own RCRA program and is responsible for reviewing applications and issuing permits. The Idaho Department of Environmental Quality has issued a RCRA permits for INL.

Notice of Intent/Modification of Existing RCRA Permit and New Non–DOE Generator/Source: IDAPA 58.01.05.012, "Hazardous Waste Permit Program," 40 CFR 270, Subpart D, "Changes to Permit," 40 CFR 270.41, "Modification or Revocation and Reissuance of Permits." When the director receives any information (for example, inspects the facility or receives information submitted by the permittee as required in the permit [see Title 40 of the CFR, Section 270.30]), he or she may determine if there exists one or more of the causes listed in paragraphs (a) and (b) of this section for modification or revocation and reissuance, or both. If cause exists, the director may modify or revoke and reissue the permit accordingly, subject to the limitations of paragraph (c) of this section, and may request an updated application if necessary.

Federal Wastewater Permitting Programs, "EPA Administered Permit Programs: NPDES," 40 CFR 122.

Under the Clean Water Act, states generally set water quality standards, and EPA or states regulate and issue permits for point source discharges as part of the NPDES Permit Program. In Idaho, EPA is responsible for issuing these permits. INL complies with two Clean Water Act permits through the implementation of procedures, policies, and best management practices. These permits are (1) discharges from Idaho Falls facilities to the City of Idaho Falls–owned treatment works and (2) NPDES general permit for stormwater discharges from construction activities, which provides protective requirements for construction activities located within the INL stormwater corridor.

Stormwater Discharge Permits for Construction Activity. DOE obtained coverage for INL under the general permit for stormwater discharges from construction sites issued in June 1993. The coverage under the general permit has been renewed twice. INL contractors obtain coverage under the general permit for individual construction projects. Stormwater pollution prevention plans are completed for individual construction projects. Inspections of construction sites are performed in accordance with permit requirements.

Only construction projects that are determined to have a reasonable potential to discharge pollutants to regulated surface water are required to have a stormwater pollution prevention plan and NPDES permit.

Notification/Review. Construction of new facilities or modifications to existing facilities will require the development of written stormwater discharge plans that conform to requirements of the existing discharge permit. The discharge permit will then need to be amended to include the additional or modified facilities.

5.3.5 Kansas City Plant, Missouri

KCP has numerous environmental permits, including a hazardous waste management facility permit for the operation of an RCRA 90-day storage facility issued by the State of Missouri (GSA and NNSA 2008).

Missouri Department of Natural Resources (MDNR), Division 10, Air Conservation Commission, Air Quality Standards and Pollution Control Regulations for the Entire State of Missouri, 10 *Code of State Regulations* (CSR) 10-6:

Notification to MDNR. The Bannister Federal Complex is located in the Metropolitan Kansas City Interstate Air Quality Control Region 94. This region is currently in attainment status for all criteria pollutants. KCP is currently designated as a major source, as defined by the NESHAPs of the Clean Air Act.

MDNR, Division 25, Hazardous Waste Management Commission, "Rules Applicable to Owners/Operators of Hazardous Waste Facilities," 10 CSR 25-7.

Notification and Modification. The current hazardous waste permit is for the management and storage of hazardous waste with a 90-day storage limitation (Missouri Hazardous Waste Management Facility Permit Part I, Permit No. Mo9890010524). The most likely regulatory scenario would be the need for a TSD facility permit in accordance with RCRA TSD facility requirements, which would require an entire permit application process.

The State of Missouri has additional regulatory requirements for hazardous waste TSD facilities above and beyond those found in the Federal regulations.

MDNR, Division 20, Clean Water Commission, "Permits: Storm Water Regulations," 10 CSR 20-6.200.

KCP has an NPDES permit for four permitted storm sewer systems, six non-permitted (i.e., non-industrial) storm sewers, and surface drainage ditches.

Notification of New Activity to MDNR, 10 CSR 20-6.200 (Stormwater Regulations). All persons who operate, use, or maintain existing stormwater point sources or who disturb land that would result in a stormwater point source shall apply to MDNR for the permits required by the Missouri Clean Water Law and these regulations. A permit must be obtained before beginning any new construction related to the above activities.

5.3.6 Savannah River Site, South Carolina

The Savannah River Site has numerous environmental permits, including a hazardous waste storage facility permit. The South Carolina Department of Health and Environmental Control (SCDHEC) is has been authorized by EPA to issue environmental permits.

SCDHEC, Bureau of Air Quality, "Air Pollution Control Regulations and Standards," ***South Carolina Regulation*** **(SCR) 61-62**

Notify SCDHEC of New Source Potential: SC**R.61-62.1, Section II, "Permit Requirements," (A) "Construction Permits," (B) "Exemptions from the Requirement to Obtain a Construction Permit."** Part 4 states, sources whose only emissions are fugitive must submit source information; the need for permit(s) will be made by SCDHEC on a case-by-case basis. This determination will take into consideration, but will not be limited to, the nature and amount of the pollutants, location, and proximity to residences and commercial establishments, among other factors.

Additionally, a commitment to comply with all applicable regulations and requirements in accordance with SCDHEC SCR.61-62.6 ("Control of Fugitive Particulate Matter") must be included in the notification to SCDHEC.

SCDHEC, "Hazardous Waste Management Regulations: Permit Administration." SCR.61-79.124

Notification to Modify (Potential to Submit Hazardous Waste TSD Facility Permit Application) and New Non–DOE Generator Sources: SCR 61-79, Section 124.5 ("Modification, Revocation, and Reissuance, Termination of Permits Under These Regulations"). (1) SCDHEC may request additional information and, in the case of a modified permit, may require the submission of an updated permit application. (2) In a permit modification under this section, only those conditions to be modified shall be reopened when a new draft permit is prepared. All other aspects of the existing permit shall remain in effect for the duration of the unmodified permit. (3) "Class 1 and 2 modifications," as defined in Title 40 of the CFR, Part 270, Subpart D, are not subject to the requirements of this section. Any modification that would increase the permitted storage capacity, as defined in the permit, would qualify as a Class 3 Modification, a substantial altering of the facility (or its operation), and would be a Class 3 permit modification. (40 CFR 270.42, Appendix I, "Classification of Permit Modification").

SCDHEC has some requirements that are above and beyond the Federal requirements identified in Title 40 of the CFR. For example, SCDHEC requires earlier and broader notification to the state and potential affected parties and greater involvement of the state and the public in permit modifications and maintains the ability to increase permit modification requirements. All of these items may have potential impacts on permit modification process.

SCDHEC "Water Pollution Control Permits: NPDES Permit," SCR.61-9.122

"Modification or Revocation and Reissuance of Permits." Section 122.62 (a). When SCDHEC receives a request for modification it may determine whether or not modification or revocation and reissuance apply. If cause exists, SCDHEC may modify and reissue the permit accordingly and may request an updated application if necessary. When a permit is modified, only the conditions subject to modification are reopened. If a permit is revoked and reissued, the entire permit is reopened and subject to revision, and the permit is reissued for a new term.

5.3.7 Waste Control Specialists, LLC, Texas

Waste Control Specialists, LLC (WCS), is a commercial, fully permitted waste processing and disposal company located in Andrews, Texas. WCS has numerous environmental permits. The Texas Commission on Environmental Quality (TCEQ) is an EPA-authorized regulatory and permitting body. TCEQ issued WCS an RCRA TSD facility permit and an NPDES permit. EPA is the prime regulatory agency for CERCLA and TSCA compliance at the WCS site.

TCEQ, "General Air Quality Rules," 30 *Texas Administrative Code* (TAC) Chapter 101

WCS has several air operating permits. Any necessary modifications to existing storage facilities would be minor and should not require any permit modifications.

TCEQ, "Consolidated Permits: Additional Conditions for Hazardous and Industrial Solid Waste Storage, Processing, or Disposal Permits," 30 TAC Chapter 305, Subchapter G

Notification to Store Mercury with Subsequent Independent Annual Environmental Audit of the Facility.

30 TAC 305.141(b)(2). TCEQ requires notification and permitting of new construction and modification of hazardous waste TSD facilities, including a list of the wastes or classes of wastes that will be stored at the facility and a description of the processes to be used for the processing, storage, or disposal of such hazardous wastes at the facility, including the design capacity of each storage unit.

30 TAC 305.147. Any amended or modified commercial hazardous waste management facility permit shall require that, within the first year after commission action on the permit, the facility owner or operator shall provide notice to affected persons of the intent to have an independent annual environmental audit of the facility performed.

30 TAC 305.69. "Solid Waste Permit Modification at the Request of the Permittee." (A) The permittee must notify the executive director concerning the modification by certified mail or other means that establish proof of delivery within 7 calendar days after the change is put into effect. This notification must specify the changes being made to permit conditions or supporting documents referenced by the permit and must explain why they are necessary.

Texas Pollutant Discharge Elimination System Permit

There should be no impacts associated with Texas Pollutant Discharge Elimination System permit. There would be no major modification that would necessitate notification to TCEQ.

5.4 CONSULTATIONS

NEPA and CEQ regulations require DOE and other Federal agencies to consult with other Federal agencies, federally recognized tribal governments, and state and local agencies with jurisdiction or special expertise regarding any environmental impact of Federal actions. Agencies involved include those with authority to issue applicable permits, licenses, and other regulatory approvals, as well as those responsible for protecting significant resources (e.g., endangered species, critical habitats, or historic resources). The majority of consultations are in the areas of ecological and cultural resources, and American Indian heritage, religious and cultural areas. In addition, DOE policies require consultation with American Indian tribal governments with regard to any DOE action that might affect any property to which these governments attach religious, or cultural importance. DOE is committed to fulfilling its responsibilities of providing open communication and full consultations with federally recognized tribal governments.

If a proposed action has the potential to disturb sensitive species or habitats, ecological resource consultations with the appropriate agencies are required. If a proposed action has the potential to disturb or disrupt a cultural resource or an archaeological site, cultural resource consultations are required.

If, at any time during implementation of a proposed action, an inadvertent discovery is made with potential impacts on ecological, cultural, or American Indian artifacts or materials or human remains, all activity would cease until consultation with affected agencies, organizations, and/or governments is completed. Actions would not resume until a plan is established to mitigate any potential adverse impacts and all applicable consultations have been completed.

5.4.1 Consultations Regarding Ecological Resources

All of the candidate locations for the DOE-designated mercury storage facility(ies) have had previous ecological resource(s) identification and listing via biological surveys, onsite assessments, data/information reviews, and associated consultation with applicable Federal and state agencies. Consultations with all applicable organizations regarding ecological resources for each of the candidate sites have been initiated (see Table 5–4). The consultations solicit input from the agencies/organizations regarding the potential for ecological impacts on threatened, endangered, or otherwise protected species or habitats that might be impacted directly or indirectly.

Table 5–4. Summary of Consultations

Candidate Site	Subject	Contact
Grand Junction Disposal Site	Ecological Resources	Patricia Gelatt, Assistant to the Field Supervisor U.S. Fish and Wildlife Service
	Ecological Resources	Ron Velarde, Regional Manager Colorado DNR, Division of Wildlife
	Cultural Resources	Mr. Edward C. Nichols, SHPO Colorado Historical Society
DOE Hanford Site	Ecological Resources	Mr. Mark Miller U.S. Fish and Wildlife Service
	Ecological Resources	Mr. Jeff Tayer, Regional Program Director Washington State Department of Fish and Wildlife
	Cultural Resources	Dr. Allyson Brooks, SHPO Office of Archeology & Historic Preservation
	American Indian	Ralph Sampson, Chairman Yakama Tribal Council Confederated Tribes and Bands of the Yakama Nation

Candidate Site	Subject	Contact
DOE Hanford Site (*Continued*)	American Indian	Jeanne Jerred, Chairwoman Confederated Tribes of the Colville Reservation Business Council
	American Indian	Rex Buck, Leader Wanapum People
	American Indian	Antone Minthorn, Chairman Board of Trustees Confederated Tribes of the Umatilla Indian Reservation
	American Indian	Samuel N. Penney, Chairman Nez Perce Tribe Executive Committee\ Nez Perce Tribe
Hawthorne Army Depot	Ecological Resources	Henry Maddux, Field Supervisor U.S. Fish and Wildlife Service Utah Ecological Services Field Office
	Ecological Resources	Glenn H. Clemmer, Program Manager Nevada Natural Heritage Program Nevada Department of Conservation and Natural Resources
	Cultural Resources	Mr. Ronald James, SHPO Historic Preservation Office
	American Indian	Edmund Reymus, Chairman Walker River Paiute Tribe
DOE Idaho National Laboratory	Ecological Resources	Dennis Mackey U.S. Fish and Wildlife Service Idaho Fish and Wildlife Office
	Ecological Resources	Jeff Gould, Bureau Chief Idaho Fish and Game, Wildlife Bureau
	Cultural Resources	Ms. Janet Gallimore, Executive Director Idaho State Historical Society
	American Indian	Alonzo Coby, Chairman Fort Hall Business Council Shoshone-Bannock Tribes
DOE Kansas City Plant	Ecological Resources	Charlie Scott, Field Supervisor U.S. Fish and Wildlife Service Columbia Ecological Services Office
	Ecological Resources	Karl Fett, Director Missouri Department of Natural Resources Field Services Division, Kansas City Regional Office
	Cultural Resources	Mr. Mark Templeton, SHPO State Department of Natural Resources State Historic Preservation Office
DOE Savannah River Site	Ecological Resources	Tim Hall, Field Supervisor U.S. Fish and Wildlife Service Charleston Ecological Services Office
	Ecological Resources	D. Breck Carmicheal Jr., Deputy Director South Carolina Department of Natural Resources Wildlife and Freshwater Fisheries Division
	Cultural Resources	Mr. Eric Emerson, SHPO Department of Archives & History
	American Indian	Donald Rodgers, Chief Catawba Indian Nation
Waste Control Specialists, LLC	Ecological Resources	U.S. Fish and Wildlife Service Austin Ecological Services Office
	Ecological Resources	Clay Brewer, Director Texas Parks and Wildlife Department
	Cultural Resources	Mr. Mark S. Wolfe, SHPO Texas Historical Commission

Key: SHPO=State Historic Preservation Officer.

5.4.2 Consultations Regarding Cultural Resources

As with ecological resource(s) identification and delineation, all of the candidate locations for the DOE-designated mercury storage facility(ies) have undergone numerous site assessments, surveys, and consultations with the applicable agencies. Consultations with all applicable historic preservation offices at each of the candidate sites have been initiated (see Table 5–4). If, at any time from project initiation through completion, an inadvertent discovery of archaeological or historic materials is made, activities would cease until all appropriate contacts and consultations have been completed.

5.4.3 Consultations with American Indian Tribal Governments

DOE is committed to fulfilling its government-to-government responsibilities and continued relationships via communication and consultation opportunities with the federally recognized American Indian tribal governments. DOE has initiated the consultation process with the various tribal nations that might be impacted by the alternatives for implementing the proposed action (see Table 5–4). Examples of some of the concerns and areas of potential impact could be places or sites of particular religious or sacred meaning, artifacts and historical items, American Indian human remains (including associated and unassociated funerary objects), and cultural/historical ceremonial objects (including cultural patrimony objects). As with all projects, upon inadvertent discovery, project activities would cease until all appropriate communications, further consultations, and any mitigation plans are implemented.

5.5 REFERENCES

DLA (Defense Logistics Agency), 2004, *Final Mercury Management Environmental Impact Statement*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DOE (U.S. Department of Energy), 2002, *Idaho High-Level Waste & Facilities Disposition, Final Environmental Impact Statement*, DOE/EIS-0287, Idaho Operations Office, Idaho Falls, Idaho, September.

DOE (U.S. Department of Energy), 2005, "State Management of Mercury (Hg)," *Safety and Health Bulletin*, DOE/ EH -0697, Issue No. 2005-08, June.

DOE (U.S. Department of Energy), 2008, *Idaho National Laboratory Site Environmental Report, Calendar Year 2007*, DOE/ID-12082(07), Idaho Operations Office, Environmental Surveillance, Education and Research Program, Idaho Falls, Idaho, September.

DOE (U.S. Department of Energy), 2009, *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury, Preliminary Draft*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June 15.

DOE and Mesa County (U.S. Department of Energy and Mesa County), 1996, *Memorandum of Understanding Between the United States Department of Energy and The Mesa County Board of Commissioners*, April 22.

GSA and NNSA (U.S. General Services Administration and National Nuclear Security Administration), 2008, *Environmental Assessment for the Modernization of Facilities and Infrastructure for the Non-nuclear Production Activities Conducted at the Kansas City Plant*, DOE/EA-1592, Kansas City, Missouri, April 21.

White, R., 2006, "Methylmercury," *Health Effects Review*, accessed through http://www.ijc.org/rel/pdf/health_effects_spring2006.pdf.

CHAPTER 6
GLOSSARY

accident – An unplanned sequence of events resulting in undesirable consequences, such as the release of hazardous material to the environment.

active fault – A fault that is likely to have another earthquake sometime in the future. Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years. In assessing seismic hazard as part of the U.S. Geological Survey's National Earthquake Hazard Reduction Program, faults for which there is surface evidence of tectonic activity during the Quaternary Period are considered active.

acute – Severe but of short duration; not chronic.

Acute Exposure Guideline Levels (AEGLs) – Threshold values published by the National Research Council and National Academy of Sciences for use in chemical emergency planning, prevention, and response programs. AEGLs represent threshold exposure limits for the general population, including susceptible individuals, and are developed for exposure periods of 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours. AEGL values are defined for varying degrees of severity of toxic effects, as follows:

AEGL-1 – The airborne level of concentration of a substance above which the exposed population could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects would not be disabling and would be transient and reversible upon cessation of exposure.

AEGL-2 – The airborne level of concentration of a substance above which the exposed population could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3 – The airborne level of concentration of a substance above which the exposed population could experience life-threatening health effects or death.

air pollutant – Generally, an airborne substance that could, in high-enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated or for which maximum guideline levels have been established due to potential harmful effects on human health and welfare.

air quality – The cleanliness of the air as measured by the levels of pollutants relative to the standards or guideline levels established to protect human health and welfare. Air quality is often expressed in terms of the pollutant for which concentrations are the highest percentage of a standard (e.g., air quality may be unacceptable if the level of one pollutant is 150 percent of its standard, even if levels of other pollutants are well below their respective standards).

air quality control region – Geographic subdivisions of the United States designed to deal with pollution on a regional or local level. Some regions span more than one state.

alloy – A mixture containing mostly metals. For example, brass is an alloy of copper and zinc. An amalgam is an alloy (e.g., an amalgam of mainly silver and mercury).

alluvium (alluvial) – Unconsolidated, poorly sorted detrital sediments, ranging from clay to gravel sizes, deposited by streams.

ambient – Surrounding.

ambient air – The atmosphere around people, plants, and structures.

ambient air quality standards – Regulations prescribing the levels of airborne pollutants that may not be exceeded during a specified time in a defined area.

American Indian Religious Freedom Act of 1978 – An act that protects and preserves for American Indians their traditional religious rights, including the rights of access to religious sites, use and possession of sacred objects, and worship through traditional ceremonies and rites.

anthropogenic – Caused or produced by humans.

aquatic – Living or growing in, on, or near water.

aquifer – An underground geologic formation, group of formations, or part of a formation capable of yielding a significant amount of water to wells or springs.

aquitard – A relatively less permeable geologic unit that inhibits the flow of water.

Archaeological Resources Protection Act of 1979 – An act protecting cultural resources on federally owned lands. This act requires a permit for archaeological excavations or the removal of any archaeological resources on public or American Indian lands. It also prohibits interstate or foreign trafficking in cultural resources taken in violation of state or local laws and requires Federal agencies to develop plans for surveying lands under their control.

archaeological site – Any location where humans have altered the terrain or discarded artifacts during prehistoric or historic times.

artifact – An object produced or shaped by human beings and of archaeological or historic interest.

artisanal gold mining – A general term used in reference to small-scale mining operations prevalent in some developing countries that employ the crude and highly polluting process of mixing mercury with sediments from river bottoms and adjacent areas to extract gold.

atmospheric dispersion – The distribution of pollutants from their source into the atmosphere by wind, turbulent air motion attributable to solar heating of Earth's surface, or air movement over rough terrain and variable land and water surfaces.

attainment area – An area considered to have air quality as good as or better than the National Ambient Air Quality Standards for a given pollutant. An area may be in attainment for one pollutant and nonattaining for others. (See also *nonattainment area*.)

basalt – The most common volcanic rock, dark gray to black in color, high in iron and magnesium and low in silica. It is typically found in lava flows.

baseline – A quantitative expression of conditions, costs, schedule, or technical progress that constitutes the standard against which to measure the performance of an effort. For National Environmental Policy Act evaluations, baseline is defined as the existing environmental conditions against which impacts of the proposed action and its alternatives can be compared. The environmental baseline is the site environmental conditions as they exist or are estimated to exist in the absence of the proposed action.

basin – Geologically, a circular or elliptical downwarp or depression in the Earth's surface that collects sediment. Younger sedimentary beds occur in the center of basins. Topographically, a depression into which water from the surrounding area drains.

bedding plane – Surface separating layers of sedimentary rocks and deposits. Each bedding plane marks the termination of one deposit and the beginning of another of different character, such as a surface separating a sandstone bed from an overlying mudstone bed. Rock tends to break or separate readily along bedding planes.

bedrock – The solid rock that lies beneath soil and other loose surface materials.

bioaccumulation – The accumulation or buildup of contaminants in living systems by biological processes. Methylmercury can bioaccumulate in animal tissue.

bioaccumulation factor – The ratio of the concentration of a chemical in an organism to its concentration in a medium to which the organism is exposed.

bound – An analysis of impacts or risks such that the result overestimates or describes a limit on (i.e., "bounds") potential impacts or risks.

bounding analysis – An analysis designed to overestimate or determine an upper limit to potential impacts or risks.

cancer – The name given to a group of diseases characterized by uncontrolled cellular growth where the cells have invasive characteristics that enable the disease to transfer from one organ to another.

carbon dioxide – A colorless, odorless, nonpoisonous gas that is a normal component of the ambient air and an expiration product of normal animal life.

carbon monoxide – A common air pollutant formed by incomplete combustion; a colorless, odorless gas that is toxic if breathed in high concentrations over an extended period; when humans are exposed to lower concentrations, it can result in chronic effects.

carbonate – A sedimentary rock made mainly of calcium carbonate ($CaCO_3$). Limestone and dolomite are common carbonate sedimentary rocks. (See *dolomite* and *limestone*.)

carcinogen – A substance or agent that produces or incites cancerous growth.

Carolina bay – A closed, elliptical-shaped depression capable of holding water; a type of wetland.

chronic – Lasting for a long period or marked by frequent recurrence.

Class I area – A specifically designated area where the degradation of air quality is stringently restricted (e.g., many national parks, wilderness areas). (See *Prevention of Significant Deterioration*.)

Class II area – Most of the country that is not designated as Class I is designated as Class II. Class II areas are generally cleaner than air quality standards require, and moderate increases in new pollution are allowed after a regulatory-mandated impacts review.

clay – The name for a family of finely crystalline sheet silicate minerals that commonly form as a product of rock weathering. Also, any soil particle smaller than or equal to about 0.002 millimeters (0.00008 inches) in diameter.

Clean Air Act – An act mandating and providing for the enforcement of regulations to control air pollution from various sources.

Clean Air Act Amendments of 1990 – Amendments expanding the U.S. Environmental Protection Agency's enforcement powers and adding restrictions on air toxics, ozone-depleting chemicals, stationary and mobile emission sources, and emissions implicated in acid rain and global warming.

Code of Federal Regulations – A publication in codified form of all Federal regulations in force.

colluvium (colluvial) – A loose deposit of rock debris accumulated at the base of a cliff or slope.

confined aquifer – A permeable geologic unit bounded above and below by aquitards and containing water at a pressure higher than atmospheric pressure.

conformity – As defined in the Clean Air Act, "the nation's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards and achieving expeditious attainment of such standards. Activities in conformity will not (1) cause or contribute to any new violation of any standard in any area, (2) increase the frequency or severity of any existing violation of any standard in any area, or (3) delay timely attainment of any standard or any required interim emission reduction or other milestones in any area."

conglomerate – A sedimentary rock made of rounded rock fragments, such as pebbles, cobbles, and boulders, in a finer-grained matrix. To be classified as a conglomerate, some of the constituent pebbles must be at least about 2 millimeters (one-thirteenth of 1 inch) across.

criteria pollutants – An air pollutant that is regulated by National Ambient Air Quality Standards. The U.S. Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in diameter, and less than 2.5 micrometers (0.0001 inch) in diameter. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. (See *National Ambient Air Quality Standards*.) *Note: Sometimes pollutants regulated by state laws are also called criteria pollutants.*

critical habitat – Habitat essential to the conservation of an endangered or threatened species that has been designated as critical by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR 424). (See *endangered species* and *threatened species*.)

The lists of critical habitats can be found in Title 50 of the *Code of Federal Regulations*, Sections 17.95 (fish and wildlife) and 17.96 (plants), and in Part 226 (marine species).

cultural resources – Archaeological sites, architectural features, historic resources, traditional-use areas, and American Indian sacred sites.

cumulative impacts – Impacts on the environment that result when the incremental impact of a proposed action is added to the impacts from other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

day-night average sound level – The 24-hour, A-weighted equivalent sound level expressed in decibels. A 10-decibel penalty is added to sound levels between 10:00 P.M. and 7:00 A.M. to account for increased annoyance due to noise during night hours.

decibel – A unit for expressing the relative intensity of sounds on a logarithmic scale from zero for the average least perceptible sound to about 130 for the average level at which sound causes pain to humans. For traffic and industrial noise measurements, the A-weighted decibel, a frequency-weighted noise unit, is widely used. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

decibel, A-weighted – A unit of sound measurement that incorporates a metering characteristic and the "A" weighting specified by the American National Standards Institute in S1.4–1983 (R 2001) to account for the frequency response of the human ear.

decontamination – The removal of chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

deposition – In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling out on ground and building surfaces of atmospheric aerosols and particles ("dry deposition") or their removal from the air to the ground by precipitation ("wet deposition").

dip – A measure of the angle between the flat horizon and the slope of a sedimentary layer, fault plane, metamorphic foliation, or other geologic structure.

discharge – In surface-water hydrology, the amount of water issuing from a spring or in a stream that passes a specific point in a given period of time.

dolomite – A mineral composed of calcium-magnesium-carbonate ($CaMg[CO_3]_2$) that is the chief constituent of a sedimentary rock commonly called dolomite, as well as of some kinds of marble. It is thought to form by the alteration of limestone by seawater. (See *carbonate*.)

drainage basin – The land area drained by a particular stream.

drinking water standards – The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

earthquake – A sudden ground motion or vibration of the Earth. It can be produced by a rapid release of stored-up energy along an active fault.

ecology – A branch of science dealing with the interrelationships of living organisms with one another and with their nonliving environment.

ecosystem – A community of organisms and their physical environment interacting as an ecological unit.

effluent – A waste stream flowing into the atmosphere, surface water, groundwater, or soil.

endangered species – Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR 424). (See *threatened species*.) The lists of endangered species can be found in Title 50 of the *Code of Federal* Regulations, Sections 17.11 (wildlife), 17.12 (plants), and 222.23(a) (marine organisms).

Endangered Species Act of 1973 – An act requiring Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions will not likely jeopardize the continued existence of any endangered or threatened species or adversely affect the habitat of such species.

environmental assessment (EA) – A concise public document that a Federal agency prepares under the National Environmental Policy Act (NEPA) to provide sufficient evidence and analysis to determine whether a proposed agency action would require preparation of an environmental impact statement (EIS) or a Finding of No Significant Impact. A Federal agency may also prepare an EA to aid its compliance with NEPA when no EIS is necessary or to facilitate preparation of an EIS when one is necessary. An EA must include brief discussions of the need for the proposal, alternatives, environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted. (See *Finding of No Significant Impact*, *environmental impact statement*, and *National Environmental Policy Act*.)

environmental impact statement – The detailed written statement that is required by Section 102(2)(C) of the National Environmental Policy Act (NEPA) for a proposed major Federal action significantly affecting the quality of the human environment. A U.S. Department of Energy (DOE) EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality NEPA regulations in Title 40 of the *Code of Federal Regulations* (CFR), Parts 1500–1508, and DOE NEPA regulations in Title 10 of the CFR, Part 1021. The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives, adverse environmental effects that cannot be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

environmental justice – The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, or commercial operations or the execution of Federal, state, local, or tribal programs and policies. Executive Order 12898 directs federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations. (See *minority population* and *low-income population*.)

epicenter – The point on the Earth's surface directly above the focus of an earthquake.

erosion – Removal of material by water, wind, or ice.

exposure – The condition of being subject to the effects of, or acquiring a dose of, a potential stressor such as a hazardous chemical agent; also, the process by which an organism acquires a dose of a chemical such as mercury. Exposure can be quantified as the amount of the agent available at various boundaries of the organism (e.g., skin, lungs, gut) and available for absorption.

exposure limit – The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur. (See *reference concentration* and *reference dose.*)

exposure pathway – The course a chemical or physical agent takes from the source to the exposed organism. An exposure pathway describes a mechanism by which chemicals or physical agents at or originating from a release site reach an individual or population. Each exposure pathway includes a source or release from a source, an exposure route, and an exposure point. If the exposure point differs from the source, the transport/exposure medium such as air or water is also included. (See *exposure*.)

Farmland Protection Policy Act – An act whose purpose is to reduce the conversion of farmland to nonagricultural uses as a result of Federal projects and programs. The act requires that Federal agencies comply to the fullest extent possible with state and local government policies to preserve farmland. It includes a recommendation that evaluations and analyses of prospective farmland conversion impacts be made early in the planning process—before a site or design is selected—and that, where possible, agencies make such evaluations and analyses part of the National Environmental Policy Act process.

fault – A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall.

Finding of No Significant Impact – A public document issued by a Federal agency briefly presenting the reasons why an action for which the agency has prepared an environmental assessment has no potential to have a significant effect on the human environment and, thus, will not require preparation of an environmental impact statement. (See *environmental assessment* and *environmental impact statement*.)

flask – A container used to store mercury. Mercury storage flasks, typically made of 0.5-centimeter-thick (0.2-inch-thick) low-carbon steel, can hold 34.6 kilograms (76 pounds) of mercury and are sealed with a threaded plug. A typical mercury storage flask is similar in size and dimensions to a 3-liter soda bottle.

floodplain – The lowlands and relatively flat areas adjoining inland and coastal waters and the flood-prone areas of offshore islands. Floodplains include, at a minimum, that area with at least a 1.0 percent chance of being inundated by a flood in any given year.

The *base floodplain* is defined as the area that has a 1.0 percent or greater chance of being flooded in any given year. Such a flood is known as a 100-year flood.

The *critical action floodplain* is defined as the area that has at least a 0.2 percent chance of being flooded in any given year. Such a flood is known as a 500-year flood.

The *probable maximum flood* is the hypothetical flood considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (e.g., sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

formation – In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

fracture – Any break in rock along which no significant movement has occurred.

geology – The science that deals with the Earth: the materials, processes, environments, and history of the planet, including rocks and their formation and structure.

global climate change – Changes in the Earth's surface temperature thought to be caused by the greenhouse effect and responsible for changes in global climate patterns. The greenhouse effect is the trapping and buildup of heat in the atmosphere (troposphere) near the Earth's surface. Some of the heat flowing back toward space from the Earth's surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then reradiated back toward the Earth's surface.

groundwater – Water below the ground surface in a zone of saturation. It usually occurs in aquifers that may supply wells and springs, as well as baseflow, to major streams and rivers.

Hazard Index – *(ecological definition)* The sum of the individual Hazard Quotients of constituents within a class that exert effects with the same toxicological mechanism or endpoint and are additive in effect.

Hazard Index – *(human health definition)* A summation of the Hazard Quotients for all chemicals now being used at a site, as well as those proposed to be added, to yield the cumulative levels for the site. A Hazard Index value of 1.0 or less means that no adverse human health effects (noncancer) are expected to occur. (See *Hazard Quotient*.)

Hazard Quotient – The value used as an assessment of non-cancer-associated toxic effects of chemicals, e.g., kidney or liver dysfunction. It is a ratio of the estimated exposure to that level of exposure at which it is expected that adverse health effects would begin to be produced. It is independent of a cancer risk, which is calculated for only those chemicals identified as carcinogens.

hazardous air pollutants – Air pollutants not covered by National Ambient Air Quality Standards but which may present a threat of adverse human health or environmental effects. Those specifically listed in Title 40 of the *Code of Federal Regulations*, Section 61.01, are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, hazardous air pollutants are any of the 188 pollutants to be regulated or reviewed under Section 112(b) of the Clean Air Act. Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

hazardous chemical – Under Title 29 of the *Code of Federal Regulations*, Part 1910, Subpart Z, hazardous chemicals are defined as "any chemical that is a physical hazard or a health hazard." Physical hazards include combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and reactives. A health hazard is any chemical for which there is good evidence that acute or chronic health effects occur in exposed employees. Hazardous chemicals include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

hazardous material – A material, including a hazardous substance as defined by Title 49 of the *Code of Federal Regulations*, Section 171.8, that poses a risk to health, safety, and property when transported or handled.

hazardous waste – A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in Title 40 of the *Code of Federal Regulations*, Sections 261.20 through 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in Sections 261.31 through 261.33.

historic resources – Archaeological sites, architectural structures, and objects dating from 1492 or later, after the arrival of the first Europeans to the Americas.

infrastructure – The basic facilities, services, and utilities needed for the functioning of an industrial facility. Transportation and electrical systems are part of the infrastructure.

interbedded – Occurring between beds (layers) or lying in a bed parallel to other beds of a different material.

interim status – Period during which treatment, storage, and disposal facilities subject to the Resource Conservation and Recovery Act are temporarily allowed to operate while awaiting the issuance or denial of a permanent permit.

labor force – All persons of a defined geographic area classified as employed or unemployed.

lacustrine – Relating to lakes, as in lacustrine sediments.

land use – A characterization of land surface in terms of its potential utility for various activities.

lava – Molten rock (magma) that reaches the Earth's surface through a volcanic eruption. When cooled and solidified, forms extrusive (volcanic) igneous rock.

limestone – A sedimentary rock composed mostly of the mineral calcite, $CaCO_3$. (See *carbonate*.)

loam – Soil material that is composed of 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

local magnitude – See *magnitude.*

low-income individuals/persons – Individuals whose income is less than the poverty threshold defined in the U.S. Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty.

low-income population – Low-income populations, defined in terms of U.S. Census Bureau annual statistical poverty levels (Current Population Reports, Series P-60 on Income and Poverty), may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect. (See *environmental justice* and *minority population*.)

magnitude – A number that reflects the relative strength or size of an earthquake. Magnitude is based on the logarithmic measurement of the maximum motion recorded by a seismograph. An increase of one unit of magnitude (for example, from 4.6 to 5.6) represents a 10-fold increase in wave amplitude on a seismograph recording or approximately a 30-fold increase in the energy released. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as "Richter magnitude," (2) surface-wave magnitude (Ms), and (3) body-wave magnitude (Mb). Each is valid for a particular type of seismic signal varying by such factors as frequency and distance. These magnitude scales will yield approximately the same value for any given earthquake within each scale's respective range of validity. A fourth scale (moment magnitude [Mw]) is the latest to be applied that better estimates the size of very large earthquakes that the other scales underestimate by varying degrees.

maximally exposed individual – A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (e.g., inhalation, ingestion, direct exposure).

megawatt – A unit of power equal to 1 million watts. Megawatt-thermal is commonly used to define heat produced, while megawatt-electric defines electricity produced.

mercury (elemental) – Elemental mercury is a dense, naturally occurring, silver-colored metallic element that is liquid at room temperature. Sometimes called "quicksilver," liquid mercury has been used extensively in manufacturing processes because it conducts electricity, reacts to temperature changes, and alloys with many other metals.

mercury (primary) – Unused, 'virgin' mercury that has been produced as the main product of mining activities.

mercury (secondary) – Mercury recycled from the dismantling of used products or equipment.

meteorology – The science dealing with the atmosphere and its phenomena, especially as relating to weather.

migration – The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

Migratory Bird Treaty Act – An act making it unlawful, except in connection with permitted activities, to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird.

minority individuals – Individuals who identify themselves as a member of the following population groups: American Indian or Alaska Native; Asian; black or African American; Hispanic or Latino; Native Hawaiian or other Pacific Islander; or multiracial minority (two or more races, at least one of which is a minority race under Council on Environmental Quality guidelines). This definition is similar to that given in the Council on Environmental Quality's environmental justice guidance; however, it has been modified to reflect revisions to the Standards for the Classification of Federal Data on Race and Ethnicity (62 FR 58782 through 58790), which is published by the Office of Management and Budget.

minority population – Minority populations exist where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than in the general population or other appropriate unit of geographic analysis (such as a governing body's jurisdiction, a neighborhood, census tract, or other similar unit). Minority refers to individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. Minority populations include either a single minority group or the total of all minority persons in the affected area. They may consist of groups of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect. (See *environmental justice* and *low-income population*.)

Mississippian – A period of the Paleozoic Era spanning the time between about 360 and 320 million years ago (following the Devonian Period and preceding the Pennsylvanian Period).

mitigation – actions taken to lessen the impacts of a proposed action, including (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

Modified Mercalli Intensity – A level on the modified Mercalli scale. A measure of the perceived intensity of earthquake ground shaking with 12 divisions, from I (not felt by people) to XII (damage nearly total). It is a unitless expression of observed effects.

mudstone – A detrital sedimentary rock composed of clay-sized particles.

National Ambient Air Quality Standards – Standards defining the highest allowable levels of certain pollutants in the ambient air (i.e., the outdoor air to which the public has access). Because the U.S. Environmental Protection Agency must establish the criteria for setting these standards, the regulated pollutants are called *criteria* pollutants. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in diameter, and less than 2.5 micrometers (0.0001 inch) in diameter. Primary standards are established to protect public health; secondary standards are established to protect public welfare (e.g., visibility, crops, animals, buildings). (See *criteria pollutant*.)

National Emission Standards for Hazardous Air Pollutants (NESHAPs) – Emission standards set by the U.S. Environmental Protection Agency for air pollutants that are not covered by National Ambient Air Quality Standards and may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in Title 40 of the *Code of Federal Regulations*, Parts 61 and 63. NESHAPs are given for many specific categories of sources (e.g., equipment leaks, industrial process cooling towers, drycleaning facilities, petroleum refineries). (See *hazardous air pollutants*.)

National Environmental Policy Act of 1969 (NEPA) – NEPA is the basic national charter for protection of the environment. It establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out the policy. Section 102(2) contains action-forcing provisions to ensure that Federal agencies follow the letter and spirit of the Act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of NEPA requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information.

National Historic Preservation Act of 1966, as amended – An act providing that property resources with significant national historic value be placed in the National Register of Historic Places. It does not require permits; rather, it mandates consultation with the proper agencies whenever it is determined that a proposed action might impact a historic property.

National Pollutant Discharge Elimination System (NPDES) – A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the U.S. Environmental Protection Agency, a state, or, where delegated, a tribal government on an American Indian reservation. The NPDES permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

National Register of Historic Places (NRHP) – The official list of the Nation's cultural resources that are worthy of preservation. The National Park Service maintains the list under direction of the Secretary of the Interior. Buildings, structures, objects, sites, and districts are included in the NRHP for their importance in American history, architecture, archaeology, culture, or engineering. Properties included in the NRHP range from large-scale, monumentally proportioned buildings to smaller-scale, regionally distinctive buildings. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties in the NRHP are found in Title 36 of the *Code of Federal Regulations*, Part 60.

Native American Graves and Repatriation Act of 1990 – An act established to protect American Indian graves and associated funerary objects. This act requires Federal agencies and museums to inventory human remains and associated funerary objects, to provide culturally affiliated tribes with the documented results of that inventory, and to return, on request, items in the inventory to the culturally affiliated tribes.

natural phenomena hazard – A category of events (e.g., earthquake, wind, flood, and lightning) that must be considered in the U.S. Department of Energy (DOE) facility design, construction, and operations, as specified in DOE Order 420.1B.

nitrogen oxides – The oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide, produced in the combustion of fossil fuels. Nitrogen dioxide emissions constitute an air pollution problem, as they contribute to acid deposition and the formation of atmospheric ozone.

noise – Undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

nonattainment area – An area that the U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.

outfall – The discharge point of a drain, sewer, or pipe into or that eventually leads to a body of water.

ozone – The triatomic form of oxygen; in the stratosphere, ozone protects the Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere, ozone is considered an air pollutant.

pallet – A small platform on which material is stored. Pallets are often constructed of wood and serve to lift the material off the ground to keep it dry. Pallets also enable the material to be easily lifted with a forklift.

particulate matter (PM) – Any finely divided solid or liquid material, other than uncombined (i.e., pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inch) in diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inch) in diameter. Total suspended particulates were first used as the indicator of particulate concentrations.

peak ground acceleration – A measure of the maximum horizontal acceleration (as a percentage of the acceleration due to Earth's gravity) experienced by a particle on the surface of the Earth during the course of earthquake motion.

Pennsylvanian – A geologic period of the Paleozoic Era spanning the time between about 320 and 286 million years ago. The Pennsylvanian may be best known for its coal-bearing deposits that originated from vast swamps that were present at the time, as well as the formation of the Appalachian Mountains from the collision of present-day Europe and North America with present-day Africa and South America.

percent *g* – In measuring earthquake ground motion, the acceleration (the rate of change in velocity) experienced relative to that due to Earth's gravity (i.e., 9.8 meters per square second).

perched aquifer/groundwater – A body of groundwater of small lateral dimensions separated from an underlying body of groundwater by an unsaturated zone.

permeability – The ability of a rock, soil, or other material to allow water to flow through its interconnected spaces.

persistence – The resistance to degradation as measured by the period of time required for complete decomposition of a material.

pH – A numeric value that indicates the relative acidity or alkalinity of a substance on a scale of 0 to 14, with the neutral point at 7.0. Acid solutions have pH values lower than 7.0, and basic (alkaline) solutions have values higher than 7.0.

plume – The elongated pattern of contaminated air or water originating at a point source such as a smokestack or hazardous waste disposal site.

$PM_{2.5}$ and **PM_{10}** – See *particulate matter.*

potable water – Water that is fit to drink.

prehistoric – Predating written history; in North America, also predating contact with Europeans.

Prevention of Significant Deterioration – Regulations required by the 1977 Clean Air Act amendments to limit increases in criteria air pollutant concentrations above baseline in areas that already meet the National Ambient Air Quality Standards. Cumulative increases in pollutant levels after specified baseline dates must not exceed specified maximum allowable amounts. These allowable increases, also known as increments, are especially stringent in areas designated as Class I areas (e.g., national parks, wilderness areas) where the preservation of clean air is particularly important. All areas not designated as Class I are currently designated as Class II. Maximum increments in pollutant levels are also given in Title 40 of the *Code of Federal Regulations*, Section 51.166, for Class III areas, if any such areas should be so designated by the U.S. Environmental Protection Agency. Class III increments are less stringent than those for Class I or Class II areas. (See *National Ambient Air Quality Standards*.)

prime farmland – As defined in Title 7 of the *Code of Federal Regulations*, Section 657.5(a), "Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods." Soil mapping units that qualify as prime farmland within each state are identified by the U.S. Department of Agriculture, National Resources Conservation Service State Conservationists.

Quaternary – The second geologic period of the Cenozoic Era, dating from about 1.6 million years ago to the present. It contains two epochs: the Pleistocene and the Holocene. It is characterized by the first appearance of human beings on Earth.

Record of Decision – A document providing a concise public record of an agency's decision on a proposed action for which an environmental impact statement was prepared. Prepared in accordance with Title 40 of the *Code of Federal Regulations*, Section 1505.2, the Record of Decision identifies the alternatives considered in reaching the decision, the environmentally preferable alternative, factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they have not.

reference concentration – The chronic exposure concentration for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur. (See *exposure limit* and *reference dose*.)

reference dose – The chronic exposure dose for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur. (See *exposure limit* and *reference concentration*.)

reflasking – The transfer of mercury from aging, damaged, or leaking 34.6-kilogram (76-pound) flasks to new 34.6-kilogram (76-pound) steel flasks.

region of influence – A site-specific geographic area. The regions of influence for different resources can vary widely in extent. For example, the region of influence for ecological resources would generally be confined to the site and nearby adjacent areas, whereas the socioeconomic region of influence would include the cities and counties surrounding each site that could be affected by the proposed action.

Resource Conservation and Recovery Act (RCRA), as amended – This law gives the U.S. Environmental Protection Agency the authority to control hazardous waste from "cradle to grave" (i.e., from the point of generation to the point of ultimate disposal), including its minimization, generation, transportation, treatment, storage, and disposal. RCRA also sets forth a framework for management of nonhazardous solid waste. (See *hazardous waste*.)

Richter magnitude – See *magnitude.*

rift – A valley caused by extension of the Earth's crust. Its floor forms as a portion of the crust moves downward along normal faults.

risk – The probability of a detrimental effect from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (i.e., the product of these two factors). However, separate presentation of probability and consequence is often more informative.

risk assessment (chemical) – The qualitative and quantitative evaluation performed to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical materials.

runoff – The portion of rainfall, melted snow, or irrigation water that flows across the ground and which may eventually enter surface waters.

sand – Loose grains of rock or mineral sediment formed by weathering that range in size from 0.0625 to 2.0 millimeters (0.0025 to 0.08 inches) in diameter and often consist of quartz particles.

sandstone – A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

sanitary waste (wastewater) – Wastes generated by normal housekeeping activities, liquid or solid (includes sludge), that are not hazardous or radioactive.

scoping – An early and open process for determining the scope of issues to be addressed in an environmental impact statement and for identifying the significant issues related to a proposed action.

sedimentary rock – Rock formed from the accumulation of sediment, which may consist of fragments and mineral grains of varying sizes from pre-existing rocks, remains or products of animals and plants, products of chemical action, or mixtures of these. Sedimentary rocks often have distinctive layering or bedding.

seismic – Pertaining to any earth vibration, especially that of an earthquake.

seismicity – The frequency and distribution of earthquakes.

sewage – The total nonhazardous organic waste and wastewater generated by an industrial establishment or a community.

sewer – A pipe or conduit (sewer) intended to carry wastewater or waterborne wastes from homes, businesses, and industries to a treatment facility.

shale – Sedimentary rock derived from mud, commonly finely laminated (bedded). Particles in shale are commonly clay minerals mixed with tiny grains of quartz eroded from pre-existing rocks. "Shaley" means like a shale or having some shale component, as in shaley sandstone.

silt – Loose particles of rock or mineral sediment that range in size from about 0.002 to 0.0625 millimeters (0.00008 to 0.0025 inches) in diameter. Silt is finer than sand, but coarser than clay.

siltstone – A fine-grained sedimentary rock composed mostly of silt-sized grains.

socioeconomics – Demographic and economic characteristics of a defined geographic area.

soils – All unconsolidated materials above bedrock. Natural earthy materials on the Earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants.

sole-source aquifer – A designation granted by the U.S. Environmental Protection Agency when groundwater from a specific aquifer supplies at least 50 percent of the drinking water for the area overlying the aquifer. Sole-source aquifers have no alternative source or combination of sources that could physically, legally, and economically supply all those who obtain their drinking water from the aquifer.

solid waste – In general, solid wastes are non-liquid, non-soluble discarded materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances. Solid wastes include sewage sludge, agricultural refuse, demolition wastes, and mining residues.

For purposes of regulation under the Resource Conservation and Recovery Act, solid waste is any garbage; refuse; sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material. Solid waste includes solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities. A more-detailed regulatory definition of solid waste can be found in Title 40 of the *Code of Federal Regulations*, Section 261.2. (See *hazardous waste* and *Resource Conservation and Recovery Act*.)

spill prevention, control, and countermeasures plan – A plan prepared by a facility to minimize the likelihood of a spill and to expedite control and cleanup activities should a spill occur.

stabilize – To convert a compound, mixture, or solution to a nonreactive form.

State Historic Preservation Officer – The state officer charged with the identification and protection of prehistoric and historic resources in accordance with the National Historic Preservation Act.

stormwater – Stormwater runoff, snowmelt runoff, and surface runoff and drainage.

sulfur oxides – Common air pollutants, primarily sulfur dioxide, a heavy, pungent, colorless gas (formed in the combustion of fossil fuels, considered a major air pollutant), and sulfur trioxide. Sulfur dioxide is involved in the formation of acid rain. It can also irritate the upper respiratory tract and cause lung damage.

surface water – All bodies of water on the surface of the Earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

tectonic – Of or relating to motion in the Earth's crust and occurring on geologic faults.

threatened species – Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and that have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, following the procedures set out in the Endangered Species Act and its implementing regulations (50 CFR 424). (See *endangered species*.) The lists of threatened species can be found in Title 50 of the *Code of Federal Regulations*, Sections 17.11 (wildlife), 17.12 (plants), and 227.4 (marine organisms). *Note: Some states also list species as threatened. Thus, in certain cases a state definition would also be appropriate.*

toxic – Poisonous (to living organisms); capable of producing disease or otherwise harmful to human health when taken into the body. Mercury is toxic.

Toxic Substances Control Act (TSCA) – This law requires that the health and environmental effects of all new chemicals be reviewed by the U.S. Environmental Protection Agency before they are manufactured for commercial purposes. This act also imposes strict limitations on the use and disposal of polychlorinated biphenyls, chlorofluoro-carbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium. In addition, the provisions of the Mercury Export Ban Act relating to the prohibition on sale, distribution, or transfer of elemental mercury by federal agencies, and to the prohibition on the export of elemental mercury, amended Sections 6 and 12, respectively of TSCA.

toxicity reference value – An exposure level from a valid scientific study that represents a threshold for some level of ecological effect.

traditional cultural property – A property or place that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices and beliefs that are (1) rooted in the history of a community and (2) important to maintaining the continuity of that community's traditional beliefs and practices.

treatment – Under the Resource Conservation and Recovery Act, any method, technique, or process designed to change the physical, chemical, or biological character or composition of any hazardous waste.

unemployment rate – The number of unemployed persons as a percentage of the labor force.

viewshed – The extent of the area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

visual resource management – A process devised by the U.S. Bureau of Land Management to assess the aesthetic quality of a landscape, and, consistent with the results of that analysis, to so design proposed activities as to minimize their visual impact on the landscape. The process consists of a rating of visual quality followed by a measurement of the degree of contrast between proposed development activities and the existing landscape. Four classifications are employed to describe different degrees of modification to landscape elements: Class I, areas where the natural landscape is preserved, including national wilderness areas and the wild sections of national wild and scenic rivers; Class II, areas with very limited land development activity, resulting in visual contrasts that are seen but do not attract attention; Class III, areas in which development may attract attention, but the natural landscape still dominates; and Class IV, areas in which development activities may dominate the view and may be the major focus in the landscape.

volatile organic compound – Any of a broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol. In regard to air pollution, any organic compound that participates in atmospheric photochemical reaction, except for those determined by the U.S. Environmental Protection Agency Administrator to have negligible photochemical reactivity.

wastewater – Water originating from human sanitary water use (domestic wastewater) and from a variety of industrial processes (industrial wastewater).

water quality standards and criteria – Limits on the concentrations of specific constituents or on the characteristics of water, often based on water use classifications (for example, drinking water, recreation, propagation of fish and aquatic life, agricultural and industrial use). Water quality standards are legally enforceable, whereas water quality criteria are nonenforceable recommendations based on biotic impacts.

water table – The boundary between the unsaturated zone and the deeper, saturated zone. The upper surface of an unconfined aquifer.

wetlands – Areas that are inundated or saturated by surface water or groundwater and that typically support vegetation adapted for life in saturated soils. Wetlands generally include swamps, marshes, bogs, and similar areas (e.g., sloughs, potholes, wet meadows, river overflow areas, mudflats, natural ponds).

CHAPTER 7
LIST OF PREPARERS

U.S. DEPARTMENT OF ENERGY

Levenstein, David
EIS Responsibilities: *Document Manager*
Education: B.S., Entomology, University of Georgia
A.A.S., Biotechnology, Farmingdale State College
Experience: 27 years

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

Beatson, Bryan
EIS Responsibilities: *Waste Management Lead*
Education: M.S., Environmental Science and Public Policy, George Mason University
B.S., Biology, Radford University
Experience: 13 years

Burns, Thomas
EIS Responsibilities: *Ecological Risks Lead*
Education: Ph.D., Ecology, University of Georgia
M.S., Marine Biology, University of Miami
B.S., Biology, University of Notre Dame
Experience: 30 years

Cavanaugh, Sydel
EIS Responsibilities: *Public Meeting Coordinator; Manager*–Chapter 8, "Distribution List"
Education: B.A., Interdisciplinary Studies-Personnel and Sociology, University of Maryland, Baltimore County
Experience: 24 years

DiMarzio, John
EIS Responsibilities: *Project Manager; Manager*–Chapter 1, "Introduction and Purpose and Need for Agency Action"
Education: M.S., Geology, George Washington University
B.S., Geology, University of Maryland
Experience: 28 years

Dixon, Sharay
EIS Responsibilities: *Infrastructure Lead*
Education: B.S., Environmental Management, University of Maryland University College
A.S., Applied Science, Weather Technology
Experience: 11 years

Folk, Kevin

EIS Responsibilities:	*Geology and Soils Lead; Water Resources Lead; Manager*–Chapter 4, "Environmental Consequences," Appendix B, "Impact Assessment Methodology"
Education:	M.S., Environmental Biology, Hood College B.A., Geoenvironmental Studies, Shippensburg University of Pennsylvania A.A., General Studies, Frederick Community College
Experience:	20 years

Gagne, Roger

EIS Responsibilities:	*Website Manager*
Education:	A.A., Computer Science/Business Programming, Montgomery Community College
Experience:	18 years

Gorden, Milton

EIS Responsibilities:	*Transportation Risk Lead*
Education:	B.S., Nuclear Engineering, North Carolina State University
Experience:	19 years

Greene, Aaron

EIS Responsibilities:	*Ecological Resources Lead; Manager*–Appendix E, "Common and Scientific Names of Plant and Animal Species"
Education:	M.S., Environmental Science, Indiana University B.S., Environmental Science, Mansfield University
Experience:	7 years

Heiser, Scott

EIS Responsibilities:	*Manager*–Chapter 2, "Facility Description, Alternatives, and Comparison of Environmental Consequences," Appendix C, "Storage Facility Construction and Operations Data," "Comment Response Document"
Education:	M.S., Engineering Management, University of Maryland B.S., Mechanical Engineering, Virginia Polytechnic Institute and State University
Experience:	18 years

Hoffman, Robert

EIS Responsibilities:	*Land Use and Visual Resources Lead*
Education:	B.S., Environmental Resource Management, Pennsylvania State University
Experience:	24 years

Kaiser, Geoffrey

EIS Responsibilities:	*Human Health Risk Lead; Manager*–Appendix D, "Human Health and Ecological Risk Assessment Analysis"
Education:	Ph.D., Theoretical Elementary Particle Physics, Cavendish Laboratory, Cambridge, United Kingdom M.A., Natural Sciences, University of Cambridge, United Kingdom B.A., Natural Sciences, University of Cambridge, United Kingdom
Experience:	41 years

Martindale, Susan
EIS Responsibilities: *Public Outreach Support*
Experience: 10 years

Mirsky, Steve
EIS Responsibilities: *Human Health Risk–Accident and Intentional Destructive Acts Analyses*
Education: M.S., Nuclear Engineering, Pennsylvania State University
B.S., Mechanical Engineering, Cooper Union
Experience: 33 years

Papa, Patricia
EIS Responsibilities: *Public Outreach Manager; Manager–Summary and Guide for Stakeholders*
Education: B.A., Journalism and Psychology, Syracuse University
Experience: 24 years

Pietzyk, Sharon
EIS Responsibilities: *Administrative Record Manager*
Education: M.S., Systems Management, University of Southern California
B.S., Biology, James Madison University
Experience: 27 years

Prindiville, Kerry
EIS Responsibilities: *Mercury Inventory Lead*
Education: M.S., Environmental Engineering, Washington State University
B.S., Environmental Science, Washington State University
Experience: 13 years

Rhone, Jacquelyn
EIS Responsibilities: *Document Production Manager; Manager*–Appendix A, "The Mercury Export Ban Act of 2008, *Federal Register* Notices, and Other Public Notices" Appendix F, "Cooperating Agency Agreements," Appendix G, "Contractor and Subcontractor National Environmental Policy Act Disclosure Statements"
Education: A.Sc., Radiological Health Technology, Central Florida Community College
Experience: 37 years

Robinson, Linda
EIS Responsibilities: *Project Quality Advisor*
Education: Executive M.B.A., Loyola College
B.S. Ed., Earth Sciences, Texas Christian University
Experience: 36 years

Robinson, Sandra
EIS Responsibilities: *Cultural Resources Lead*
Education: A.A., General Studies, Frederick Community College
Experience: 21 years

Schatzel, Sean
EIS Responsibilities: *Socioeconomics Lead; Environmental Justice Lead*
Education: B.A., Political Economics/Public Administration, Bloomsburg University
Experience: 2 years

Schinner, James
EIS Responsibilities: *Cumulative Impacts Lead; Manager*–Chapter 3, "Affected Environment"
Education: Ph.D., Wildlife Management, Michigan State University
M.S., Zoology, University of Cincinnati
B.S., Zoology, University of Cincinnati
Experience: 37 years

Smith, Alison
EIS Responsibilities: *Editor; Manager*–Chapter 6, "Glossary," Chapter 9, "Index"
Education: B.A., English Language and Literature, University of Maryland, College Park
Experience: 3 years

Smith, Charlotte
EIS Responsibilities: *Public Outreach Support*
Experience: 11 years

Soverow, Walter
EIS Responsibilities: *Administrative Record Coordinator; Public Outreach Support*
Education: B.S., Business Administration, Rochester Institute of Technology
Experience: 15 years

Werth, Robert
EIS Responsibilities: *Meteorology, Air Quality, and Noise Lead*
Education: B.A., Physics, Gordon College
Experience: 35 years

Wherley, Patricia
EIS Responsibilities: *Responsible Corporate Manager, SAIC*
Education: B.A., Geography, George Washington University
Experience: 39 years

SPECTRA TECH, INC.

Stevens, Pam
EIS Responsibilities: *Manager*–Chapter 5, "Environmental Laws, Regulations, Permits, and Other Potentially Applicable Requirements"
Education: B.A., Biology, University of Tennessee at Chattanooga
Experience: 17 years

CHAPTER 8
DISTRIBUTION LIST

The U.S. Department of Energy provided copies of this *Draft Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement (Mercury Storage EIS)* to members of Congress, American Indian tribal governments, state and local governments, other Federal agencies, and organizations and individuals listed in this chapter. Approximately 150 copies of the complete *Draft Mercury Storage EIS* and 600 copies of the *"Draft Mercury Storage EIS" Summary and Guide for Stakeholders* were distributed, along with a compact disk of the complete *Draft Mercury Storage EIS.* Copies will be provided to others upon request.

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U.S. Department of the Army
U.S. Department of the Interior
U.S. Department of Transportation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. General Services Administration
U.S. Government Accountability Office

State Government

Colorado

Colorado Governor
Bill Ritter, Jr.

Senators
Josh Penry, District 7

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Steve King, District 54
Laura Bradford, District 55

Colorado Department of Natural Resources
Ron Velarde

Colorado Department of Public Health and Environment
James Martin, Executive Director
Michael Cosby, UMTRA Property Specialist
Tammy Ottmer, WIPP Program Manager
Martha Rudolph, Director of Environmental Programs
Joe Schieffelin, Manager, Hazardous Materials & Solid Waste Program
Warren Smith, Community Involvement Manager

Colorado Historical Society
Edward C. Nichols, State Historic Preservation Officer

Georgia

Georgia Governor
Sonny Perdue

Georgia Department of Natural Resources
Albert J. Frazier, Jr., Manager, ERT/RMP/EPCRA Programs, Environmental Protection Division

Idaho

State Officials
C.L. "Butch" Otter, Governor
Bonnie Butler, Special Assistant to the Governor, Office of the Governor

Senators
Denton Darrington, District 27
R. Steven Bair, District 28
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Jeffrey D. Thompson, District 33
Lenore Hardy Barrett, District 35
JoAn E. Wood, District 35

Idaho Department of Environmental Quality
Robert E. Bullock, Hazardous Waste Permitting Manager
Craig Halverson, Program Manager
Toni Hardesty, Director

Idaho Department of Labor
Roger B. Madsen, Director

Idaho Fish and Game
Jeff Gould, Chief, Wildlife Bureau

Idaho Office of Energy Resources
John Chatburn, Energy Policy Analyst

Idaho State Historical Society
Janet Gallimore, Executive Director

Kansas

Governor
Mark Parkinson

Missouri

Governor
Jay Nixon

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Jason Holsman, District 45

Environmental Management Commission of Kansas City, Missouri
Carol T. Adams, Board Member
Bob Berkebile, Board Member

Missouri Department of Health and Senior Services
Jonathan Garoutte, Environmental Specialist

Missouri Department of Natural Resources
Keith Bertels, Environmental Specialist, Hazardous Waste Program, Department of Environmental Quality
Karl Fett, Director
Mark Templeton, State Historic Preservation Officer

Nevada

Governor
James A. Gibbons

Senators
Mike McGinness, Central Nevada Senatorial District

Representatives
Ed Goedhart, District 36

Nevada Agency for Nuclear Projects
Bruice Breslow, Executive Director
Joe Strolin

Nevada Department of Conservation and Natural Resources
Allen Biaggi, Director
Glenn H. Clemmer, Program Manager, Nevada Natural Heritage Program

Nevada Division of Environmental Protection
Colleen Cripps, Deputy Administrator
Eric Noack, Chief, Bureau of Waste Management

Nevada State Historic Preservation Office
Ronald James, State Historic Preservation Officer

New Mexico

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Oregon Department of Energy
Ken Niles, Assistant Director

Oregon Department of Environmental Quality
Mitch Wolgamott, Interim Regional Administrator
Neil Mullane, Water Quality Division Administrator

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Mark Sanford

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W. Greg Ryberg, District 24
Shane Massey, District 25

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Tom Young, District 81
William Clyburn, District 82
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J. Roland Smith, District 84
James Stewart, Jr., District 86

South Carolina Department of Archives & History
Eric Emerson, State Historic Preservation Officer

South Carolina Department of Health & Environmental Control
Shelley Wilson, Federal Facilities Liaison

South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division
D. Breck Carmichael, Jr., Deputy Director

Tennessee

Governor
Phil Bredesen

Texas

Governor
Rick Perry

Senators
Kel Seliger, District 31

Representatives
G.E. Buddy West, District 81

Texas Commission on Environmental Quality
Mark R. Vickery, P.G., Executive Director

Texas Historical Commission
Mark S. Wolfe, State Historic Preservation Officer

Texas Parks and Wildlife Department
Clay Brewer, Director

Texas State Energy Conservation Office
Roger Mulder

Washington

State Officials
Christine Gregoire, Governor
Mark Rupp, Director, Governor's Washington DC Office

Senators
Jerome Delvin, District 8
Mark Schoesler, District 9
Janéa Holmquist, District 13
Curtis King, District 14
Jim Honeyford, District 15
Mike Hewitt, District 16

Representatives
Larry Haler, District 8
Brad Klippert, District 8
Don Cox, District 9
Joe Schmick, District 9
Cary Condotta, District 12
William Hinkle, District 13
Judy Warnick, District 13
Norm Johnson, District 14
Charles Ross, District 14
Bruce Chandler, District 15
Daniel Newhouse, District 15
Maureen Walsh, District 16

Washington State Department of Ecology
Madeleine Brown, SEPA
Maria Victoria Peeler, Senior Policy Specialist
Ron Skinnarland, Waste Management Sector Manager

Washington State Department of Fish and Wildlife
Jeff Tayer, Regional Program Director

Washington State Department of Health
John Martell, Manager, Division of Environmental Health, Office of Radiation Protection

Washington State Department of Natural Resources
Sandy Swope Moody, Environmental Review Coordinator, Washington Natural Heritage Program

Washington State Office of Archaeology and Historic Preservation
Allyson Brooks, Ph.D., State Historic Preservation Officer

National Environmental Policy Act State Points of Contact

Lezlie Aller, Department of Environmental Quality, Idaho National Laboratory Oversight Program, Idaho

Susan Burke, Department of Environmental Quality, Idaho National Laboratory Oversight Program, Idaho

Robert Stout, Missouri Department of Natural Resources

Richard AuBuchon, Office of Lieutenant Governor, Missouri

Clearinghouse Coordinator, Nevada State Clearinghouse, Department of Administration

Clearinghouse Coordinator, State Clearinghouse, Office of State Budget, South Carolina

Mary Parkman, Tennessee Department of Environment and Conservation

John Owsley, Tennessee Department of Environment and Conservation
Denise Stines Francis, Governor's Office of Budget, Planning, and Policy, Texas
State Environmental Policy Act Unit Supervisor, Washington State Department of Ecology

LOCAL GOVERNMENT

Colorado

Delta County Officials
Rob Fiedler, Emergency Manager, Sheriff's Office

Grand Junction Officials
Bruce Hill, Mayor
Laurie Kadrich, City Manager
Bill Pitts, City Council
Drew Reekie, Hazmat Coordinator, Fire Department

Mesa County Officials
Steve Acquafresca, District 2, Board of County Commissioners
Steve DeFeyter, Director of Environmental Health, Mesa County Health Department
Dave Frankel, Mesa County Attorney's Office
James Grady, Mesa County Board of Health
Kurt Larsen, Director of Planning and Economic Development
Craig Meis, District 1, Board of County Commissioners
John Rodwick, Ph.D., Mesa County Health Department
Donna Ross, Development Services Director, Mesa County Planning

Pitkin County, Board of County Commissioners
Patti Kay-Clapper, Chairwoman

Georgia

Mayor
Deke Copenhaver, Augusta

Idaho

Mayor
Jared Fuhriman, Idaho Falls

Butte County Commissioner
Seth E. Beal, Chairman

Missouri

Kansas City Officials
Mark Funkhouser, Mayor
Wayne A. Cauthen, City Manager
Cathy Jolly, District 6, City Council
Dennis Murphey, Chief Environmental Officer, Office of Environmental Quality
John A. Sharp, District 6, City Council

Nevada

Mineral County, Board of County Commissioners
Jerrie Tipton, Chair

New Mexico

Eunice Officials
Matt White, Mayor
Curtis Schrader, City Manager

Lea County Officials
Michael Beverly, County Manager
Gary Schubert, Chairman, Board of County Commissioners

Oregon

Portland Officials
Sam Adams, Mayor
Lisa Libby, Planning and Systems
Amy Ruiz, Planning and Sustainability Policies Advisor, Mayor's Office

Mosier Officials
Kathleen Fitzpatrick, City Council

South Carolina

Aiken City Officials
Fred Cavanaugh, Mayor
Roger LeDuc, City Manager

Aiken County Officials
J. Clay Killian, County Administrator
Ronnie Young, Chairman, County Council

Texas

Andrews Officials
Robert Zap, Mayor
Wesley Burnett, Director, Economic Development
Danny Griffin, Plant Manager
Glen E. Hackler, City Manager
Dolphus Bud Jones, Chief of Police, Department of Public Safety
Richard H. Dolgener, County Judge

Washington

Benton City Officials
Lloyd Carnahan, Mayor

Benton County Officials
Max Benitz, Chairman, Benton County Commissioners
Rick Garza, Deputy Director, Benton County Emergency Management
Hans Kwast, Director, Benton County Emergency Services
Gwen Luper, Executive Director, Benton-Franklin Council of Governments
Scott D. Keller, Executive Director, Port of Benton

Franklin County Officials
Rick Miller, Chairman, Board of County Commissioners

Kennewick Officials
Robert Hammond, City Manager
Tom Moak, Mayor

Pasco Officials
Gary Crutchfield, City Manager
Joyce Olson, Mayor

Port of Benton (Benton County) Board of Commissioners
Jane Hagarty, President

Port of Pasco (Franklin County) Board of Commissioners
James Klindworth, President

Prosser Officials
Paul Warden, Mayor

Richland Officials
John Fox, Mayor
Cindy Johnson, City Manager
Edward Revell, Mayor Pro Tem

West Richland Officials
Dale Jackson, Mayor
David Weiser, City Administrator

ADVISORY BOARDS

Environmental Management Advisory Board
Environmental Management Site-Specific Advisory Boards (SSAB)

AMERICAN INDIAN TRIBAL REPRESENTATIVES

Colorado
No American Indian tribal representatives have been identified.

Idaho

Nez Perce Tribe
Samuel N. Penney, Chairman, Nez Perce Tribe Executive Committee
John Stanfill, Hanford Coordinator

Shoshone-Bannock Tribes
Alonzo Coby, Chairman, Fort Hall Business Council
Tino Batt, Treasurer
Willie Preacher, Tribal Department of Energy Director

Kansas
No American Indian tribal representatives have been identified.

Missouri
No American Indian tribal representatives have been identified.

Nevada

Walker River Paiute Tribe
Edmund Reymus, Chairman

Oregon

Confederated Tribes of the Umatilla Indian Reservation
Elwood Patawa, Chairman, Board of Trustees
Tomas Bailor, Department of Science and Engineering
Stuart Harris, Manager, Department of Science and Engineering
Les Minthorn, Treasurer

South Carolina

Catawba Indian Nation
Donald Rodgers, Chief

Tennessee
No American Indian tribal representatives have been identified.

Texas
No American Indian tribal representatives have been identified.

Washington

Confederated Tribes and Bands of the Yakama Nation
Ralph Sampson Jr., Chairman, Yakama Tribal Council
Russell Jim, Director, Yakama Nation Environmental Restoration and Waste Management Program

Confederated Tribes of the Colville Reservation
Michael O. Finley, Chairman, Colville Business Council

Wanapum People
Rex Buck, Leader

Reading Rooms and Libraries

COLORADO
U.S. Department of Energy
Office of Legacy Management
2597 B ¾ Road
Grand Junction, CO 81503
(970) 248-6089

Mesa County Library
530 Grand Avenue
Grand Junction, CO 81502
(970) 243-4442

GEORGIA
Reese Library
Augusta State University
2500 Walton Way
Augusta, GA 30904
(706) 737-1745

Asa H. Gordon Library
Savannah State University
2200 Tompkins Road
Savannah, GA 31404
(912) 356-2183

IDAHO
U.S. Department of Energy
Public Reading Room
1776 Science Center Drive
Idaho Falls, ID 83402
(208) 526-0833

MISSOURI
Mid-Continent Public Library
Blue Ridge Branch
9253 Blue Ridge Boulevard
Kansas City, MO 64138
(816) 761-3382

NEVADA
Mineral County Library
First & "A" Street
Hawthorne, NV 89415
(775) 945-2778

NEW MEXICO
Eunice Public Library
1039 10th Street
Eunice, NM 88231
(575) 394-2336

OREGON
Portland State University
Government Information
Branford Price Millar Library
1875 SW Park Avenue
Portland, OR 97201
(503) 725-5874

SOUTH CAROLINA
Gregg-Graniteville Library
University of South Carolina-Aiken
471 University Parkway
Aiken, SC 29801
(803) 641-3320

South Carolina State Library
1500 Senate Street
Columbia, SC 29211
(803) 734-8026

TEXAS
Andrews County Library
109 NW 1st Street
Andrews, TX 79714
(432) 523-9819

WASHINGTON
U.S. Department of Energy
Public Reading Room
Consolidated Information Center
2770 University Drive, Room 101L
Richland, WA 99352
(509) 372-7443

University of Washington
Suzzallo-Allen Library
Government Publications Division
Seattle, WA 98195
(206) 543-1937

Gonzaga University
Foley Center Library
101-L East 502 Boone
Spokane, WA 99258
(509) 313-5931

WASHINGTON, D.C.
U.S. Department of Energy
Freedom of Information Reading Room
1000 Independence Avenue, SW, 1G-033
Washington, D.C. 20585
(202) 586-5955

ORGANIZATIONS /PUBLIC INTEREST GROUPS

David Deck, Alliance for Democracy
Gisela Ray, Alliance for Democracy
Susan Gordon, Alliance for Nuclear Accountability
Robert J. Simon, American Chemistry Council
Julia Wallace, Andrews Chamber of Commerce
Darrell Jackson, Andrews Industrial Foundation
Paul Abernathy, Association of Lighting and Mercury Recyclers
Richard Haddock, Barrick Gold Corporation
Bruce Lawrence, Bethlehem Appartus Company, Inc.
Elizabeth Fulton, Bray and Company
A. Turner Shipman, Bridespur Homes Association
Carol and KB Winterowd, Center Planning and Development Council
James Divine, ChemMet Ltd PC
Mildred McClain, Citizens for Environmental Justice
Greg deBruler, Columbia Riverkeeper
Lauren Goldberg, Columbia Riverkeeper
Jim Groat, Columbia Riverkeeper
Brett Vandenheuvel, Columbia Riverkeeper
Cort Richardson, Council of State Governments, Eastern Regional Conference
Lisa Janairo, Council of State Governments, Midwest Office
Leslie Soderquist, CWI
Craig Lorch, Eco Lights Northwest
Bruce Rodgers, EKC on Line
Chuck Broscious, Environmental Defense Institute
Bob Cooper, Evergreen Public Affairs, LLC
Keith Mueller, EWG
B.J. Smartt, Fluid Transports
Tom Clements, Friends of the Earth
Andrew Templeton, GAI
Ron Sherman, Genesis
Tim Leftwich, GL Environmental, Inc.
Orion Trist, Global Fund for Women
Michael S. Giannotto, Goodwin Proctor LLP (for Newmont)
Louis Clark, Government Accountability Project
Mark Cohen, Government Accountability Project
Karen Stoberg, Grand Valley Peace and Justice
Charlotte Denniston, Greenpeace
Bill Keller, Greenpeace
Robin Klein, Hanford Action of Oregon
Tom Carpenter, Hanford Challenge
Pam Larsen, Hanford Communities
Steve Hudson, Hanford Watch
Claire Hughes, Health Canada
Aubrey Bouman, Heart of America Northwest
Jan Caslte, Heart of America Northwest
Ryan Jarvis, Heart of America Northwest
Gerald Pollet, Heart of America Northwest
Sarah Washburn, Heart of America Northwest
Mark Mendiola, Idaho Business Review
Sean Ellis, Idaho State Journal

Brett E. Cox, Industrial Health, Inc.
Lois Chalmers, Institute for Energy and Environmental Research
Arjun Makhijani, Ph.D., Institute for Energy and Environmental Research
John Fitzpatrick, Irwin Research
Mary Woollen, Keep Yellowstone Nuclear Free
Megan Boatwright, KIFI-TV 8
David Barrington, KIFI-TV 8
Beau Berman, KOSA-TV
Suzanne Hobbs, KPVI -News Channel 6/NBC
Adrian Geana, Lets Make it Better Now
Sharon Duncan, Linden Hill Homes and Center Planning & Development Council
Leslie LaMons, Linden Hills Neighborhood Association
Jan Secunda, Linnton Neighborhood Association
Valina Hill, Marlborough Community Coalition
Stephanie Lindsay, Marlborough Community Coalition
Betty Ost-Everley, Marlborough Community Coalition
Michael Bender, Mercury Policy Project
Jim Hattler, Mercury Waste Solutions
Peter Larson, Mercury Waste Solutions
Brad J. Buscher, Mercury Waste Solutions
Karla Ashton, Miss Karla's Pre-school
Karen Bennett, National Mining Association
Tawny A. Bridgeford, National Mining Association
Geoff Fettus, Natural Resources Defense Council
Allen Hershkowitz, Natural Resources Defense Council
Susan Egan Keane, Natural Resources Defense Council
David Lennett, Natural Resources Defense Council (consultant)
Jeff White, Newmont Mining Corporation
Dustin Cuzick, News Channel 6/NBC
John C. Shaw, North West Toxic Communities Coalition Board
Scott Kovac, Nuclear Watch New Mexico
Norman A. Mulvenon, Oak Ridge Reservation Local Oversight Committee
Reagan Williams, Office Congressman Paul Brown
Geoff Jolley, Office of Congressman Emanuel Cleaver
Linda Noris, Office of Congressman Mike Crapo
Trudy Kareus, Office of Senator Michael Bennet
David Reeploeg, Office of Senator Maria Cantwell
Nancy Bobbitt, Office of Senator Johnny Isakson
Amy Taylor, Office of Senator James E. Risch
Gaspar Perricone, Office of Senator Mark Udall
Ruth O. Currie, Older Women's League
Elaine K. Patterson, Olin Chloralkali Products
Paige Knight, Oregon Hanford Cleanup Board
John Marks, Oregon League of Conservation Voters
Dona Marie Hippert, Oregon Toxics Alliance
Lane Allgood, Partnership for Science and Technology
Cole Lee, Peace and Unity
Lynn and Kris Cheatum, Peace Works
Ann Suellentrop, Peace Works
Jane C. Luxton, Pepper Hamilton, LLP
Will Callaway, Physicians for Social Responsibility
Mathew D. Burtis, Plumbers and Pipefitters #145

Tom Smith, Public Citizen
Alan S. Caldwell, Riverpoint Development Foundation
Dvija Michael Bertish, Rosemere Neighborhood Association
Carol Panfilio, Rosemere Neighborhood Association
Leslie Zega, Rosemere Neighborhood Association
Bill Ross, Ross & Associates
John Elmer, S.M. Stoller Corporation
Doug Gail, S.M. Stoller Corporation
William R. Toole, Savannah River Site Community Reuse Organization
Frank Carl, Savannah Riverkeeper
Richard C. Tolbert, Save the Bannister Mall Group
Adam Greenwood, Save the Oqallala Aquifer
Scott Dye, Sierra Club
Niki Widmayer, Sierra Club
Susan Corbett, Sierra Club - South Carolina Chapter
Glenn Miller, Sierra Club Toiyabe Chapter
Rose Strickland, Sierra Club Toiyabe Chapter
Ed Hopkins, Sierra Club, Washington DC Office
Susan Justice, Sierra Club, Western Colorado Congress
Beatrice Brailsford, Snake River Alliance
Denis Snider, Snider Farms
Donna R. Heath, Social Action Council, UU Church of Vancouver WA
Christopher Wells, Southern States Energy Board
Sandra Carroll, Tetra Tech
Arthur E. Dungan, The Chlorine Institute, Inc.
Geri Anderson, The Daily Sentinel
Chad Day, The Kansas City Star
Craig Lorch, Total Reclaimed Eco Lights Northwest
Andy Sloop, Total Reclaimed Eco Lights Northwest
Michele Elliott, UMB Trust Real Estate Trustee - GW Miller Co.
Alexia Lang, U-News
L. Lehr Brisbin, Ph.D., University of Georgia, Savannah Ecology Laboratory
Ken McLeod, University of Georgia, Savannah Ecology Laboratory
Marcus Iszard, UMKC, School of Pharmacy
Sidney Kerner, URS - Washington Group
Matthew Rolfe, VA Local 145
Charles Weems, Washington Physicians for Social Responsibility
Bruce A. Johnson, Washington State Grange
Linda Beach, Waste Control Specialists, LLC
Jay Britten, Waste Control Specialists, LLC
Michael Burney, Waste Control Specialists, LLC
Ramon Carrascu, Waste Control Specialists, LLC
Chuck Cronenworth, Waste Control Specialists, LLC
Robin Ghanooni, Waste Control Specialists, LLC
Candance Greenwood, Waste Control Specialists, LLC
Brance Hudson, Waste Control Specialists, LLC
Masood A. Inayaf, Waste Control Specialists, LLC
Mark Orsak, Waste Control Specialists, LLC
Sheil Parker, Waste Control Specialists, LLC
Charles E. Taylor, Waste Control Specialists, LLC
Ryan Williams, Waste Control Specialists, LLC
Penny Pauline Heuscher, Western Colorado Congress

Alex Schroeder, Western Governors' Association
Brian Schwietzer, Western Governors' Association
Jennifer Bailey, Western Slope Conservative Alliance
Tom Klammer, www.tellsomebody.us

INDIVIDUALS

Mary Jo Aardsma
Art Adams
Eric Adman
Pamela Allee
La Var Alvey
Susan Anderson
Bruce Angle
Paul M. Arcell
Joyce Armstrong
Susan Babilon
Meghan Baldwin
Eldon Ball
Phillip Barr
Don Barshay
Amy Bennett
Victor Benveniste
Yvonne Berg
Audrey L. Berry
Mark Bimbach
Cheryl Bodin
Bennett Boeschenstein
Robert Bonestell
Alaya Bouche
Lara Boudreaux
Elisabeth Bowman
Dan Brennecke
Scott Brenner
Michael Brown
Andrew Bryden
Rachel Bunn
Terry Burns
Richard Bush
Kristina Cambridge-Upsons
Helen and Reid Cameron
David Casey
Michael Castellon
Monique Caudell
Nick Cerretani
Mary Chambers
Aluna Chen
Heidi Cies
Gavin Clark
Karen Cobble
Jeff Cogen
Mim Collins
Twink-Lorelei Conklin
Mike Conlan
R.C. Cooper
Maurice Copeland
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Jennifer Covarrubias
Emmett and Emily Crain
Megan Crotty
Lawrence Crowley
Rickey Dailey
LouAnne Dale
Ralph D'Andrea
Andrea Dazzi
Lindsay Dean
Nancy Deauville
Eugene DeBattista Sr.
Marice L. Dechant
Bertie Deering
Stephanie Dees
Melissa Devlin
Beth Dickson
Karen Dickson
Dawn Ditter
Chris Dolson
Donna M. Donahue
Laurie Dornberger
Marian Drake
Rebecca Dreisewerd
Kelly Drummey
Viginia Duffy
J.L. Dunn
Nichole Ekman
Randal Ellison
Karin Engstrom
James Eschenfelder
Peter Evans
Per Fagereng
Mickail Farrin
Sharon Fasnacht
John Felton
Gary J. Fields
Alex Fish
Christine Fleming
Randolph Flowe
Joyce Follingstad
Richard Freeman
L. Gangi
James Gardner
Rose Gardner
Kima Garrison
Richard L. Geddes
Brandy Gee
Dionna Ghalambor
Alex Gibson
Robert Gibson

Judith W. Ginn
Susana Gladwin
Kathe Golden
Colin Goldstein
Joshua Graul
Jacob Green
Shelly Grimshaw
Chris Groutt
Aloke Guha
Julia Gumper
Jane Guthridge
Margaret Guthrie
Richard Haack
Jennifer Hall
Marcia Hall
Cyndy Hallford
Betty Hamilton
Sondra Hardgrave
Brian Harris
Alex C. Haskell III
Neil Hastings
Callie Hatch
Pat Hazlett
David Henderson
Christine L. Herres
Stephen Herrington
Rhonda Hess
O. Hibschle
Liz Hickman-Heyner
Christina Hildebrandt
Joseph Hiller
Carol Hiltner
Ian Himell
Donna Hoffman
Richard R. Hoffman
Frank Holmes
Marci Homer
Teresa Hopkins
Veva Horne
Jon Howland
Carol Hruby
Ravf Hunjan
McLaren Innes
Charlotte Jackson
Anne Jansen
Jennifer Jenkins
L. Jensen
Carla Johnson
Dean Johnson
Janet Johnson
Colette Jorgensen
Joel Kabakov
Sandra T. Kaiser
Matthew Keever
Bill Kella
Harry Kershner
Shelley Kilbon
Tim Kilbride
Roy King
Jack Kingsley
G.R. Kirkham
Joanna Kirkpatrick
Maria Kollas
G. Kortes
Peter Kraft
Mike Krieg
Kathy Krisinski
Lisa LaDue
Ellen Leatham
Margaret Leech
John Lemmon
Dean Levesque
Nashay Lewis
Daniel Lichtenwald
Eileen List
Willie Littles
Ann Littlewood
Marie Logsden
Bruce Lolemiller
Carlo A. Loper
Nathan Lord
Roger Louden
Bob Ludlow
Leah Lyon
James Macinnis
Jodie Maclavish
George Manning
Peggy Markel
Susan Martin
Wesley Martin
Andrew Martsolf
Blair Matbaum
Valarie Matinjussi
Patricia Matthews
Gene McAffee
Maurice McAffee
Lucy McAllister
Bill McCall
Melanie McCloskey
Carlos McCluskey
Dave McCone
William McDoanld
Sammye Meadows
William Merline

Jodi Messenich
Martin Mijal
Stan Miller
Pam Milmoe
Javen Mondragon
Ron Moody
Jerome Murray
Joyce Namba
Susan Nash
J. Natre
Alexis Nefzger
Gareth Nisbett
Karyn Nixon
Thomas Norris
Jaime Norton
Bethanie O'Driscoll
Carl Ohgren
Mary Orn
Wallace Orr
Madya Panfilio
John P. Paris
Trent Peaker
Abigail Pecore
Robert Peel
Judy A. Pegg
Martha Perez
Susan Perigo
Gaspar Perricone
Steven and Patricia Perrott
Andrea Peterson
Merry Ann Peterson
Kay Peterson-Cook
Jordana Pilmanis
Megan Pingree
Aubrey Pluta
Lee Poe
Eric Polczynski
Tom Powers
Valerie L. Prentice
Sandra Price
Melody Pryor
Peggy Pryor
Joellen Raderstorf
Peter Raich
Ronda Redman
Kate Redmond
Martha Reed
Jill Reifschneider
David Reinortson
Ruth Remple
Nancy Rhine
Rodney Rice
Robert Richardson
Linda Richmond
Peter Rickards
Eli Ringel
Joe Ritchey
Sandra R. Ross
Tim Ross
Peter Roth
Elizabeth Rowan
Jenny Russell
Robert Sadin
Reginald Sanderson
Ellen Sassano
Patricia Savoy
Madelyn Schaefer
Page Scherbl
Edwin Schlapfer
Debra and Eugene Seitz
Megna Shah
Pete F. Shaw
C. Barry Shedrow
Laurel Shefferd
Jeff and Pam Shouse
Sue Silver
Nicole Sirbu
Jonathan Sirotek
Fredd Smith
Linda Smith
Terry Snyder
Laurie Solomon
Paul Somlo
John Spear
Jim Spehar
Elizabeth Spencer
Donald Stephens
Irwin Stewart
Michael Stieber
Mindy Stone
Shawn Strate
Laura Stuntz
Mary Swanson
Riva Sweetrocket
Gwendolyn Swift
Beverly Tennant
V.C. Ternhahan
Nancy Terrill
Jay Thiemeyer
Roderic Thomas
Grace Todd
Christopher Tracy
Sara Tscheschxe
John Tucker

Roger Turner
Eric Tussey
Jane Ulrich
Angie Unruh
Jane Valentine
Paul Vero
W.S. Vertal
Robert von Tobel
Eric von Wettberg
Denise Walters
Mel Walz
Wayne Wathen
Thomas Watson
Carol Watts
Peter R. Wawrzonkiewicz
Scott Wegs
Nick Welch
Gracia Wenzel
Caryn Wertheimer
Bernadette Wheeler
Dick Whitehurst
Den Mark Wichar
Nicolas Williams
Karla Williamson
Roe and Helene Willis
Jody Wiser
Mr. and Mrs. Wojo
John and Polly Wood
Janet Woodman
Shirley Woodruff
Drisana Young-Taft
David Zeutzius
Michael Zotter
Jarrett Zuboy

CHAPTER 9
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APPENDIX A
THE MERCURY EXPORT BAN ACT OF 2008, *FEDERAL REGISTER* NOTICES, AND OTHER PUBLIC NOTICES

Table of Contents

A.1 PUBLIC LAW 110-414: MERCURY EXPORT BAN ACT—OCTOBER 14, 2008

PUBLIC LAW 110–414—OCT. 14, 2008 122 STAT. 4341

Public Law 110–414
110th Congress

An Act

To prohibit the sale, distribution, transfer, and export of elemental mercury, and for other purposes.

Oct. 14, 2008
[S. 906]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Mercury Export Ban Act of 2008.
15 USC 2601 note.

SECTION 1. SHORT TITLE.

This Act may be cited as the "Mercury Export Ban Act of 2008".

SEC. 2. FINDINGS.

15 USC 2611 note.

Congress finds that—

(1) mercury is highly toxic to humans, ecosystems, and wildlife;

(2) as many as 10 percent of women in the United States of childbearing age have mercury in the blood at a level that could put a baby at risk;

(3) as many as 630,000 children born annually in the United States are at risk of neurological problems related to mercury;

(4) the most significant source of mercury exposure to people in the United States is ingestion of mercury-contaminated fish;

(5) the Environmental Protection Agency reports that, as of 2004—

(A) 44 States have fish advisories covering over 13,000,000 lake acres and over 750,000 river miles;

(B) in 21 States the freshwater advisories are statewide; and

(C) in 12 States the coastal advisories are statewide;

(6) the long-term solution to mercury pollution is to minimize global mercury use and releases to eventually achieve reduced contamination levels in the environment, rather than reducing fish consumption since uncontaminated fish represents a critical and healthy source of nutrition worldwide;

(7) mercury pollution is a transboundary pollutant, depositing locally, regionally, and globally, and affecting water bodies near industrial sources (including the Great Lakes) and remote areas (including the Arctic Circle);

(8) the free trade of elemental mercury on the world market, at relatively low prices and in ready supply, encourages the continued use of elemental mercury outside of the United States, often involving highly dispersive activities such as artisinal gold mining;

(9) the intentional use of mercury is declining in the United States as a consequence of process changes to manufactured products (including batteries, paints, switches, and measuring devices), but those uses remain substantial in the developing world where releases from the products are extremely likely due to the limited pollution control and waste management infrastructures in those countries;

(10) the member countries of the European Union collectively are the largest source of elemental mercury exports globally;

(11) the European Commission has proposed to the European Parliament and to the Council of the European Union a regulation to ban exports of elemental mercury from the European Union by 2011;

(12) the United States is a net exporter of elemental mercury and, according to the United States Geological Survey, exported 506 metric tons of elemental mercury more than the United States imported during the period of 2000 through 2004; and

(13) banning exports of elemental mercury from the United States will have a notable effect on the market availability of elemental mercury and switching to affordable mercury alternatives in the developing world.

SEC. 3. PROHIBITION ON SALE, DISTRIBUTION, OR TRANSFER OF ELEMENTAL MERCURY.

Section 6 of the Toxic Substances Control Act (15 U.S.C. 2605) is amended by adding at the end the following:

"(f) MERCURY.—

Effective date.

"(1) PROHIBITION ON SALE, DISTRIBUTION, OR TRANSFER OF ELEMENTAL MERCURY BY FEDERAL AGENCIES.—Except as provided in paragraph (2), effective beginning on the date of enactment of this subsection, no Federal agency shall convey, sell, or distribute to any other Federal agency, any State or local government agency, or any private individual or entity any elemental mercury under the control or jurisdiction of the Federal agency.

"(2) EXCEPTIONS.—Paragraph (1) shall not apply to—

"(A) a transfer between Federal agencies of elemental mercury for the sole purpose of facilitating storage of mercury to carry out this Act; or

"(B) a conveyance, sale, distribution, or transfer of coal.

"(3) LEASES OF FEDERAL COAL.—Nothing in this subsection prohibits the leasing of coal.".

SEC. 4. PROHIBITION ON EXPORT OF ELEMENTAL MERCURY.

Section 12 of the Toxic Substances Control Act (15 U.S.C. 2611) is amended—

(1) in subsection (a) by striking "subsection (b)" and inserting "subsections (b) and (c)"; and

(2) by adding at the end the following:

"(c) PROHIBITION ON EXPORT OF ELEMENTAL MERCURY.—

Effective date.

"(1) PROHIBITION.—Effective January 1, 2013, the export of elemental mercury from the United States is prohibited.

"(2) INAPPLICABILITY OF SUBSECTION (a).—Subsection (a) shall not apply to this subsection.

"(3) REPORT TO CONGRESS ON MERCURY COMPOUNDS.—

"(A) REPORT.—Not later than one year after the date of enactment of the Mercury Export Ban Act of 2008, the Administrator shall publish and submit to Congress a report on mercuric chloride, mercurous chloride or calomel, mercuric oxide, and other mercury compounds, if any, that may currently be used in significant quantities in products or processes. Such report shall include an analysis of— Publication.

"(i) the sources and amounts of each of the mercury compounds imported into the United States or manufactured in the United States annually;

"(ii) the purposes for which each of these compounds are used domestically, the amount of these compounds currently consumed annually for each purpose, and the estimated amounts to be consumed for each purpose in 2010 and beyond;

"(iii) the sources and amounts of each mercury compound exported from the United States annually in each of the last three years;

"(iv) the potential for these compounds to be processed into elemental mercury after export from the United States; and

"(v) other relevant information that Congress should consider in determining whether to extend the export prohibition to include one or more of these mercury compounds.

"(B) PROCEDURE.—For the purpose of preparing the report under this paragraph, the Administrator may utilize the information gathering authorities of this title, including sections 10 and 11.

"(4) ESSENTIAL USE EXEMPTION.—(A) Any person residing in the United States may petition the Administrator for an exemption from the prohibition in paragraph (1), and the Administrator may grant by rule, after notice and opportunity for comment, an exemption for a specified use at an identified foreign facility if the Administrator finds that—

"(i) nonmercury alternatives for the specified use are not available in the country where the facility is located;

"(ii) there is no other source of elemental mercury available from domestic supplies (not including new mercury mines) in the country where the elemental mercury will be used;

"(iii) the country where the elemental mercury will be used certifies its support for the exemption;

"(iv) the export will be conducted in such a manner as to ensure the elemental mercury will be used at the identified facility as described in the petition, and not otherwise diverted for other uses for any reason;

"(v) the elemental mercury will be used in a manner that will protect human health and the environment, taking into account local, regional, and global human health and environmental impacts;

"(vi) the elemental mercury will be handled and managed in a manner that will protect human health and the environment, taking into account local, regional, and global human health and environmental impacts; and "(vii) the export of elemental mercury for the specified use is consistent with international obligations of the United States intended to reduce global mercury supply, use, and pollution.

"(B) Each exemption issued by the Administrator pursuant to this paragraph shall contain such terms and conditions as are necessary to minimize the export of elemental mercury and ensure that the conditions for granting the exemption will be fully met, and shall contain such other terms and conditions as the Administrator may prescribe. No exemption granted pursuant to this paragraph shall exceed three years in duration and no such exemption shall exceed 10 metric tons of elemental mercury.

"(C) The Administrator may by order suspend or cancel an exemption under this paragraph in the case of a violation described in subparagraph (D).

"(D) A violation of this subsection or the terms and conditions of an exemption, or the submission of false information in connection therewith, shall be considered a prohibited act under section 15, and shall be subject to penalties under section 16, injunctive relief under section 17, and citizen suits under section 20.

"(5) CONSISTENCY WITH TRADE OBLIGATIONS.—Nothing in this subsection affects, replaces, or amends prior law relating to the need for consistency with international trade obligations.

"(6) EXPORT OF COAL.—Nothing in this subsection shall be construed to prohibit the export of coal.".

Deadline.
42 USC 6939f.

SEC. 5. LONG-TERM STORAGE.

(a) DESIGNATION OF FACILITY.—

(1) IN GENERAL.—Not later than January 1, 2010, the Secretary of Energy (referred to in this section as the "Secretary") shall designate a facility or facilities of the Department of Energy, which shall not include the Y–12 National Security Complex or any other portion or facility of the Oak Ridge Reservation of the Department of Energy, for the purpose of long-term management and storage of elemental mercury generated within the United States.

(2) OPERATION OF FACILITY.—Not later than January 1, 2013, the facility designated in paragraph (1) shall be operational and shall accept custody, for the purpose of long-term management and storage, of elemental mercury generated within the United States and delivered to such facility.

(b) FEES.—

(1) IN GENERAL.—After consultation with persons who are likely to deliver elemental mercury to a designated facility for long-term management and storage under the program prescribed in subsection (a), and with other interested persons, the Secretary shall assess and collect a fee at the time of delivery for providing such management and storage, based on the pro rata cost of long-term management and storage of elemental mercury delivered to the facility. The amount of such fees—

Public information.

(A) shall be made publically available not later than October 1, 2012;

(B) may be adjusted annually; and

(C) shall be set in an amount sufficient to cover the costs described in paragraph (2).

(2) COSTS.—The costs referred to in paragraph (1)(C) are the costs to the Department of Energy of providing such management and storage, including facility operation and maintenance, security, monitoring, reporting, personnel, administration, inspections, training, fire suppression, closure, and other costs required for compliance with applicable law. Such costs shall not include costs associated with land acquisition or permitting of a designated facility under the Solid Waste Disposal Act or other applicable law. Building design and building construction costs shall only be included to the extent that the Secretary finds that the management and storage of elemental mercury accepted under the program under this section cannot be accomplished without construction of a new building or buildings.

(c) REPORT.—Not later than 60 days after the end of each Federal fiscal year, the Secretary shall transmit to the Committee on Energy and Commerce of the House of Representatives and the Committee on Environment and Public Works of the Senate a report on all of the costs incurred in the previous fiscal year associated with the long-term management and storage of elemental mercury. Such report shall set forth separately the costs associated with activities taken under this section.

(d) MANAGEMENT STANDARDS FOR A FACILITY.—

(1) GUIDANCE.—Not later than October 1, 2009, the Secretary, after consultation with the Administrator of the Environmental Protection Agency and all appropriate State agencies in affected States, shall make available, including to potential users of the long-term management and storage program established under subsection (a), guidance that establishes procedures and standards for the receipt, management, and long-term storage of elemental mercury at a designated facility or facilities, including requirements to ensure appropriate use of flasks or other suitable shipping containers. Such procedures and standards shall be protective of human health and the environment and shall ensure that the elemental mercury is stored in a safe, secure, and effective manner. In addition to such procedures and standards, elemental mercury managed and stored under this section at a designated facility shall be subject to the requirements of the Solid Waste Disposal Act, including the requirements of subtitle C of that Act, except as provided in subsection (g)(2) of this section. A designated facility in existence on or before January 1, 2013, is authorized to operate under interim status pursuant to section 3005(e) of the Solid Waste Disposal Act until a final decision on a permit application is made pursuant to section 3005(c) of the Solid Waste Disposal Act. Not later than January 1, 2015, the Administrator of the Environmental Protection Agency (or an authorized State) shall issue a final decision on the permit application.

Procedures.
Standards.
Deadline.

(2) TRAINING.—The Secretary shall conduct operational training and emergency training for all staff that have responsibilities related to elemental mercury management, transfer, storage, monitoring, or response.

(3) EQUIPMENT.—The Secretary shall ensure that each designated facility has all equipment necessary for routine operations, emergencies, monitoring, checking inventory, loading, and storing elemental mercury at the facility.

(4) FIRE DETECTION AND SUPPRESSION SYSTEMS.—The Secretary shall—

(A) ensure the installation of fire detection systems at each designated facility, including smoke detectors and heat detectors; and

(B) ensure the installation of a permanent fire suppression system, unless the Secretary determines that a permanent fire suppression system is not necessary to protect human health and the environment.

(e) INDEMNIFICATION OF PERSONS DELIVERING ELEMENTAL MERCURY.—

(1) IN GENERAL.—(A) Except as provided in subparagraph (B) and subject to paragraph (2), the Secretary shall hold harmless, defend, and indemnify in full any person who delivers elemental mercury to a designated facility under the program established under subsection (a) from and against any suit, claim, demand or action, liability, judgment, cost, or other fee arising out of any claim for personal injury or property damage (including death, illness, or loss of or damage to property or economic loss) that results from, or is in any manner predicated upon, the release or threatened release of elemental mercury as a result of acts or omissions occurring after such mercury is delivered to a designated facility described in subsection (a).

(B) To the extent that a person described in subparagraph (A) contributed to any such release or threatened release, subparagraph (A) shall not apply.

Records.

(2) CONDITIONS.—No indemnification may be afforded under this subsection unless the person seeking indemnification—

Notification. Deadline.

(A) notifies the Secretary in writing within 30 days after receiving written notice of the claim for which indemnification is sought;

(B) furnishes to the Secretary copies of pertinent papers the person receives;

(C) furnishes evidence or proof of any claim, loss, or damage covered by this subsection; and

(D) provides, upon request by the Secretary, access to the records and personnel of the person for purposes of defending or settling the claim or action.

(3) AUTHORITY OF SECRETARY.—(A) In any case in which the Secretary determines that the Department of Energy may be required to make indemnification payments to a person under this subsection for any suit, claim, demand or action, liability, judgment, cost, or other fee arising out of any claim for personal injury or property damage referred to in paragraph (1)(A), the Secretary may settle or defend, on behalf of that person, the claim for personal injury or property damage.

(B) In any case described in subparagraph (A), if the person to whom the Department of Energy may be required to make indemnification payments does not allow the Secretary to settle or defend the claim, the person may not be afforded indemnification with respect to that claim under this subsection.

(f) TERMS, CONDITIONS, AND PROCEDURES.—The Secretary is authorized to establish such terms, conditions, and procedures as are necessary to carry out this section.

(g) EFFECT ON OTHER LAW.—

(1) IN GENERAL.—Except as provided in paragraph (2), nothing in this section changes or affects any Federal, State, or local law or the obligation of any person to comply with such law.

(2) EXCEPTION.—(A) Elemental mercury that the Secretary is storing on a long-term basis shall not be subject to the storage prohibition of section 3004(j) of the Solid Waste Disposal Act (42 U.S.C. 6924(j)). For the purposes of section 3004(j) of the Solid Waste Disposal Act, a generator accumulating elemental mercury destined for a facility designated by the Secretary under subsection (a) for 90 days or less shall be deemed to be accumulating the mercury to facilitate proper treatment, recovery, or disposal.

(B) Elemental mercury may be stored at a facility with respect to which any permit has been issued under section 3005(c) of the Solid Waste Disposal Act (42 U.S.C. 6925(c)), and shall not be subject to the storage prohibition of section 3004(j) of the Solid Waste Disposal Act (42 U.S.C. 6924(j)) if— Certification.

(i) the Secretary is unable to accept the mercury at a facility designated by the Secretary under subsection (a) for reasons beyond the control of the owner or operator of the permitted facility;

(ii) the owner or operator of the permitted facility certifies in writing to the Secretary that it will ship the mercury to the designated facility when the Secretary is able to accept the mercury; and

(iii) the owner or operator of the permitted facility certifies in writing to the Secretary that it will not sell, or otherwise place into commerce, the mercury.

This subparagraph shall not apply to mercury with respect to which the owner or operator of the permitted facility fails to comply with a certification provided under clause (ii) or (iii).

(h) STUDY.—Not later than July 1, 2014, the Secretary shall transmit to the Congress the results of a study, conducted in consultation with the Administrator of the Environmental Protection Agency, that— Deadline.

(1) determines the impact of the long-term storage program under this section on mercury recycling; and

(2) includes proposals, if necessary, to mitigate any negative impact identified under paragraph (1).

SEC. 6. REPORT TO CONGRESS.

At least 3 years after the effective date of the prohibition on export of elemental mercury under section 12(c) of the Toxic Substances Control Act (15 U.S.C. 2611(c)), as added by section 4 of this Act, but not later than January 1, 2017, the Administrator of the Environmental Protection Agency shall transmit to the Committee on Energy and Commerce of the House of Representatives and the Committee on Environment and Public Works of the Senate a report on the global supply and trade of elemental mercury, including but not limited to the amount of elemental mercury traded globally that originates from primary mining, where such primary mining is conducted, and whether additional primary mining has occurred as a consequence of this Act.

Approved October 14, 2008.

LEGISLATIVE HISTORY—S. 906:

SENATE REPORTS: No. 110–477 (Comm. on Environment and Public Works).
CONGRESSIONAL RECORD, Vol. 154 (2008):
Sept. 26, considered and passed Senate.
Sept. 27, 29, considered and passed House.

A.2 REQUEST FOR EXPRESSIONS OF INTEREST IN HOSTING A FACILITY OR FACILITIES FOR THE LONG-TERM MANAGEMENT AND STORAGE OF ELEMENTAL MERCURY

A.2.1 Long-Term Management and Storage of Elemental Mercury as Posted on FedBiz.Opps.gov–March 17, 2009

99--LONG-TERM MANAGEMENT AND STORAGE OF ELEMENTAL MERCURY
Solicitation Number: DE-SOL-0000415
Agency: Department of Energy
Office: Federal Locations
Location: All DOE Federal Contracting Offices

Notice Type:
Presolicitation

Posted Date:
March 17, 2009

Response Date:
April 20, 2009

Archiving Policy:
Automatic, on specified date

Archive Date:
May 20, 2009

Original Set Aside:
N/A

Set Aside:
N/A

Classification Code:
99 -- Miscellaneous

NAICS Code:
562 -- Waste Management and Remediation Services/562112 -- Hazardous Waste Collection

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Synopsis:
Added: Mar 17, 2009 5:09 pm
THIS IS A SPECIAL NOTICE.

REQUEST FOR EXPRESSIONS OF INTERESTLONG-TERM MANAGEMENT AND STORAGE OF ELEMENTAL MERCURY

I. OBJECTIVE OF THE REQUEST FOR EXPRESSIONS OF INTEREST

THIS IS A REQUEST FOR EXPRESSIONS OF INTEREST. NO PROPOSALS ARE ALLOWED.

The U.S. Department of Energy (DOE) is seeking Expressions of Interest from the private sector regarding potential locations for a facility or facilities where DOE can store and manage elemental mercury pursuant to the Mercury Export Ban Act of 2008 (the Act). The Act directs DOE to designate by January 1, 2010, a facility or facilities of DOE for the long-term management and storage of elemental mercury. At least one such facility must be operational by January 1, 2013.

DOE intends to initiate an Environmental Impact Statement in early 2009 and seeks to identify facilities to consider as potential alternatives. Accordingly, respondents to this Request for Expressions of Interest may have the facilities they identify considered during the environmental review scoping process. The environmental review will also analyze the potential environmental impacts of storing elemental mercury at one or more DOE or other Federal facilities.

This Request for Expressions of Interest is for planning purposes only and is not a Request for Proposals.

II. GENERAL INFORMATION

The Mercury Export Ban Act of 2008 prohibits the export of elemental mercury from the United States effective January 1, 2013. To ensure that elemental mercury is managed and stored safely, the Act directs DOE to take a number of actions. By October 1, 2009, DOE must issue guidance establishing standards and procedures for the receipt, management and long-term storage of elemental mercury generated within the United States at a facility or facilities of DOE. DOE must designate such facilities by January 1, 2010, but is prohibited by the Act from locating such a facility at DOE's Oak Ridge Reservation. At least one such facility must be operational by January 1, 2013.

In addition to the standards and procedures referenced above, elemental mercury managed and stored at a designated facility will be subject to the requirements of the Solid Waste Disposal Act, as amended (Resource Conservation and Recovery Act (RCRA)), 42 U.S.C. ? 6901 et seq. A designated facility in existence on or before January 1, 2013, is authorized to operate under interim status pursuant to RCRA section 3005(e), 42 U.S.C. ? 6925(e), until a final decision on a permit application is made pursuant to RCRA section 3005(c), 42 U.S.C. ? 6925 (c). The U.S. Environmental Protection Agency (EPA), or an authorized State, shall issue a final decision on the permit application by January 1, 2015.

Currently elemental mercury in the United States comes from several sources, including mercury used in the chlorine and caustic soda manufacturing process, mercury reclaimed from recycling and waste recovery activities, and mercury generated as a byproduct of the gold mining process. In a November 2007 "Mercury Storage Costs Estimates" report, EPA assumed the total amount of excess mercury supply from commercial sources that would require storage to be between 7,500 and 10,000 metric tons over 40 years. The 7,500 metric ton scenario assumes that approximately 1,200 metric tons would come from mercury cell chlor-alkali plants, approximately 2,050 metric tons would come from product recycling and waste recovery, and approximately 4,250 metric tons would be a byproduct of gold mining. The 10,000 metric ton scenario assumes that an additional 2,500 metric tons would result from imports. There are uncertainties associated with these estimates, and DOE anticipates updating thes e estimates in conjunction with its activities to comply with the National Environmental Policy Act (NEPA).

In addition, DOE currently stores approximately 1,200 metric tons of elemental mercury at its Oak Ridge Reservation in Tennessee. Also, the Department of Defense (DOD) stores approximately 4,400 metric tons at various locations. At this time, no decision has been made as to how much elemental mercury from DOE or DOD would be stored in the DOE-designated facilities required by the Act.

As required by Council on Environmental Quality and DOE NEPA regulations, DOE's designation of facilities for the purpose of long-term management and storage of elemental mercury generated in the United States must include consideration of the range of reasonable management and storage alternatives and the environmental impacts of those alternatives. The purpose of this Request is to determine if there is interest on the part of commercial entities in proposing locations for long-term DOE management and storage facilities. Identification of such facilities will enable DOE to consider them for potential inclusion in its NEPA review.

Consideration of a facility in the environmental review process is not a guarantee of its selection. Proposed sites and facilities will be reviewed against a series of technical screening criteria to consider their suitability for a long-term elemental mercury management and storage mission. In addition, in accordance with NEPA implementing regulations, DOE will conduct public outreach, such as a scoping meeting or meetings, for those sites and facilities considered to be reasonable alternatives, to allow the public to comment.

III. REQUEST FOR EXPRESSIONS OF INTEREST:

THIS IS A REQUEST FOR EXPRESSIONS OF INTEREST. NO PROPOSALS ARE ALLOWED.

DOE intends to consider a range of reasonable alternatives, including existing and new DOE facilities, in its selection process. DOE is in the process of conducting an inventory of its national complex to determine potential alternative facilities. Likewise, DOE is also seeking by this action expressions of interest from commercial entities on locations and facilities for the long-term management and storage of elemental mercury. Because the Act states that this mercury would be stored at a "facility or facilities of [DOE]", DOE would work, as necessary, with the commercial entity on acquiring an appropriate interest in the facility prior to site designation.

DOE plans to review each submission to determine if it should be included as a reasonable alternative in DOE's NEPA analysis, which will assess the environmental impacts of each alternative, including existing and new DOE facilities, as they relate to the long-term storage and management of elemental mercury.

As noted above, the amount of mercury to be stored is not well defined. The size requirements for long-term storage and management facilities will depend on a number of factors, including the amount of elemental mercury ultimately received and the storage configuration of the elemental mercury containers. Based on currently available information, for planning purposes DOE is looking for locations with one or more existing facilities with a total of approximately 20,000 to 100,000 square feet of storage space, or locations where such facilities could be constructed. DOE anticipates refining the estimate of required storage space during the environmental review process. DOE also requires that the facilities be in compliance with all current building codes and construction standards, be located in a geologically stable area (e.g., not in a flood plain or seismically-active zone), and be operated and maintained with appropriate security measures in place. In addition, the Ac t requires that the facilities obtain and operate in accordance with a RCRA hazardous waste facility permit.

IV. AREAS TO ADDRESS IN SUBMISSION

DOE requires the following information for each potential storage location and facility:

1. Name of the company making the Expression of Interest, including a contact person's name, telephone number, and email address;2. Company address;3. Company size (please specify as either Large, Small, Small Disadvantaged, Woman Owned Small Business, Veteran Owned Small Business, Service-Disabled Veteran Owned Small Business, 8(a), Hubzone Small Business or other);4. Name of the city and state in which each potential facility is or would be located;5. A site map showing the location of the potential storage building or buildings on the site, as well as nearby (within 10 miles) political (e.g., city, county) boundaries, communities (especially minority, low income or Native American), roads, railroads, airports, and water bodies, wetlands, floodplains, parkland, known fault lines or other environmentally sensitive areas;6. A description of the potential

site, including ownership, current activities, access control system, hazardous materials handling experience, mercury handling experience, current tenants, existing permits, previous regulatory compliance problems, and existing environmental contamination; and 7. A description of the potential storage building, if pre-existing, including date and type of construction, floor condition, any special features that provide protection against leaks and external environmental hazards, fire suppression system, heating, ventilation and air-conditioning system, access control system, current activities and materials in storage, current tenants, and existing environmental contamination.

If available, Expressions of Interest should also identify equipment, materials, and labor required to upgrade or construct the potential facility to accept elemental mercury for long-term management and storage, as well as any environmental, health and safety approvals that will be required by Federal, state or local law.

V. FORMAT

The length of the Expression of Interest should be no more than 20 pages using 12-point font. Although each respondent may determine how best to organize the Expression of Interest, DOE recommends the following format: Section 1 -- Summary; and Section 2 -- Description of Location with specific reference to the items requested by DOE above.

DOE reserves the right to use any and all information submitted by, or obtained from, an interested party in any manner DOE determines is appropriate. An interested party should avoid including any business confidential and/or proprietary information in its Expression of Interest. However, if an interested party must submit such information, the information must be clearly marked accordingly, and the interested party must provide sufficient justification as to why such information is business confidential and/or proprietary. DOE will review said information and handle it in accordance with the Freedom of Information Act (5 U.S.C. ? 552) and all applicable Federal law.

This Request for Expressions of Interest is not a formal solicitation requesting proposals and does not represent a commitment by DOE to award a contract. This Request for Expressions of Interest does not confer any commitment or obligation from DOE. Under no circumstances does this Request for Expressions of Interest seek to award a contract for services under the Federal Acquisition Regulations or a financial assistance agreement under Part 600 of Title 10 of the Code of Federal Regulations.

DOE does not intend to formally respond to information submitted in response to this Request for Expressions of Interest.

The cost for the preparation and submittal of a response to the Request for Expressions of Interest is the sole responsibility of the interested party.

VI. SUBMISSION DEADLINE

Commercial entities wishing to make an Expression of Interest should do so in writing no later than 30 days from the date this notice is published. Please submit hard copies of Expression of Interest to Mr. David Levenstein, Mail Stop: EM-11/Cloverleaf 2128, U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585. Electronic versions of Expressions of Interest may be submitted in portable document format (pdf) by email to david.levenstein@em.doe.gov. Questions may be submitted in writing by letter or email. DOE may ask vendors to clarify information provided in their Expression of Interest or submit additional information.

Contracting Office Address:
EMCBCU.S. Department of EnergyEM Consolidated Business Center250 E. 5th Street, Suite 500CincinnatiOH45202

Point of Contact(s):
David Levenstein; david.levenstein@em.doe.gov

David Levenstein

Opportunity History

- **Original Synopsis**
  Mar 17, 2009
  5:09 pm

A.2.2 Request for Expressions of Interest in Hosting a Facility or Facilities for the Long-Term Management and Storage of Elemental Mercury (74 FR 11923, March 20, 2009)

Federal Register / Vol. 74, No. 53 / Friday, March 20, 2009 / Notices 11923

DEPARTMENT OF ENERGY

Environmental Management Site-Specific Advisory Board, Oak Ridge Reservation

AGENCY: Department of Energy.

ACTION: Notice of open meeting.

SUMMARY: This notice announces a meeting of the Environmental Management Site-Specific Advisory Board (EM SSAB), Oak Ridge Reservation. The Federal Advisory Committee Act (Pub. L. 92–463, 86 Stat. 770) requires that public notice of this meeting be announced in the **Federal Register**.

DATES: Wednesday, April 8, 2009, 6 p.m.

ADDRESSES: DOE Information Center, 475 Oak Ridge Turnpike, Oak Ridge, Tennessee.

FOR FURTHER INFORMATION CONTACT: Pat Halsey, Federal Coordinator, Department of Energy Oak Ridge Operations Office, P.O. Box 2001, EM–90, Oak Ridge, TN 37831. Phone (865) 576–4025; Fax (865) 576–2347 or e-mail: *halseypj@oro.doe.gov* or check the Web site at *http://www.oakridge.doe.gov/em/ssab*.

SUPPLEMENTARY INFORMATION:

Purpose of the Board: The purpose of the Board is to make recommendations to DOE in the areas of environmental restoration, waste management, and related activities.

Tentative Agenda: The main meeting presentation will be on the DOE Transuranic (TRU) Waste Processing Center.

Public Participation: The EM SSAB, Oak Ridge, welcomes the attendance of the public at its advisory committee meetings and will make every effort to accommodate persons with physical disabilities or special needs. If you require special accommodations due to a disability, please contact Pat Halsey at least seven days in advance of the meeting at the phone number listed above. Written statements may be filed with the Board either before or after the meeting. Individuals who wish to make oral statements pertaining to the agenda item should contact Pat Halsey at the address or telephone number listed above. Requests must be received five days prior to the meeting and reasonable provision will be made to include the presentation in the agenda. The Deputy Designated Federal Officer is empowered to conduct the meeting in a fashion that will facilitate the orderly conduct of business. Individuals wishing to make public comment will be provided a maximum of five minutes to present their comments.

Minutes: Minutes will be available by writing or calling Pat Halsey at the address and phone number listed above. Minutes will also be available at the following Web site: *http://www.oakridge.doe.gov/em/ssab/minutes.htm*.

Issued at Washington, DC, on March 16, 2009.

LaTanya Butler,

Acting Deputy Committee Management Officer.

[FR Doc. E9–6135 Filed 3–19–09; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Request for Expressions of Interest in Hosting a Facility or Facilities for the Long-Term Management and Storage of Elemental Mercury

AGENCY: Department of Energy.

ACTION: Notice of request for expressions of interest.

SUMMARY: The U.S. Department of Energy (DOE) is seeking Expressions of Interest from Federal agencies and from the private sector regarding potential locations for a facility or facilities where DOE can store and manage elemental mercury pursuant to the Mercury Export Ban Act of 2008 (the Act). The Act directs DOE to designate by January 1, 2010, a facility or facilities of DOE for the long-term management and storage of elemental mercury. At least one such facility must be operational by January 1, 2013.

DOE intends to initiate an Environmental Impact Statement in early 2009 and seeks to identify facilities to consider as potential alternatives. Accordingly, respondents to this Request for Expressions of Interest may have the facilities they identify considered during the environmental review scoping process. This is a request for expressions of interest. No proposals are allowed.

DATES: Federal agencies and commercial entities wishing to make an Expression of Interest should do so in writing no later than 30 days from the date this notice is published. Questions may be submitted in writing by letter or e-mail. DOE may ask vendors to clarify information provided in their Expressions of Interest or submit additional information.

ADDRESSES: Please submit hard copies of Expressions of Interest to Mr. David Levenstein, Mail Stop: EM–11/Cloverleaf 2128, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585–2040. Electronic versions of Expressions of Interest may be submitted in portable document format (pdf) by e-mail to *david.levenstein@em.doe.gov*.

SUPPLEMENTARY INFORMATION:

Background

The Mercury Export Ban Act of 2008 prohibits the export of elemental mercury from the United States effective January 1, 2013. To ensure that elemental mercury is managed and stored safely, the Act directs DOE to take a number of actions. By October 1, 2009, DOE must issue guidance establishing standards and procedures for the receipt, management and long-term storage of elemental mercury generated within the United States at a facility or facilities of DOE. DOE must designate such facilities by January 1, 2010, but is prohibited by the Act from locating such a facility at DOE's Oak Ridge Reservation. At least one such facility must be operational by January 1, 2013. In addition to the standards and procedures referenced above, elemental mercury managed and stored at a designated facility will be subject to the requirements of the Solid Waste Disposal Act, as amended (Resource Conservation and Recovery Act (RCRA)), 42 U.S.C. 6901 *et seq.* A designated facility in existence on or before January 1, 2013, is authorized to operate under interim status pursuant to RCRA section 3005(e), 42 U.S.C. 6925(e), until a final decision on a permit application is made pursuant to RCRA section 3005(c), 42 U.S.C. 6925(c). The U.S. Environmental Protection Agency (EPA), or an authorized State, shall issue a final decision on the permit application by January 1, 2015.

Currently elemental mercury in the United States comes from several sources, including mercury used in the chlorine and caustic soda manufacturing process, mercury reclaimed from recycling and waste recovery activities, and mercury generated as a byproduct of the gold mining process. In a November 2007 ''Mercury Storage Costs Estimates'' report, EPA assumed the total amount of excess mercury supply from commercial sources that would require storage to be between 7,500 and 10,000 metric tons over 40 years. The 7,500 metric ton scenario assumes that approximately 1,200 metric tons would come from mercury cell chlor-alkali plants, approximately 2,050 metric tons would come from product recycling and waste recovery, and approximately 4,250 metric tons would be a byproduct of gold mining. The 10,000 metric ton scenario assumes that an additional 2,500 metric tons would result from imports. There are uncertainties associated with these estimates, and DOE anticipates updating these estimates in conjunction with its activities to comply with the National Environmental Policy Act (NEPA).

In addition, DOE currently stores approximately 1,200 metric tons of elemental mercury at its Oak Ridge Reservation in Tennessee. Also, the Department of Defense (DOD) stores approximately 4,400 metric tons at various locations. At this time, no decision has been made as to how much elemental mercury from DOE or DOD would be stored in the DOE-designated facilities required by the Act.

As required by Council on Environmental Quality and DOE NEPA regulations, DOE's designation of facilities for the purpose of long-term management and storage of elemental mercury generated in the United States must include consideration of the range of reasonable management and storage alternatives and the environmental impacts of those alternatives. The purpose of this Request is to determine if there is interest on the part of Federal agencies or commercial entities in proposing locations for long-term DOE management and storage facilities. Identification of such facilities will enable DOE to consider them for potential inclusion in its NEPA review.

Consideration of a facility in the environmental review process is not a guarantee of its selection. Proposed sites and facilities will be reviewed against a series of technical screening criteria to consider their suitability for a long-term elemental mercury management and storage mission. In addition, in accordance with NEPA implementing regulations, DOE will conduct public outreach, such as a scoping meeting or meetings, for those sites and facilities considered to be reasonable alternatives, to allow the public to comment.

Request for Expressions of Interest: This is a request for expressions of interest. No proposals are allowed.

DOE intends to consider a range of reasonable alternatives, including existing and new DOE facilities, in its selection process. DOE is in the process of conducting an inventory of its national complex to determine potential alternative facilities. Likewise, DOE is also seeking by this action expressions of interest from Federal agencies and from commercial entities on locations and facilities for the long-term management and storage of elemental mercury. Because the Act states that this mercury would be stored at a ''facility or facilities of [DOE]'', DOE would work, as necessary, with the Federal agency or commercial entity on acquiring an appropriate interest in the facility prior to site designation.

DOE plans to review each submission to determine if it should be included as a reasonable alternative in DOE's NEPA analysis, which will assess the environmental impacts of each alternative, including existing and new DOE facilities, as they relate to the long-term storage and management of elemental mercury.

The size requirements for long-term storage and management facilities will depend on a number of factors, including the amount of elemental mercury ultimately received and the storage configuration of the elemental mercury containers. Based on currently available information, for planning purposes DOE is looking for locations with one or more existing facilities with a total of approximately 20,000 to 100,000 square feet of storage space, or locations where such facilities could be constructed. DOE anticipates refining the estimate of required storage space during the environmental review process. DOE also requires that the facilities be in compliance with all current building codes and construction standards, be located in a geologically stable area (*e.g.*, not in a flood plain or seismically-active zone), and be operated and maintained with appropriate security measures in place. In addition, the Act requires that the facilities obtain and operate in accordance with a RCRA hazardous waste facility permit.

Content of Expressions of Interest: DOE requires the following information for each potential storage location and facility:

1. Name of the Federal agency or private company making the Expression of Interest, including a contact person's name, telephone number, and e-mail address;
2. Agency or company address;
3. If a private company, company size (please specify as either Large, Small, Small Disadvantaged, Woman Owned Small Business, Veteran Owned Small Business, Service-Disabled Veteran Owned Small Business, 8(a), Hubzone Small Business or other);
4. Name of the city and state in which each potential facility is or would be located;
5. A site map showing the location of the potential storage building or buildings on the site, as well as nearby (within 10 miles) political (*e.g.*, city, county) boundaries, communities (especially minority, low income or Native American), roads, railroads, airports, and water bodies, wetlands, floodplains, parkland, known fault lines, or other environmentally sensitive areas;
6. A description of the potential site, including ownership, current activities, access control system, hazardous materials handling experience, mercury handling experience, current tenants, existing permits, previous regulatory compliance problems, and existing environmental contamination; and
7. A description of the potential storage building, if pre-existing, including date and type of construction, floor condition, any special features that provide protection against leaks and external environmental hazards, fire suppression system, heating, ventilation and air-conditioning system, access control system, current activities and materials in storage, current tenants, and existing environmental contamination.

If available, Expressions of Interest should also identify equipment, materials, and labor required to upgrade or construct the potential facility to accept elemental mercury for long-term management and storage, as well as any environmental, health and safety approvals that will be required by Federal, State or local law.

Expression of Interest Format: The length of the Expression of Interest should be no more than 20 pages using 12-point font. Although each respondent may determine how best to organize the Expression of Interest, DOE recommends the following format: Section 1—Summary; and Section 2—Description of Location with specific reference to the items requested by DOE above.

DOE reserves the right to use any and all information submitted by, or obtained from, an interested party in any manner DOE determines is appropriate. An interested party should avoid including any business confidential and/or proprietary information in its Expression of Interest. However, if an interested party must submit such information, the information must be clearly marked accordingly, and the interested party must provide sufficient justification as to why such information is business confidential and/or proprietary. DOE will review said information and handle it in accordance with the Freedom of Information Act (5 U.S.C. 552) and all applicable Federal law.

This Request for Expressions of Interest is not a formal solicitation requesting proposals and does not represent a commitment by DOE to award a contract. This Request for Expressions of Interest does not confer

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any commitment or obligation from DOE. Under no circumstances does this Request for Expressions of Interest seek to award a contract for services under the Federal Acquisition Regulations or a financial assistance agreement under Part 600 of Title 10 of the Code of Federal Regulations.

DOE does not intend to formally respond to information submitted in response to this Request for Expressions of Interest.

The cost for the preparation and submittal of a response to the Request for Expressions of Interest is the sole responsibility of the interested party.

Issued in Washington, DC, on March 11, 2009.

Inos R. Triay,

Acting Assistant Secretary for Environmental Management.

[FR Doc. E9–6136 Filed 3–19–09; 8:45 am]

BILLING CODE 6540–01–P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Project No. 13–023]

Green Island Power Authority; Notice of Application Tendered for Filing With the Commission and Establishing Procedural Schedule for Licensing and Deadline for Submission of Final Amendments

March 12, 2009.

Take notice that the following hydroelectric application has been filed with the Commission and is available for public inspection.

a. *Type of Application:* New major license.

b. *Project No.:* 13–023.

c. *Date Filed:* March 2, 2009.

d. *Applicant:* Green Island Power Authority.

e. *Name of Project:* Green Island Hydroelectric Project.

f. *Location:* The existing project is located on the Hudson River in Albany County, New York. The project would occupy Federal land managed by the U.S. Army Corps of Engineers.

g. *Filed Pursuant to:* Federal Power Act 16 U.S.C. 791(a)–825(r).

h. *Agent Contact:* James A. Besha, President, Albany Engineering Corporation, 5 Washington Square, Albany, NY 12205; (518) 456–7712.

i. *FERC Contact:* Tom Dean, (202) 502–6041.

j. This application is not ready for environmental analysis at this time.

k. *Project Description:* The existing Green Island Project utilizes the U.S. Army Corps of Engineers (Corps) Green Island-Troy lock and dam that consists of: (1) A dam with a main spillway with a fixed crest elevation of 14.33 feet mean sea level (msl); and (2) an auxiliary spillway with a crest elevation of 16.33 feet msl.

The Green Island Project consists of: (1) 2-foot-high pneumatic flashboards along the top of the main spillway with a crest elevation of 16.33 feet msl; (2) a 700-acre impoundment with a normal water surface elevation of 16.33 feet msl; (3) a bulkhead and forebay structure located downstream and at the west end of the Corps dam; (4) a powerhouse containing four 1.5 megawatt (MW) generating units with a total installed capacity of 6.0 MW; (5) a 34.5 kilovolt underground transmission cable; and (6) appurtenant facilities.

Green Island Power Authority proposes to: (1) Lower the existing main spillway to a crest elevation of 12.5 feet msl, and install new hydraulically operated crest gates with a maximum crest gate elevation of 18.5 feet msl; (2) install a new trash boom extending across and upstream of the forebay; (3) construct a new bulkhead structure equipped with a new 300-foot-wide, 300-foot-long fish protection system screen; and (4) expand the existing powerhouse to the east and west and install four new 6.0 MW generating units, and replace the four existing generating units with four new 6.0 MW generating units with a total installed capacity of 48 MW.

l. *Locations of the Application:* A copy of the application is available for review at the Commission in the Public Reference Room or may be viewed on the Commission's Web site at *http://www.ferc.gov* using the "eLibrary" link. Enter the docket number excluding the last three digits in the docket number field to access the document. For assistance, contact FERC Online Support at *FERCOnlineSupport@ferc.gov* or toll-free at 1–866–208–3676, or for TTY, (202) 502–8659. A copy is also available for inspection and reproduction at the address in item (h) above.

m. You may also register online at *http://www.ferc.gov/docs-filing/esubscription.asp* to be notified via e-mail of new filings and issuances related to this or other pending projects. For assistance, contact FERC Online Support.

n. *Procedural Schedule:* The application will be processed according to the following Hydro Licensing Schedule. Revisions to the schedule may be made as appropriate.

Milestone	Target date
Notice of Acceptance and Ready for Environmental Analysis	May 1, 2009.
Filing interventions, comments, recommendations, preliminary terms and conditions, and fishway prescriptions	June 30, 2009.
Notice of availability of the EA	October 28, 2009.
Filing comments on EA	November 27, 2009.
Filing modified terms and conditions	January 26, 2010.

o. Final amendments to the application must be filed with the Commission no later than 30 days from the issuance date of the notice of ready for environmental analysis.

Kimberly D. Bose,

Secretary.

[FR Doc. E9–6071 Filed 3–19–09; 8:45 am]

BILLING CODE

A.2.3

Assistance Required to Identify a Storage Facility for Elemental Mercury (March 30, 2009)

Department of Energy
Washington, DC 20585
March 30, 2009

MEMORANDUM FOR DISTRIBUTION

FROM: INÉS R. TRIAY
ACTING ASSISTANT SECRETARY FOR ENVIRONMENTAL MANAGEMENT

SUBJECT: Assistance Required to Identify a Storage Facility for Elemental Mercury

The purpose of this memorandum is to obtain your assistance as we seek information on current and planned facilities that may be available for the long-term storage of elemental mercury. The Mercury Export Ban Act (the Act) of 2008 prohibits the export of elemental mercury from the United States (U.S.) effective January 1, 2013. It directs the Department of Energy (DOE) to provide a facility or facilities for the long-term storage of elemental mercury generated in the U.S. but specifically prohibits the facility from being sited on the Oak Ridge Reservation, including Y-12. The Act requires DOE to identify a storage facility (or facilities) by January 1, 2010, and to have at least one facility operational by January 1, 2013. Pursuant to the Act, such a facility will need to have and operate under a Resource Conservation and Recovery Act (RCRA) hazardous waste facility permit.

DOE has determined the Office of Environmental Management (EM) in coordination with the Office of Legacy Management (LM) will have the lead for this project (Attachment 1). EM will be accomplishing the selection of the storage facility by means of an environmental impact statement in accordance with the National Environmental Policy Act. In order to designate such a facility or facilities I am requesting that you assess facilities and areas for the sites under your purview and provide a list of viable candidates for further evaluation. For your information, a copy of the Federal Register notice seeking Expressions of Interest (EOI) from parties outside DOE is attached (Attachment 2). The criteria described in the EOI should be used by DOE sites to evaluate potential storage facilities.

The amount of mercury expected to be stored is not well-defined. Based on the current available information, for planning purposes DOE is looking for locations with one or more existing facilities (i.e., storage capacity) of approximately 20,000 – 100,000 square feet, or locations where such facilities could be constructed. Therefore, we are seeking information from sites about existing or planned buildings that could provide long-term storage of elemental mercury, and that have or could obtain a RCRA permit. DOE anticipates refining the estimate of required storage space during the environmental review process.

Please respond by April 22, 2009, with a listing of potentially suitable facilities as described in the attached EOI. Negative responses are also requested. Your response should be directed to Mr. David Levenstein, the Office of Environmental Management (EM) National Environmental Policy Act Document Manager for the Mercury Storage Environmental Impact Statement. If you have any further questions, please contact Mr. Levenstein at (301) 903-6500 or by email: david.levenstein@em.doe.gov .

Distribution

David Geiser, Acting Director, Office of Legacy Management
Tom D'Agostino, Administrator, National Nuclear Security Administration
Vic Der, Acting Assistant Secretary for Fossil Energy
Steve G. Chalk, Acting Assistant Secretary for Energy Efficiency and Renewable Energy
Patricia Dehmer, Acting Director, Office of Science
Robert Shane Johnson, Acting Assistant Secretary for Nuclear Energy
David A. Brockman, Manager, Richland Operations Office
Dennis Miotla, Acting Manager, Idaho Operations Office
Shirley Olinger, Manager, Office of River Protection
Jeffrey M. Allison, Manager, Savannah River Operations Office
David C. Moody, Manager, Carlsbad Field Office
William E. Murphie, Manager, Portsmouth/Paducah Project Office
Gerald Boyd, Manager, Oak Ridge Office (OR)
Jack Craig, Director, Consolidated Business Center Ohio
Mike Moore, Acting Director, Small Sites Projects

cc
Thad T. Konopnicki, Associate Administrator for Infrastructure and Environment, NA-50
Bill Ostendorff, Principal Deputy Administrator for National Nuclear Security, NA-1
George Malosh, Deputy Director for Field Operations, SC-3
Marcus Jones, Associate Director, Office of Safety Security and Infrastructure, SC-31
Tracey Bishop, Acting Director, Office of Laboratory Facilities Management, (NE-32)
Richard Schassburger, Director, Oakland Projects Office
John Rampe, Director, Separations Process Research Unit (SPRU)
Bryan Bower, Director, West Valley Demonstration Project Office (WVDP)
Donald Metzler, Director, Moab Federal Project Office (MOAB)
Tom Vero, Acting Director, Brookhaven Federal Project Office (BNL)
Steve McCracken, Assistant Manager, Oak Ridge Office (OR)
Richard B. Provencher, Deputy Manager, Idaho Operations Office (ID)
James Owendoff, Chief Operations Officer, EM-3
James Fiore, Director, Office of Management Analysis, EM-6
Frank Marcinowski, Deputy Assistant Secretary for Regulatory Compliance, EM-10
Mark A. Gilbertson, Deputy Assistant Secretary for Engineering and Technology, EM-20
Merle Sykes, Deputy Assistant Secretary for Program Planning and Budget, EM-30
Barry Smith, Director, Office of Site Support, EM-3.3

ATTACHMENT 1

The Deputy Secretary of Energy
Washington, DC 20585

December 1, 2008

MEMORANDUM FOR INES TRIAY
ACTING ASSISTANT SECRETARY FOR
ENVIRONMENTAL MANAGEMENT

MICHAEL OWEN
DIRECTOR, OFFICE OF LEGACY MANAGEMENT

FROM: JEFFREY F. KUPFER
ACTING DEPUTY SECRETARY

SUBJECT: Mercury Export Ban Act of 2008

Section 5 of the Mercury Export Ban Act of 2008 (the Act), Pub. L. 110-414, 122 Stat. 4341, sets forth ambitious requirements for the Department of Energy (DOE) to establish and manage a facility for the storage of Government and commercial stocks of elemental mercury within the United States. At a meeting on November 12, 2008, we discussed assigning the responsibilities for complying with the Act to operational elements within the Department. We agreed that these responsibilities would be assigned to the Offices of Environmental Management (EM) and Legacy Management (LM), and, therefore, I am sending you this memorandum to formalize those assignments.

Pursuant to section 5(a)(1) of the Act, EM will have the lead responsibility to designate one or more DOE facilities (other than Oak Ridge) for the purpose of long-term management and storage of elemental mercury generated within the United States. EM also will have the lead responsibility to have these facilities operational and able to receive mercury for storage, as provided under section 5(a)(2) of the Act. After consulting with the Environmental Protection Agency (EPA), EM will prepare guidance establishing procedures and standards for managing mercury at these facilities in accordance with section 5(d)(1) of the Act. Prior to operation of the facilities, EM also will be responsible for setting fees based on the costs of providing long-term management and storage of elemental mercury delivered to the facilities and will publicly announce the amount of such fees by October 1, 2012, as required under section 5(b) of the Act.

Once the facilities are operational and able to receive elemental mercury, LM will manage the facilities, assess, collect, and manage the mercury storage and management fees, and report each year to Congress on all of the costs incurred during the previous year in accordance with sections 5(b) and 5(c) of the Act. Pursuant to sections 5(b)(1)(B)-(C) of the Act, LM may adjust such fees annually as necessary. LM will train all staff responsible for managing the mercury and ensure that all facilities are properly equipped for routine operations and emergencies, as required under sections 5(d)(2)-(4)

of the Act. LM and the Office of the General Counsel also will implement section 5(e) of the Act regarding indemnification. After consulting with EPA, LM will comply with section 5(h) of the Act by submitting by July 1, 2014, a report to Congress discussing the impact of the long-term storage program on mercury recycling; this report will include any proposals to mitigate any negative impact from such program.

EM and LM will coordinate their respective responsibilities and also will coordinate with EPA, the Department of Defense, and other affected agencies and DOE organizations, including the Office of the General Counsel and the National Nuclear Security Administration.

cc: Thomas Paul D'Agostino, NA-1
Glenn Podonsky, HSS-1

ATTACHMENT 2

6540-01-P

DEPARTMENT OF ENERGY

Request for Expressions of Interest in Hosting a Facility or Facilities for the Long-Term Management and Storage of Elemental Mercury

AGENCY: Department of Energy

ACTION: Request for Expressions of Interest

SUMMARY: THIS IS A REQUEST FOR EXPRESSIONS OF INTEREST. NO PROPOSALS ARE ALLOWED

The U.S. Department of Energy (DOE) is seeking Expressions of Interest from Federal agencies and from the private sector regarding potential locations for a facility or facilities where DOE can store and manage elemental mercury pursuant to the Mercury Export Ban Act of 2008 (the Act). The Act directs DOE to designate by January 1, 2010, a facility or facilities of DOE for the long-term management and storage of elemental mercury. At least one such facility must be operational by January 1, 2013.

DOE intends to initiate an Environmental Impact Statement in early 2009 and seeks to identify facilities to consider as potential alternatives. Accordingly, respondents to this Request for Expressions of Interest may have the facilities they identify considered during the environmental review scoping process.

DATES: Federal agencies and commercial entities wishing to make an Expression of Interest should do so in writing no later than 30 days from the date this notice is published. Questions may be submitted in writing by letter or email. DOE may ask vendors to clarify information provided in their Expressions of Interest or submit additional information.

ADDRESSES: Please submit hard copies of Expressions of Interest to Mr. David Levenstein, Mail Stop: EM-11/Cloverleaf 2128, U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585-2040. Electronic versions of Expressions of Interest may be submitted in portable document format (pdf) by email to david.levenstein@em.doe.gov.

SUPPLEMENTARY INFORMATION:

Background: The Mercury Export Ban Act of 2008 prohibits the export of elemental mercury from the United States effective January 1, 2013. To ensure that elemental mercury is managed and stored safely, the Act directs DOE to take a number of actions. By October 1, 2009, DOE must issue guidance establishing standards and procedures for the receipt, management and long-term storage of elemental mercury generated within the United States at a facility or facilities of DOE. DOE must designate such facilities by January 1, 2010, but is prohibited by the Act from locating such a facility at DOE's Oak Ridge Reservation. At least one such facility must be operational by January 1, 2013. In addition to the standards and procedures referenced above, elemental mercury managed and stored at a designated facility will be subject to the requirements of the Solid Waste Disposal Act, as amended (Resource Conservation and Recovery Act (RCRA)), 42 U.S.C. § 6901 et seq. A designated facility in existence on or before January 1, 2013, is authorized to operate under interim status pursuant to RCRA section 3005(e), 42 U.S.C. § 6925(e), until a final decision on a permit application is made pursuant to RCRA section 3005(c), 42 U.S.C. § 6925(c). The U.S. Environmental Protection Agency (EPA), or an authorized State, shall issue a final decision on the permit application by January 1, 2015.

Currently elemental mercury in the United States comes from several sources, including mercury used in the chlorine and caustic soda manufacturing process, mercury reclaimed from recycling and waste recovery activities, and mercury generated as a byproduct of the gold mining process. In a November 2007 "Mercury Storage Costs Estimates" report, EPA assumed the total amount of excess mercury supply from commercial sources that would require storage to be between 7,500 and 10,000 metric tons over 40 years. The 7,500 metric ton scenario assumes that approximately 1,200 metric tons would come from mercury cell chlor-alkali plants, approximately 2,050 metric tons would come from product recycling and waste recovery, and approximately 4,250 metric tons would be a byproduct of gold mining. The 10,000 metric ton scenario assumes that an additional 2,500 metric tons would result from imports. There are uncertainties associated with these estimates, and DOE anticipates updating these estimates in conjunction with its activities to comply with the National Environmental Policy Act (NEPA).

In addition, DOE currently stores approximately 1,200 metric tons of elemental mercury at its Oak Ridge Reservation in Tennessee. Also, the Department of Defense (DOD) stores approximately 4,400 metric tons at various locations. At this time, no decision has been made as to how much elemental mercury from DOE or DOD would be stored in the DOE-designated facilities required by the Act.

As required by Council on Environmental Quality and DOE NEPA regulations, DOE's designation of facilities for the purpose of long-term management and storage of elemental mercury generated in the United States must include consideration of the range of reasonable management and storage alternatives and the environmental impacts of those alternatives. The purpose of this Request is to determine if there is interest on the part of Federal agencies or commercial entities in proposing locations for long-term DOE management and storage facilities. Identification of such facilities will enable DOE to consider them for potential inclusion in its NEPA review.

Consideration of a facility in the environmental review process is not a guarantee of its selection. Proposed sites and facilities will be reviewed against a series of technical screening criteria to consider their suitability for a long-term elemental mercury management and storage mission. In addition, in accordance with NEPA implementing regulations, DOE will conduct public outreach, such as a scoping meeting or meetings, for those sites and facilities considered to be reasonable alternatives, to allow the public to comment.

Request for Expressions of Interest: **THIS IS A REQUEST FOR EXPRESSIONS OF INTEREST. NO PROPOSALS ARE ALLOWED.**

DOE intends to consider a range of reasonable alternatives, including existing and new DOE facilities, in its selection process. DOE is in the process of conducting an inventory of its national complex to determine potential alternative facilities. Likewise, DOE is also seeking by this action expressions of interest from Federal agencies and from commercial entities on locations and facilities for the long-term management and storage of elemental mercury. Because the Act states that this mercury would be stored at a "facility or facilities of [DOE]", DOE would work, as necessary, with the Federal agency or commercial entity on acquiring an appropriate interest in the facility prior to site designation.

DOE plans to review each submission to determine if it should be included as a reasonable alternative in DOE's NEPA analysis, which will assess the environmental impacts of each alternative, including existing and new DOE facilities, as they relate to the long-term storage and management of elemental mercury.

The size requirements for long-term storage and management facilities will depend on a number of factors, including the amount of elemental mercury ultimately received and the storage configuration of the elemental mercury containers. Based on currently available information, for planning purposes DOE is looking for locations with one or more existing facilities with a total of approximately 20,000 to 100,000 square feet of storage space, or locations where such facilities could be constructed. DOE anticipates refining the estimate of required storage space during the environmental review process. DOE also requires that the facilities be in compliance with all current building codes and construction standards, be located in a geologically stable area (e.g., not in a flood plain or seismically-active zone), and be operated and maintained with appropriate security measures in place. In addition, the Act requires that the facilities obtain and operate in accordance with a RCRA hazardous waste facility permit.

Content of Expressions of Interest: DOE requires the following information for each potential storage location and facility:

1. Name of the Federal agency or private company making the Expression of Interest, including a contact person's name, telephone number, and email address;
2. Agency or company address;
3. If a private company, company size (please specify as either Large, Small, Small Disadvantaged, Woman Owned Small Business, Veteran Owned Small Business,

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Service-Disabled Veteran Owned Small Business, 8(a), Hubzone Small Business or other);

4. Name of the city and state in which each potential facility is or would be located;
5. A site map showing the location of the potential storage building or buildings on the site, as well as nearby (within 10 miles) political (e.g., city, county) boundaries, communities (especially minority, low income or Native American), roads, railroads, airports, and water bodies, wetlands, floodplains, parkland, known fault lines, or other environmentally sensitive areas;
6. A description of the potential site, including ownership, current activities, access control system, hazardous materials handling experience, mercury handling experience, current tenants, existing permits, previous regulatory compliance problems, and existing environmental contamination; and
7. A description of the potential storage building, if pre-existing, including date and type of construction, floor condition, any special features that provide protection against leaks and external environmental hazards, fire suppression system, heating, ventilation and air-conditioning system, access control system, current activities and materials in storage, current tenants, and existing environmental contamination.

If available, Expressions of Interest should also identify equipment, materials, and labor required to upgrade or construct the potential facility to accept elemental mercury for long-term management and storage, as well as any environmental, health and safety approvals that will be required by Federal, state or local law.

Expression of Interest Format: The length of the Expression of Interest should be no more than 20 pages using 12-point font. Although each respondent may determine how best to

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organize the Expression of Interest, DOE recommends the following format: Section 1 Summary; and Section 2 – Description of Location with specific reference to the items requested by DOE above.

DOE reserves the right to use any and all information submitted by, or obtained from, an interested party in any manner DOE determines is appropriate. An interested party should avoid including any business confidential and/or proprietary information in its Expression of Interest. However, if an interested party must submit such information, the information must be clearly marked accordingly, and the interested party must provide sufficient justification as to why such information is business confidential and/or proprietary. DOE will review said information and handle it in accordance with the Freedom of Information Act (5 U.S.C. § 552) and all applicable Federal law.

This Request for Expressions of Interest is not a formal solicitation requesting proposals and does not represent a commitment by DOE to award a contract. This Request for Expressions of Interest does not confer any commitment or obligation from DOE. Under no circumstances does this Request for Expressions of Interest seek to award a contract for services under the Federal Acquisition Regulations or a financial assistance agreement under Part 600 of Title 10 of the Code of Federal Regulations.

DOE does not intend to formally respond to information submitted in response to this Request for Expressions of Interest.

The cost for the preparation and submittal of a response to the Request for Expressions of Interest is the sole responsibility of the interested party.

Issued in Washington, DC, on March // 2009.

Inés R. Triay,
Acting Assistant Secretary for Environmental Management

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A.3 NOTICE OF INTENT TO PREPARE AN ENVIRONMENTAL IMPACT STATEMENT FOR THE LONG-TERM MANAGEMENT AND STORAGE OF ELEMENTAL MERCURY (74 FR 31723, JULY 2, 2009)

viewpoint. Participants will be selected on a first-come, first-served basis. However, to maximize diversity of input, only one participant per organization or entity will be chosen if necessary. Participants will receive confirmation by 12 p.m. EDT on Friday, July 10, 2009. Those who are not selected to speak may provide written comments. Requests to speak may be sent to the EAC via e-mail at *testimony@eac.gov,* via mail addressed to the U.S. Election Assistance Commission, 1225 New York Avenue, NW., Suite 1100, Washington, DC 20005, or by fax at 202–566–1389. All requests must include a description of what will be said, contact information which will be used to notify the requestor with status of request (phone number on which a message may be left or e-mail), and include the subject/attention line (or on the envelope if by mail): Technology and Disability Access. Please note that these comments will be made available to the public at *http://www.eac.gov.*

Written comments from members of the public, regarding technological solutions for voting systems that ensure that voters with disabilities can vote in a private and independent manner, will also be accepted. This testimony will be included as part of the written record of the hearing, and available on our Web site. Written testimony must be received by 5 p.m. EDT on Friday, July 10, 2009, and should be submitted via e-mail at *testimony@eac.gov,* via mail addressed to the U.S. Election Assistance Commission 1225 New York Avenue, NW., Suite 1100, Washington, DC 20005, or by fax at 202–566–1389. All correspondence that contains written testimony must have in the subject/attention line (or on the envelope if by mail): Written Submission for Technology and Disability Access.

Members of the public may observe but not participate in EAC meetings unless this notice provides otherwise. Members of the public may use small electronic audio recording devices to record the proceedings. The use of other recording equipment and cameras requires advance notice to and coordination with the Commission's Communications Office.*

* View EAC Regulations Implementing Government in the Sunshine Act.

This meeting will be open to the public.

PERSON TO CONTACT FOR INFORMATION: Bryan Whitener, Telephone: (202) 566–3100.

Alice Miller,

Chief Operating Officer, U.S. Election Assistance Commission.

[FR Doc. E9–15798 Filed 6–30–09; 4:15 pm]

BILLING CODE 6820–KF–P

DEPARTMENT OF ENERGY

Notice of Intent To Prepare an Environmental Impact Statement for the Long-Term Management and Storage of Elemental Mercury

AGENCY: Department of Energy.

ACTION: Notice of intent.

SUMMARY: As required by the Mercury Export Ban Act of 2008 (Pub. L. 110–414), hereafter referred to as the Act, the Department of Energy (DOE or the Department) plans to designate a facility or facilities for the long-term management and storage of elemental mercury generated within the United States. To this end, the Department intends to prepare an environmental impact statement (EIS) in accordance with the National Environmental Policy Act (NEPA) of 1969 regulations of the President's Council on Environmental Quality (40 CFR parts 1500–1508) and DOE's implementing procedures (10 CFR part 1021). This EIS will evaluate alternatives for such a facility or facilities in order to have the requisite capability operational by January 1, 2013, as stipulated in the Act. The United States Environmental Protection Agency (EPA) is a cooperating agency for this EIS.

DATES: DOE invites public comment on the scope of this EIS during a 45-day public scoping period commencing July 2, 2009 and ending on August 17, 2009. In defining the scope of the EIS, DOE will consider all comments received or postmarked by the end of the scoping period. Comments received or postmarked after the scoping period end date will be considered to the extent practicable. For dates, times and locations of public scoping meetings, see **SUPPLEMENTARY INFORMATION** below.

ADDRESSES: Written comments on the scope of the EIS may be submitted by mail to: Mr. David Levenstein, EIS Document Manager, P.O. Box 2612, Germantown, MD 20874, by toll free fax to 1–877–274–5462; or through the EIS Web site at *http://www.mercurystorageeis.com.*

To be placed on the EIS distribution list, any of the methods listed under **ADDRESSES** above can be used. In requesting a copy of the Draft EIS, please specify whether the request is for a copy of the Summary only, the entire Draft EIS, or the entire Draft EIS (which includes the Summary) on a compact disc. In addition, the Draft EIS will be available on the DOE NEPA Web site at *http://www.gc.energy.gov/NEPA/* and at the EIS Web site referenced above.

FOR FURTHER INFORMATION CONTACT: For further information about the EIS, please contact David Levenstein, EIS Document Manager, Office of Regulatory Compliance (EM–10), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585. For general information concerning DOE's NEPA process, contact: Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance (GC–20), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, e-mail: *askNEPA@hq.doe.gov*; telephone 202–586–4600, fax 202–586–7031, or leave a message at 1–800–472–2756. This Notice will be available at *http://www.gc.energy.gov/NEPA/* and at *http://www.mercurystorageeis.com.*

SUPPLEMENTARY INFORMATION:

Background

The Mercury Export Ban Act of 2008 (Pub. L. 110–414) prohibits, as of January 1, 2013, the sale, distribution, or transfer of elemental mercury by Federal agencies to any other Federal agency, any State or local government agency, or any private individual or entity that is under the control of a Federal agency (with certain limited exceptions). It also prohibits the export of elemental mercury from the United States effective January 1, 2013 (subject to certain essential use exceptions). Section 5 of the Act, *Long-Term Storage,* directs DOE to designate a facility or facilities for the long-term management and storage of elemental mercury generated within the United States. DOE's facility or facilities must be operational by January 1, 2013, and ready to accept custody of elemental mercury delivered to such a facility. The Act also requires DOE to assess fees based upon the pro rata costs of long-term management and storage.

Inventory: There are several sources of elemental mercury in the United States, including mercury used in the chlorine and caustic soda manufacturing process (*i.e.,* chlor-alkali industry), reclaimed from recycling and waste recovery activities, and generated as a byproduct of the gold mining process. In addition, DOE stores approximately 1,200 metric tons of elemental mercury at the Y–12 National Security Complex in Oak Ridge, Tennessee. The Department of Defense (DOD) stores approximately

4,400 metric tons of elemental mercury at various locations.

An EPA report, ''Mercury Storage Cost Estimates'' (2007), estimates the total amount of elemental mercury from non-governmental sources that would be eligible for DOE storage is between 7,500 and 10,000 metric tons over a 40-year period. DOE plans to use such estimates and other credible sources of information to develop an annual and long-term inventory estimate for EIS evaluation. During the scoping period, DOE invites commentors to provide inventory data on elemental mercury for consideration in the EIS.

Purpose and Need for Action

DOE needs to develop a capability for the safe and secure long-term management and storage of elemental mercury as required by the Act. Accordingly, the Department needs to identify an appropriate facility or facilities to host this activity.

Proposed Action

DOE proposes to select one or more existing (including modification as needed) or new facilities for the long-term management and storage of elemental mercury in accordance with the Act. Facilities to be constructed as well as existing or modified facilities must comply with applicable requirements of Section 5(d) of the Act, *Management Standards for a Facility,* including the requirements of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA), and other permitting requirements. DOE intends to identify the facility or facilities through the NEPA process. EPA is a cooperating agency on the EIS.

Proposed Alternatives

As required by the Council on Environmental Quality and DOE NEPA implementing procedures at 40 CFR parts 1500–1508 and 10 CFR part 1021, respectively, DOE will evaluate the range of reasonable alternatives for a facility or facilities for the long-term management and storage of elemental mercury. These alternatives will include the modification of existing facilities as may be necessary. Recognizing that new construction may be needed at some candidate locations, DOE proposes to evaluate a generic, newly constructed facility that would meet RCRA requirements, such that new construction could be considered at some candidate locations along with modification of existing facilities as appropriate. DOE has developed the following preliminary criteria to use as a framework for identifying candidate host locations:

- The facility or facilities will not create significant conflicts with any existing DOE site mission and will not interfere with future mission compatibility;
- The candidate host location has an existing facility or facilities suitable for mercury storage with the capability and flexibility for operational expansion, if necessary;
- The facility or facilities is, or potentially will be, capable of complying with RCRA permitting requirements, including siting requirements;
- The facility or facilities has supporting infrastructure, including a capability or potential capability for flooring that would support mercury loadings;
- Storage of elemental mercury at the facility or facilities is compatible with local and regional land use plans;
- The facility or facilities is accessible to major transportation routes; and
- The candidate host location has sufficient information on hand in order to adequately characterize the site.

In March 2009, DOE published a Request for Expressions of Interest in the **Federal Register** (74 FR 11923, March 20, 2009) as well as in the *Federal Business Opportunities* seeking interest from Federal agencies and from the private sector regarding potential locations for a facility or facilities where DOE can store and manage mercury pursuant to the Act. Based on the responses received and on the criteria identified above, DOE proposes to evaluate the following candidate host sites as alternatives for the long-term management and storage of elemental mercury:

- Grand Junction Disposal Site, Grand Junction, CO;
- Hanford Site, Richland, WA;
- Hawthorne Army Depot, Hawthorne, NV;
- Idaho National Laboratory, Idaho Falls, ID;
- Kansas City Plant, Kansas City, MO;
- Savannah River Site, Aiken, SC; and
- Waste Control Specialists, Andrews, TX.

As required by NEPA, the EIS will evaluate a No Action alternative to serve as a basis for comparison with the action alternatives. Under the No Action alternative, long-term management and storage of privately-owned elemental mercury would remain the responsibility of its owners, and government-owned elemental mercury would remain at existing facilities.

Preliminary Identification of Environmental Issues

DOE proposes to address the issues listed below when considering the potential impacts of the proposed management and storage alternatives in the EIS. This list is presented to facilitate public comment during the scoping period and will be revisited as DOE considers the scoping comments. It is not intended to be comprehensive, nor to imply any predetermination of impacts.

- Potential effects on the public health from exposure to hazardous materials under routine operations and credible accident scenarios including natural disasters (floods, hurricanes, tornadoes, and seismic events);
- Impacts on surface and groundwater, floodplains and wetlands, and on water use and quality;
- Impacts on air quality (including global climate change) and noise;
- Impacts on plants and animals and their habitats, including species that are Federal- or State-listed as threatened or endangered, or of special concern;
- Impacts on geology and soil;
- Impacts on cultural resources such as historic, archeological, and Native American culturally important sites;
- Socioeconomic impacts on potentially affected communities;
- Environmental Justice, particularly whether or not long-term elemental mercury management and storage activities have a disproportionately high and adverse effect on minority and low-income populations;
- Potential impacts on land-use plans, policies and controls, and visual resources;
- Pollution prevention and waste management practices and activities;
- Unavoidable adverse impacts, and irreversible and irretrievable commitments of resources;
- Potential cumulative environmental effects of past, present, and reasonably foreseeable future actions;
- Status of compliance with all applicable Federal, state and local statutes and regulations, international agreements, and required Federal and State environmental permits, consultations, and notifications; and
- Potential impacts of intentional destructive acts, including sabotage and terrorism.

EIS Process and Invitation To Comment

NEPA implementing regulations require an early and open process for determining the scope of an EIS and for identifying the significant issues related to the proposed action. Accordingly, DOE invites Federal agencies, State,

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local and Tribal governments, the general public and international community to comment on the scope of the EIS, including identification of reasonable alternatives and specific issues to be addressed.

DOE will hold public scoping meetings from 5:30 p.m.–9:30 p.m. on the following dates and locations:

- July 21, 2009 Two Rivers Convention Center, 159 Main Street, Grand Junction, CO 81501.
- July 23, 2009 Embassy Suites Kansas City—Plaza, 220 West 43rd Street, Kansas City, MO 64111.
- July 28, 2009 Clarion Hotel and Conference Center, 1515 George Washington Way, Richland, WA 99352.
- July 30, 2009 North Augusta Municipal Center, 100 Georgia Avenue, North Augusta, SC 29841.
- August 4, 2009 El Capitan Resort, 540 F Street, Hawthorne, NV 89415.
- August 6, 2009 James Roberts Civic Center, 855 E. Broadway, Andrews, TX 79714.
- August 11, 2009 Shilo Inn/ O'Callahans Convention Center, 780 Lindsay Blvd., Idaho Falls, ID 83402.

Additional details on the scoping meetings will be provided in local media and at *http://www.mercurystorageeis.com.*

At each scoping meeting, DOE plans to hold an open house one hour prior to the formal portion of the meetings to allow participants to register to provide oral comments, view informational materials, and engage project staff. The registration table will have an oral comment registration form as well as a sign up sheet for those who do not wish to give oral comments but who would like to be included on the mailing list to receive future information. The public may provide written and/or oral comments at the scoping meetings.

Analysis of all public comments provided during the scoping meetings as well as those submitted as described in **ADDRESSES** above, will be considered in helping DOE further develop the scope of the EIS and potential issues to be addressed. DOE expects to issue a Draft EIS in the fall of 2009.

Issued in Washington, DC, on June 24, 2009.

Scott Blake Harris,

General Counsel.

[FR Doc. E9–15704 Filed 7–1–09; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Basic Energy Sciences Advisory Committee

AGENCY: Department of Energy, Office of Science.

ACTION: Notice of open meeting.

SUMMARY: This notice announces a meeting of the Basic Energy Sciences Advisory Committee (BESAC). Federal Advisory Committee Act (Pub. L. 92–463, 86 Stat. 770) requires that public notice of these meetings be announced in the **Federal Register**.

DATES: Thursday, July 9, 2009, 8:30 a.m.–5:30 p.m., and Friday, July 10, 2009, 8:30 a.m. to 12 noon.

ADDRESSES: Bethesda North Marriott Hotel and Conference Center, 5701 Marinelli Road, North Bethesda, MD 20852.

FOR FURTHER INFORMATION CONTACT: Katie Perine; Office of Basic Energy Sciences; U. S. Department of Energy; Germantown Building, Independence Avenue, Washington, DC 20585; Telephone: (301) 903–6529.

SUPPLEMENTARY INFORMATION: *Purpose of the Meeting:* The purpose of this meeting is to provide advice and guidance with respect to the basic energy sciences research program.

Tentative Agenda: Agenda will include discussions of the following:

- News from Office of Science/DOE;
- News from the Office of Basic Energy Sciences;
- Report from the New Era Subcommittee's Photon Workshop;
- Energy Frontier Research Center Update;
- COV Report for Materials Science and Engineering Division;
- New BESAC Charge.

Public Participation: The meeting is open to the public. If you would like to file a written statement with the Committee, you may do so either before or after the meeting. If you would like to make oral statements regarding any of the items on the agenda, you should contact Katie Perine at 301–903–6594 (fax) or *katie.perine@science.doe.gov* (e-mail). Reasonable provision will be made to include the scheduled oral statements on the agenda. The Chairperson of the Committee will conduct the meeting to facilitate the orderly conduct of business. Public comment will follow the 10-minute rule. This notice is being published less than 15 days before the date of the meeting due to programmatic issues that had to be resolved.

Minutes: The minutes of this meeting will be available for public review and copying within 30 days at the Freedom of Information Public Reading Room; 1E–190, Forrestal Building; 1000 Independence Avenue, SW.; Washington, D.C. 20585; between 9 a.m. and 4 p.m., Monday through Friday, except holidays.

Issued in Washington, DC, on June 30, 2009.

Rachel M. Samuel,

Deputy Committee Management Officer.

[FR Doc. E9–15779 Filed 7–1–09; 8:45 am]

BILLING CODE 6450–01–P

ENVIRONMENTAL PROTECTION AGENCY

[EPA–HQ–OAR–2009–0234; FRL–8925–7]

Agency Information Collection Activities: Proposed Collection; Comment Request; Information Request for National Emission Standards for Coal- and Oil-fired Electric Utility Steam Generating Units; EPA ICR No. 2362.01

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: In compliance with the Paperwork Reduction Act (PRA) (44 U.S.C. 3501 *et seq.*), this action announces that EPA is planning to submit a request for a new Information Collection Request (ICR) to the Office of Management and Budget (OMB). Before submitting the ICR to OMB for review and approval, EPA is soliciting comments on the proposed information collection as described below.

DATES: Comments must be submitted on or before August 31, 2009.

ADDRESSES: Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2009–0234, by one of the following methods:

- *www.regulations.gov:* Follow the on-line instructions for submitting comments.
- E-mail: *a-and-r-docket@epa.gov.*
- Fax: (202) 566–1741.
- Mail: Air and Radiation Docket and Information Center, Environmental Protection Agency, Mailcode: 22821T, 1200 Pennsylvania Ave., NW., Washington, DC 20460.
- Hand Delivery: Air and Radiation Docket and Information Center, U.S. EPA, Room 3334, EPA West Building, 1301 Constitution Avenue, NW., Washington, DC. Such deliveries are only accepted during the Docket's normal hours of operation, and special arrangements should be made for deliveries of boxed information.

A.4 NOTICE OF AN ADDITIONAL SCOPING MEETING FOR THE ENVIRONMENTAL IMPACT STATEMENT FOR THE LONG-TERM MANAGEMENT AND STORAGE OF ELEMENTAL MERCURY, EXTENSION OF THE PUBLIC COMMENT PERIOD, AND CORRECTION (74 FR 36684, JULY 24, 2009)

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constitute an unwarranted invasion of personal privacy. As such, the discussions are protected by exemptions 2 and 6 of section 552b(c) of Title 5 U.S.C.

The full Board will meet in closed session on August 8 from 8:30 a.m. to 10 a.m. to receive a demonstration on NAEP Science Interactive Computer Tasks. The interactive computer tasks are secure items and cannot be discussed in an open meeting. Premature disclosure of the test items would significantly impede implementation of the NAEP program, and is therefore protected by exemption 9(B) of section 552b(c) of Title 5 U.S.C.

Thereafter, the Board will meet in open session from 10:15 a.m. to 12 p.m. to review and take action on Committee reports. The August 8, 2009 session of the Board meeting is scheduled to adjourn at 12 p.m.

Detailed minutes of the meeting, including summaries of the activities of the closed sessions and related matters that are informative to the public and consistent with the policy of section 5 U.S.C. 552b(c) will be available to the public within 14 days of the meeting. Records are kept of all Board proceedings and are available for public inspection at the U.S. Department of Education, National Assessment Governing Board, Suite #825, 800 North Capitol Street, NW., Washington, DC, from 9 a.m. to 5 p.m. Eastern Standard Time, Monday through Friday.

Electronic Access to This Document: You may view this document, as well as all other documents of this Department published in the **Federal Register**, in text or Adobe Portable Document Format (PDF) on the Internet at the following site: *http://www.ed.gov/news/fedregister/index.html* To use PDF you must have Adobe Acrobat Reader, which is available free at this site. If you have questions about using PDF, call the U.S. Government Printing Office (GPO), toll free at 1–888–293–6498; or in the Washington, DC, area at (202) 512–1530.

Note: The official version of this document is the document published in the **Federal Register**. Free Internet access to the official edition of the **Federal Register** and the Code of Federal Regulations is available on GPO Access at: *http://www.gpoaccess.gov/nara/index.html*.

Dated: July 21, 2009.

Cornelia Orr,

Executive Director, National Assessment Governing Board, U.S. Department of Education.

[FR Doc. E9–17728 Filed 7–23–09; 8:45 am]

BILLING CODE 4000–01–P

DEPARTMENT OF ENERGY

Notice of an Additional Scoping Meeting for the Environmental Impact Statement for the Long-Term Management and Storage of Elemental Mercury, Extension of the Public Comment Period, and Correction

AGENCY: Department of Energy.

ACTION: Notice of an Additional Scoping Meeting, Extension of the Public Comment Period, and Correction.

SUMMARY: On July 2, 2009, the Department of Energy (DOE or the Department) published its Notice of Intent to prepare an *Environmental Impact Statement for the Long-Term Management and Storage of Elemental Mercury* (*Mercury Storage EIS*) (74 FR 31723). In that Notice of Intent, DOE invited public comments on the proposed scope of the Mercury Storage EIS during a 45-day public scoping period and announced seven public scoping meetings would be held in the vicinity of the sites proposed for evaluation in this EIS as candidate facilities for the long-term management and storage of elemental mercury generated within the United States. DOE is now announcing the addition of a public scoping meeting to be held on August 13, 2009, in Portland, Oregon, and an extension of the public scoping period. DOE also is correcting language contained in the July 2, 2009, Notice of Intent.

DATES: DOE is extending the scoping period from the 45 days previously announced to 52 days. DOE invites public comment on the scope of this EIS during a public scoping period that commenced on July 2, 2009, and has been extended from August 17, 2009, to August 24, 2009. DOE will hold all of the public scoping meetings on this EIS from 5:30 p.m.–9:30 p.m.. The added public scoping meeting will be held as follows:

August 13, 2009. Red Lion Portland Convention Center, 1021 NE., Grand Avenue, Portland, OR 97232.

All other public scoping meetings will be held as announced in the July 2, 2009, Notice of Intent. Additional details on all scoping meetings will be provided in local media and at *http://www.mercurystorageeis.com*.

In defining the scope of the EIS, DOE will consider all comments received or postmarked by the end of the scoping period. Comments received or postmarked after the scoping period end date will be considered to the extent practicable.

ADDRESSES: Written comments on the scope of the EIS may be submitted by mail to: Mr. David Levenstein, EIS Document Manager, P.O. Box 2612 Germantown, MD 20874, by toll free fax to 1–877–274–5462; or through the EIS Web site at *http://www.mercurystorageeis.com*.

To be placed on the EIS distribution list, any of the methods listed under **ADDRESSES** above can be used. In requesting a copy of the Draft EIS, please specify whether the request is for a copy of the Summary only, the entire Draft EIS, or the entire Draft EIS (which includes the Summary) on a compact disc. In addition, the Draft EIS will be available on the DOE NEPA Web site at *http://www.gc.energy.gov/NEPA/* and at the EIS Web site referenced above.

FOR FURTHER INFORMATION CONTACT: For further information about the EIS, please contact Mr. David Levenstein, EIS Document Manager, Office of Regulatory Compliance (EM–10), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585. For general information concerning DOE's NEPA process, contact: Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance (GC–20), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585; e-mail: *askNEPA@hq.doe.gov*; telephone 202–586–4600; fax 202–586–7031; or leave a message at 1–800–472–2756. This Notice will be available at *http://www.gc.energy.gov/NEPA/* and at *http://www.mercurystorageeis.com.*

SUPPLEMENTARY INFORMATION: On July 2, 2009 (74 FR 31723), the Department published a Notice of Intent in the **Federal Register**. We believe it is necessary to issue the following correction to read:

- On page 31723, the first sentence of the "Background" section is corrected to read: The Mercury Export Ban Act of 2008 (Pub. L. No. 110–414), amends section 6 of the Toxic Substances Control Act (TSCA) (15 USC 2605) to prohibit, effective October 14, 2008, any Federal agency from conveying, selling, or distributing (with certain limited exceptions) to any other Federal agency, any State or local government agency, or any private individual or entity any elemental mercury under the control or jurisdiction of the Federal agency. In all other respects, the **SUPPLEMENTARY INFORMATION** section of the July 2, 2009, Notice of Intent remains the same.

The Mercury Export Ban Act also prohibits the export of elemental mercury from the United States effective January 1, 2013 (subject to certain essential use exceptions). Section 5 of the Act, *Long-Term Storage*, directs DOE to designate a facility or facilities for the long-term management and storage of elemental mercury generated within the United States. DOE's facility or facilities must be operational by January 1, 2013, and ready to accept custody of elemental mercury delivered to such a facility. The Act also requires DOE to assess fees based upon the *pro rata* costs of long-term management and storage. For additional supplementary information regarding anticipated mercury inventory, proposed NEPA alternatives, and preliminary identification of environmental issues, please refer to the July 2, 2009, Notice of Intent.

Purpose and Need for Action

DOE needs to develop a capability for the safe and secure long-term management and storage of elemental mercury as required by the Act. Accordingly, the Department needs to identify an appropriate facility or facilities to host this activity.

Proposed Action

DOE proposes to select one or more existing (including modification as needed) or new facilities for the long-term management and storage of elemental mercury in accordance with the Act. Facilities to be constructed as well as existing or modified facilities must comply with applicable requirements of section 5(d) of the Act, *Management Standards for a Facility,* including the requirements of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA), and other permitting requirements. DOE intends to identify the facility or facilities through the NEPA process. EPA is a cooperating agency on the EIS.

EIS Process and Invitation to Comment

NEPA implementing regulations require an early and open process for determining the scope of an EIS and for identifying the significant issues related to the proposed action. Accordingly, DOE has invited Federal agencies, State, local and Tribal governments, the general public and international community to comment on the scope of the EIS, including identification of reasonable alternatives and specific issues to be addressed. DOE will hold public meetings on the scope of the EIS. (See **DATES** section above for detailed information.)

At each scoping meeting, DOE plans to hold an open house one hour prior to the formal portion of the meetings to allow participants to register to provide oral comments, view informational materials, and engage project staff. The registration table will have an oral comment registration form as well as a sign up sheet for those who do not wish to give oral comments but who would like to be included on the mailing list to receive future information. The public may provide written and/or oral comments at the scoping meetings. Analysis of all public comments provided during the scoping meetings as well as those submitted as described in **ADDRESSES** above, will be considered in helping DOE further develop the scope of the EIS and potential issues to be addressed. DOE expects to issue a Draft EIS in the fall of 2009.

Issued in Washington, DC on July 17, 2009.

Frank Marcinowski,

Deputy Assistant Secretary for Regulatory Compliance, Office of Environmental Management.

[FR Doc. E9–17566 Filed 7–23–09; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Project No. 10359–044]

Public Utility District No. 1 of Snohomish County, WA ; Notice of Application for Amendment of License and Soliciting Comments, Motions To Intervene, and Protests

July 17, 2009.

Take notice that the following hydroelectric application has been filed with the Commission and is available for public inspection:

a. *Application Type:* Amendment of License.

b. *Project No.:* 10359–044.

c. *Date Filed:* June 19, 2009.

d. *Applicant:* Public Utility District No. 1 of Snohomish County, WA.

e. *Name of Project:* Youngs Creek Hydroelectric Project.

f. *Location:* When constructed, the proposed project will be located on Youngs Creek, in Snohomish County, Washington.

g. *Filed Pursuant to:* Federal Power Act, 16 U.S.C. 791a–825r.

h. *Applicant Contact:* Steve Klein, General Manager, Snohomish County PUD No. 1, 2320 California Street, P.O. Box 1107, Everett, Washington 98206; telephone (425) 783–8473.

i. *FERC Contact:* Anthony DeLuca, telephone (202) 502–6632, and e-mail address *Anthony.deluca@ferc.gov.*

j. *Deadline for filing comments, motions to intervene, and protests:* August 18, 2009.

Comments, protests, and interventions may be filed electronically via the Internet in lieu of paper. See 18 CFR 385.2001(a)(1)(iii) and the instructions on the Commission's Web site (*http://www.ferc.gov*) under the "e-filing" link. The Commission strongly encourages electronic filings.

All documents (original and eight copies) filed by paper should be sent to: Secretary, Federal Energy Regulatory Commission, 888 First Street, NE., Washington, DC 20426. Please include the project number (P–10359–044) on any comments or motions filed.

The Commission's Rules of Practice and Procedure require all interveners filing documents with the Commission to serve a copy of that document on each person whose name appears on the official service list for the project. Further, if an intervener files comments or documents with the Commission relating to the merits of an issue that may affect the responsibilities of a particular resource agency, they must also serve a copy of the document on that resource agency. A copy of any motion to intervene must also be served upon each representative of the Applicant specified in the particular application.

k. *Description of Request:*

(i) *Amendment to Project Design:* The Public Utility District No. 1 of Snohomish County proposes to decrease the project's rated turbine capacity from the originally licensed 8.3 MW (11,067 horsepower) to 7.5 MW (10,000 horsepower), and to change the type of turbine to a horizontal shaft, 2-jet impulse Pelton turbine connected to a synchronous type generator rated at 8,333 kVA at a 0.9 power factor (7,500 kW). This decrease in the turbine's capacity will decrease the project's maximum hydraulic capacity from 140 cfs to 120 cfs. The licensee also plans to change the operating voltage of the project transmission line to 12.5 kilovolts as originally licensed, correct the length of transmission line in the original license from 6.1 miles to 8.2 miles, and install certain segments of transmission line on existing overhead distribution poles while installing the remaining segments of the transmission line underground. The transmission line will continue to follow the alignment as provided in the current license.

l. *Locations of the Application:* A copy of the application is available for inspection and reproduction at the Commission's Public Reference Room, located at 888 First Street, NE, Room 2A, Washington, DC 20426, or by calling (202) 502–8371. This filing may also be viewed on the Commission's Web site at *http://www.ferc.gov* using the "eLibrary" link. Enter the docket number excluding the last three digits in

A.5 MEMORANDUM OF UNDERSTANDING BETWEEN THE UNITED STATES DEPARTMENT OF ENERGY AND THE MESA COUNTY BOARD OF COMMISSIONERS (APRIL 22, 1996)

MCM 96-69

1754167 0404PM 04/23/96
MONIKA TODD CLK&REC MESA COUNTY CO

MEMORANDUM OF UNDERSTANDING

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BETWEEN
THE UNITED STATES DEPARTMENT OF ENERGY
AND
THE MESA COUNTY BOARD OF COMMISSIONERS

The purpose of this Memorandum of Understanding between the United States Department of Energy, Grand Junction Projects Office (hereinafter "Department") and the Mesa County Board of Commissioners (hereinafter "County"), is to build confidence and trust and to improve communication between the Parties by formalizing a protocol for the Department to provide meaningful consultation with and participation of the County in the Department's utilization of the Cheney Repository. This Memorandum of Understanding shall serve in lieu of the County's Conditional Use Permit and Certificate of Designation adopted by the County by Resolution No. MCM 88-30, dated March 29, 1988 and the amendments thereto.

The County acknowledges that the Department's operation of the Cheney Repository, which is located on federal land within Mesa County, is part of a pervasive federal scheme established by Congress in the Uranium Mill Tailings Radiation Control Act, 42 U.S.C. § 7901 *et seq.*, (hereinafter "UMTRCA") to properly control and dispose of residual radioactive material from inactive uranium processing sites so as to protect the public health, safety and welfare from the potential harmful affects of such materials.

The Department acknowledges that the citizens of Mesa County and its elected officials have a vital interest in the operation of the Cheney Repository and must be consulted with and actively participate in the Department's decision making process for the utilization of the Cheney Repository. The Department shall incorporate or otherwise respond to the views of the County and its citizens in making any decisions concerning the Cheney Repository.

Therefore, the Department and the County agree to the following:

(1) Consistent with the terms of this Memorandum of Understanding, the Department agrees that it will only consider disposing of the following types of radioactive materials at the Cheney Repository:

   (a) Residual radioactive material, as that term is defined in 42 U.S.C. § 7911 (7);
   (b) Byproduct material, as that term is defined in 42 U.S.C. § 2014 (e) (2); and
   (c) Radioactively contaminated debris and naturally occurring radioactive material from the Department's Grand Junction Projects Office compound.

(2) The Department shall never dispose of any radioactive material at the Cheney Repository without obtaining the prior approval of its regulator, the U.S. Nuclear Regulatory Commission and, in those instances where they have regulatory jurisdiction, the U.S. Environmental Protection Agency or the State of Colorado.

(3) The Department shall, on an annual basis, provide the County with a management plan of the Cheney Repository for the County's review and comment. The annual management plan shall, at a minimum, include the types, estimated quantities and source of radioactive materials which the Department proposes to dispose of at the Cheney Repository, and the estimated remaining capacity of the Cheney Repository. The Department shall provide the management plan to the County at least sixty days prior to the start of the calendar year or sixty days prior to the seasonal opening of the Cheney Repository; and the County will provide the Department with any comments or concerns within 30 days of receipt of the plan. The Department shall also periodically conduct public meetings to inform the citizens of Mesa County of the status of the Cheney Repository.

(4) It is the Department's intent to use the Cheney Repository almost exclusively as a facility for the continued disposal of radioactive material from properties located within Mesa County, with first priority being given to the material within Mesa County. The Department shall consult with the County on any proposal to use the Cheney Repository to dispose of radioactive material from properties located outside Mesa County, and shall identify the proposed quantities of such materials in the Department's annual management plan for the Cheney Repository. Any decision to accept materials outside of Mesa County will take into consideration the volumes to be disposed, and the impact that these volumes will have on the remaining capacity of

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the Cheney Repository to accept Mesa County material. DOE will strive to maintain sufficient capacity to accommodate the needs of Mesa County, given the information available.

(5) The Department shall abide by any reasonable requirements sought by the County regarding the transportation of radioactive material to the Cheney Repository, including the maintenance of an Emergency Contingency Plan.

(6) At the County's request, the Department shall make available to the County all records relevant to the operation of the Cheney Repository which are not otherwise protected from disclosure by law, and shall make its employees and contractors available to respond to any questions concerning the Cheney Repository.

(7) The Department and the County agree to work cooperatively to seek legislative authority from Congress to continue to operate the Cheney Repository after the Department's authority to perform remedial action expires under UMTRCA.

Any requirement for the payment or obligation of funds by the Department established by the terms of this Memorandum of Understanding shall be subject to the availability of appropriated funds, and no provision herein shall be interpreted to require the obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341.

This Memorandum of Understanding shall apply to and be binding upon the Parties, together with their administrative officers, agents, and employees, notwithstanding any change in administration or governance of the Parties.

This Memorandum of Understanding may be amended by written agreement between the Parties.

This Memorandum of Understanding may be terminated by mutual written agreement of the Parties.

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION PROJECTS OFFICE

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By:

James Lampley, Manager

Date: 3/29/96

U.S. DEPARTMENT OF ENERGY
ALBUQUERQUE OPERATIONS OFFICE

By:

John Arthur, Manager
Office of Environment and Project Management

Date: 4/4/96

MESA COUNTY BOARD OF COMMISSIONERS

By:

Kathy Hall, Chair

Date: 4/22/96

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APPENDIX B
IMPACT ASSESSMENT METHODOLOGY

This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the alternatives in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement*. Included are impact assessment methods for land use and visual resources; geology and soils; water resources; meteorology, air quality, and noise; ecological resources; cultural and paleontological resources; site infrastructure; waste management; socioeconomics; environmental justice; and cumulative impacts. Each section includes a description of the affected resource, including the associated region of influence and the impact assessment method. Detailed descriptions of the methods for the evaluation of occupational and public health and safety and ecological risk from normal operations, facility accidents, and mercury transportation are presented separately in Appendix D.

B.1 INTRODUCTION

Methods for assessing environmental impacts vary for each resource area (discipline). In addition, disciplines are analyzed in a manner commensurate with their importance and the expected level of impact on them under a specific alternative—the sliding-scale assessment approach. This is consistent with U.S. Department of Energy (DOE) guidance contained in its *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (known as *The Green Book*) (DOE 2004:1, 2, 19, 20), in which DOE expands on Council on Environmental Quality (CEQ) instructions for preparing environmental impact statements (EISs) (40 CFR 1502.2) by stating that impacts should be discussed in proportion to their significance and specifically recommending the use of the sliding scale for impact identification and quantification.

For air quality, for example, pollutant emissions from the mercury[1] storage activities were evaluated for their effect on ambient concentrations and compliance with ambient air quality standards. Comparison with regulatory standards is a commonly used method for benchmarking environmental impacts and is conducted—where appropriate—to provide perspective on the magnitude of identified impacts. Impacts in all resource areas were analyzed consistently; that is, the impact values were estimated using a consistent set of input variables and computations. Moreover, efforts were made to ensure that calculations in all areas used accepted protocols and up-to-date models.

In this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement* (*Mercury Storage EIS*), impacts are typically described in terms of intensity and duration. The term "impact," when used in this EIS, refers to adverse, long-term impacts, unless otherwise stated. A set of standardized impacts terminology was developed for use. Beneficial impacts are those that would improve current conditions, while adverse impacts would degrade current conditions. Intensities are categorized as negligible, minor, moderate, or major, with durations classified as either short term (less than or equal to 5 years) or long term. These categories are defined as follows:

- Negligible: There would be little or no impact on the resource in the region of influence (ROI). Where slight impacts occur, they would be relatively short term, and/or the impacts would not be of any perceptible consequence over the long term.

- Minor: Effects on the resource in the ROI would be detectable, although localized, relatively small, and of little long-term consequence to the overall makeup of the ROI. Resource loss, consumption, or change would be a small percentage (i.e., generally between 1 and 10 percent) of the resource or resource indicator in the ROI. There would be no loss, damage, or alteration of

[1] Unless indicated otherwise, elemental mercury is referred to hereafter simply as "mercury" in this environmental impact statement.

any rare, unique, special status, or other legally protected resources (e.g., threatened and endangered species or critical habitat).

- Moderate: Effects on the resource would be readily detectable, generally long term, and localized; the impact on the ROI would be moderate. Resource loss, consumption, or change would be a sizable percentage (i.e., generally between 10 and 40 percent) of the resource or resource indicator in the ROI. Such impacts may prompt consideration of specific project design changes and/or compensatory mitigation for resource loss. Moderate effects may also denote resource conditions that are not expected to affect or impair project implementation but that could prompt consideration of special design or construction mitigation.

- Major: Effects on the resource would be obvious and long term and would have substantial consequences; the impact on the ROI would be major. Either substantial project design changes and/or compensatory mitigation for resource loss would be evaluated. Major effects may also denote resource conditions (e.g., presence of active geologic fault) prompting consideration of substantial changes in project implementation in terms of location and/or special design or construction mitigation.

These terms are used for the analysis of impacts for all resources areas, exclusive of occupational and public health and safety and ecological risk, which are presented separately in Appendix D. The ROIs for each resource are described in the following sections.

B.2 LAND USE AND VISUAL RESOURCES

B.2.1 Land Use

B.2.1.1 Description of Affected Resources

Analysis of land use includes the land on and adjacent to each candidate mercury storage site, the physical features that influence current or proposed uses, pertinent land use plans and regulations, and land ownership and availability. The ROI for land use varies due to the extent of land ownership, adjacent land use patterns and trends, and other geographic or safety considerations.

B.2.1.2 Description of Impact Assessment

The amount of land disturbed and conformity with existing land use were considered to evaluate potential impacts (see Table B–1). The *Mercury Storage EIS* evaluates the impacts of mercury storage alternatives on land use within each candidate mercury storage site, adjacent Federal or state lands, adjacent communities, and wildlife or resource areas. The analysis focuses on the net land area affected, its relationship to conforming and nonconforming land uses, current growth trends, and other factors pertaining to land use. Land use impacts could vary from site to site, depending on existing facility land use configurations, adjoining land uses, and proximity to residential areas.

Evaluation of existing land use at each of the potentially affected sites entailed review of available facility land use plans. Where land adjacent to the candidate site is managed by local government, applicable community general plans, zoning ordinances, and population growth trend data were reviewed. Where such land is managed under the jurisdiction of a Federal or state land management agency, the respective agency resource management plans and policies were reviewed.

Total additional land area requirements include those areas to be occupied by the footprint of facility modifications or new facilities in conjunction with any additional paved roads, parking areas, graveled areas, construction laydown areas, as well as land graded and cleared of vegetation to support the proposed action.

Table B–1. Land Use and Visual Resources Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Land use	Areal extent of site location affected and existing land use designations	Facility acreage requirements (hectares); location of facility on the site; expected modifications of site activities and uses to accommodate the alternatives	Area converted to project use and incompatibility with existing or future land use
Visual resources	Current appearance of mercury storage site and current visual resource management classification	Location of facility on the site; facility dimensions and appearance	Change in appearance of mercury storage site and current visual resource management classification

B.2.2 Visual Resources

B.2.2.1 Description of Affected Resources

Visual resources are the natural and manmade features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The ROI for visual resources includes the geographic area from which the mercury storage facilities may be seen.

B.2.2.2 Description of Impact Assessment

Visual resource assessments are based on a description of the viewshed and the U.S. Bureau of Land Management's visual resource management classification (DOI 1986). A qualitative visual resource analysis was conducted to determine whether disturbances associated with mercury storage activities would alter the visual environment of the candidate mercury storage sites. Classifications of visual contrast settings are provided in Table B–2. Classifications were derived from an inventory of scenic qualities, sensitivity levels, and distance zones for particular areas.

Table B–2. U.S. Bureau of Land Management Visual Resources Classifications

Classification	Visual Settings
Class I	Very limited management activity; natural ecological change.
Class II	Management activities may be seen, but should not attract the attention of the casual observer, such as solitary small buildings or dirt roads.
Class III	Management activities may attract attention, but should not dominate the view of the casual observer; the natural landscape still dominates buildings, utility lines, and secondary roads.
Class IV	Management activities may dominate the view and major focus of viewer attention, such as clusters of two-story buildings, large industrial or office complexes, primary roads, and limited clearcutting for utility lines or ground disturbances.

Source: DOI 1986:6, 7.

The visual resources analysis focuses on the degree of contrast between the proposed action and the surrounding landscape, the location and sensitivity levels of public vantage points, and the visibility of the proposed action from the vantage points. The distance from a vantage point to the affected area and atmospheric conditions were also taken under consideration, as distance and haze can diminish the degree of contrast and visibility. A qualitative assessment of the degree of contrast between proposed facility construction or modification and operations and the existing visual landscape is presented, as applicable.

B.3 GEOLOGY AND SOILS

B.3.1 Description of Affected Resources

Geologic resources encompass consolidated and unconsolidated earth materials, including rock and mineral assets, such as ore and aggregate materials (e.g., sand, gravel), and fossil fuels, such as coal, oil, and natural gas. Geologic conditions include hazards such as earthquakes, faults, volcanoes, landslides, sinkholes, and other conditions leading to land subsidence and unstable soils. Soil resources include the loose surface materials of the earth in which plants grow, usually consisting of mineral particles from disintegrating rock, organic matter, and soluble salts. Certain soils are important farmlands that are designated as such by the U.S. Department of Agriculture Natural Resources Conservation Service. Important farmlands include prime farmland, unique farmland, and other farmland of statewide or local importance, as defined in "Prime and Unique Farmlands: Identification of Important Farmlands" (7 CFR 657.5), that may be subject to the Farmland Protection Policy Act (7 U.S.C. 4201 et seq.).

Geology and soils were considered with respect to those attributes and geologic and soil resources that could be affected by the alternatives, as well as those geologic conditions that could affect each alternative and associated facility site. The ROI for geology and soils includes the project site and nearby offsite areas subject to disturbance by mercury management activities during facility construction or modification and operations and those areas beneath an existing or new facility that would remain inaccessible for the life of the facility. Conditions that could affect the integrity and safety of the mercury storage facilities under the alternatives include large-scale geologic hazards (e.g., earthquakes, volcanic activity, landslides, land subsidence, and erosional processes) and local hazards associated with the site-specific attributes of the soil and bedrock beneath candidate sites. Thus, the area in which these geologic conditions exist is also used to define the ROI for this resource area.

B.3.2 Description of Impact Assessment

Facility construction or modification and operational activities under each of the mercury storage alternatives were considered from the perspective of impacts on specific geologic resources and soil attributes to encompass the consumption of geologic resources. Key factors in the analysis were the (1) land area to be disturbed and geologic resources consumed to support the alternatives considered; (2) depth and extent of excavation work to support facility construction and/or refurbishment/modification; (3) land areas occupied during operations; and (4) identification of unstable geologic strata (such as soils or sediments prone to subsidence, liquefaction, shrink-swell, or erosion) (see Table B–3).

The geology and soils impact analysis also considered risks to proposed facilities (existing, new, or modified/refurbished) from large-scale geologic hazards such as faulting and earthquakes, lava extrusions and other volcanic activity, landslides, and sinkholes (i.e., conditions that tend to affect broad expanses of land). In general, the facility hazard assessment was based on the presence of any identified hazard and the distance of the facilities from it. This element of the assessment includes collection of site-specific information regarding the potential for impacts on site facilities from local and large-scale geologic conditions. Historical seismicity within a given radius of the candidate mercury storage sites was reviewed, and potential earthquake source areas (including proximity to potentially active geologic faults) were identified as a means of assessing the potential for future earthquake activity and seismic risk.

Table B–3. Geology and Soils Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Geologic hazards	Presence of geologic hazards within the region of influence	Location of facility	Potential for damage to facility
Mineral and energy resources	Presence of any rare and/or valuable mineral or energy resources on the site location and availability of geologic resources within the region of influence	Location of facility and projected resource demands	Potential to consume, destroy, or render resources inaccessible
Important farmland soils	Presence of prime or other important farmland soils near the site location	Location of facility	Conversion of important farmland soils to nonagricultural use

Earthquakes are described in this *Mercury Storage EIS* in terms of classification scheme and parameters, as presented in Table B–4. Probabilistic earthquake ground-motion data that include peak (horizontal) ground acceleration were specifically evaluated to provide a comparative assessment of seismic hazard. Estimates of probabilistic ground motion at a particular location consider earthquake-shaking at all future possible earthquake magnitudes and at all possible distances from the location (USGS 2009a). Peak ground acceleration indicates what an object on the ground would experience during an earthquake and approximates what a short structure would be subjected to in terms of horizontal force (USGS 2009b). Peak ground acceleration is one parameter used by the U.S. Geological Survey National Seismic Hazard Mapping Project. The U.S. Geological Survey hazard maps have been adapted for use in the seismic design portions of the International Building Code (Petersen 2008; USGS 2009b, 2009c).

DOE Order 420.1B and its companion guide (DOE Guide 420.1-2) require that nuclear and nonnuclear DOE facilities be designed, constructed, and operated so that the public, workers, and environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. The Order stipulates natural phenomena hazards mitigation requirements for DOE facilities and specifically provides for reevaluation and upgrade of existing DOE facilities when there is a significant degradation in the safety basis for the facility. Standards 1020-2002 and 1023-95 implement DOE Order 420.1B and provide criteria for design of new structures, systems, and components, as well as for evaluation, modification, or upgrade of existing structures, systems, and components, so that DOE facilities can safely withstand the effects of natural phenomena hazards such as earthquakes. The criteria specifically reflect adoption of the seismic design and construction provisions and associated seismic hazard maps of the International Building Code as the minimum standard for design and evaluation of DOE facilities (i.e., for Performance Category 1 and 2 structures, systems, and components). For structures, systems, and components requiring a higher level of performance from a safety perspective (i.e., Performance Category 3 and 4), a more-rigorous design analysis is required, including performance of a probabilistic seismic hazard assessment to determine the design-basis earthquake.

An evaluation was also performed to estimate requirements for rock, aggregate, soil, and products derived from rock and mineral resources used to support mercury storage activities, including facility construction or modification and operations. The analysis of impacts on geologic resources also included a determination of whether the mercury storage activities under each alternative could destroy or preclude the use of valuable rock, mineral, or energy resources.

Table B–4. The Modified Mercalli Intensity Scale of 1931, with Generalized Correlations to Magnitude, Earthquake Classification, and Peak Ground Acceleration

Modified Mercalli Intensity[a]	Observed Effects of Earthquake[a]	Approximate Magnitude[b]	Class	Peak Ground Acceleration[c](g)
I	Usually not felt except by a very few persons under very favorable conditions.	Less than 3	Micro	Less than 0.0017
II	Felt by only a few persons at rest, especially on the upper floors of buildings.	3 to 3.9	Minor	0.0017 to 0.014
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck.			
IV	Felt indoors by many; outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sounds. Sensation like heavy object striking building. Standing motorcars rock noticeably.	4 to 4.9	Light	0.014 to 0.039
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.			0.039 to 0.092
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	5 to 5.9	Moderate	0.092 to 0.18
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	6 to 6.9	Strong	0.18 to 0.34
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings, with partial collapse. Damage great in poorly built structures. Falling chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	7 to 7.9	Major	0.34 to 0.65
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.			0.65 to 1.24
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.			1.24 and higher
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	8 and higher	Great	
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.			

[a] Intensity is a unitless expression of observed effects of earthquake-produced ground shaking. Effects may vary greatly between locations based on earthquake magnitude, distance from the earthquake, and local subsurface geology. The descriptions given are abbreviated from the Modified Mercalli Intensity Scale of 1931.

[b] Magnitude is a logarithmic measure of the strength (size) of an earthquake related to the strain energy released by it. There are several magnitude "scales" (mathematical formulas) in common use, including local "Richter" magnitude, body-wave magnitude, and surface-wave magnitude. Each has applicability for measuring particular aspects of seismic signals and may be considered equivalent within each scale's respective range of validity. For very large earthquakes, the moment magnitude scale provides the best overall measurement of earthquake size.

[c] Acceleration is expressed as a factor that should be multiplied by Earth's gravitational acceleration *(g)* (i.e., *g* is equal to 980 centimeters [386 inches] per second squared). Given values are correlated to Modified Mercalli Intensity based on measurements of California earthquakes (Wald et al. 1999). Site-specific earthquake history, ground motion, and risk assessment data for candidate mercury storage sites are presented in Chapter 3.

Source: Compiled from USGS 2009d, 2009e; Wald et al. 1999.

Pursuant to the Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 et seq.) and its implementing regulations, the presence of important farmland soils, including prime farmland, was also evaluated. This act requires agencies to make Farmland Protection Policy Act evaluations part of the National Environmental Policy Act process to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. However, otherwise qualifying farmlands in or already committed to urban development; lands acquired for a project on or prior to August 4, 1984; and lands acquired or used by a

Federal agency for national defense purposes are exempt from the act's provisions (7 CFR 658.2 and 658.3). Based on the foregoing and other factors, none of the candidate mercury storage sites were found to have qualifying important farmland soils.

B.4 WATER RESOURCES

B.4.1 Description of Affected Resources

Water resources are the surface and subsurface waters that are suitable for human consumption, aquatic or wildlife propagation, agricultural purposes, irrigation, or industrial or commercial purposes. The ROI used for water resources encompasses those surface-water and groundwater systems on and adjacent to each candidate site that could be impacted by water withdrawals, effluent discharges, and spills or stormwater runoff associated with facility construction or modification and operational activities under the mercury storage alternatives.

B.4.2 Description of Impact Assessment

Analysis of the potential impacts on water resources consisted of comparing site-generated data and best available engineering-basis estimates of water use and effluent discharges associated with proposed mercury storage activities with applicable regulatory standards, design parameters and standards commonly used in the water and wastewater engineering fields, and recognized measures of environmental impact. Certain assumptions were made to facilitate the impacts assessment: (1) all water supply production and treatment and waste effluent treatment facilities would be available and approved by the governing approval authority; (2) the waste effluent treatment facilities would meet the effluent limitations imposed by the respective National Pollutant Discharge Elimination System permits and/or the state-issued discharge permits; and (3) any stormwater runoff from construction and operations activities would be addressed in accordance with the regulations of the appropriate permitting authority. It was also assumed that, during construction and other land-disturbing activities, sediment fencing or other erosion-control devices would be used to mitigate short-term adverse impacts of sedimentation and, as appropriate, stormwater holding ponds would be constructed to lessen the impacts of runoff on surface-water quality.

B.4.2.1 Water Use and Availability

This analysis involved the review of engineering estimates of expected surface-water and/or groundwater use and effluent discharge associated with facility construction or modification and operations for each alternative and the impacts on local and regional water availability in terms of quantity and quality. Impacts on water use and availability were generally assessed by determining changes in the volume of current water usage and effluent discharge as a result of the proposed activities. For facilities intending to use surface water, no credit was taken for effluent discharges back to surface waters. The impact of discharging withdrawn groundwater to surface waters or back to the subsurface was also considered, as appropriate. A separate analysis (see below) was performed as necessary to determine the potential for impacts of mercury storage activities on ambient surface-water or groundwater quality, based in part on the results of the effluent treatment capacity analysis.

Because water use and withdrawals from water sources were found to be relatively small, and no routine effluent discharges (except for uncontaminated stormwater) from the candidate mercury storage sites and facilities are expected, additional detailed analyses to include comparison with design capacity of existing water supply systems or effluent treatment facilities were not performed.

B.4.2.2 Water Quality

The water quality impact assessment for this *Mercury Storage EIS* analyzed how any routine effluent discharges and nonroutine releases (e.g., spills, containment failure) to surface water, as well as discharges reaching groundwater, from new or modified facilities required under each alternative could potentially affect current water quality over the short term. The impacts of the alternatives were assessed by comparing the projected effluent quality with relevant regulatory standards and implementing regulations under the Clean Water Act (33 U.S.C. 1251 et seq.), Safe Drinking Water Act (42 U.S.C. 300(f) et seq.), state laws, and existing site permit conditions, as summarized in Table B–5. The impact analyses evaluated the potential for contaminants to affect the water quality of waterways receiving spills and other releases under the alternatives. Separate analyses were conducted for surface-water and groundwater impacts.

Table B–5. Water Quality Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Surface-water quality	Surface waters near the facility location in terms of stream classifications and water quality	Expected contaminants and contaminant concentrations in discharges to surface waters	Potential for exceedance of relevant surface-water-quality criteria or standards under the Clean Water Act or state regulations and existing permits
Groundwater quality	Groundwater near the facility location in terms of classification, presence of designated sole-source aquifers, and quality of groundwater	Expected contaminants and contaminant concentrations in discharges that could reach groundwater	Potential for contaminant concentrations in groundwater to exceed relevant standards or criteria established in accordance with the Safe Drinking Water Act or state regulations and/or existing permits

Surface-Water Quality. The evaluation of surface-water-quality impacts focused on the quality and quantity of any effluents (including stormwater) that could be discharged during facility construction or modification or operations, as well as other releases, and the quality of the receiving stream upstream and downstream from the discharges. Factors that currently degrade water quality were also identified, where relevant.

During facility construction and substantial facility modifications that result in ground disturbance, surface waters could be affected by site runoff and siltation and possibly spills (e.g., fuels from equipment). Such impacts relate to the amount of land disturbed, the type of soil at the site, the topography, and weather conditions. They would be minimized by application of standard management practices for stormwater and erosion control (e.g., sediment fences, mulching disturbed areas) and adherence to spill prevention and material-handling practices.

During operations, surface waters could be affected by increased runoff from impervious surfaces (e.g., buildings) or cleared areas. Stormwater from these areas could be contaminated with materials deposited by airborne pollutants, automobile exhaust and residues, materials-handling releases (such as spills), and process effluents. Impacts of stormwater discharges could be highly variable and site-specific, and mitigation would depend on management practices, the design of holding facilities (if any), the topography, and adjacent land use. Data from existing water quality data sources were compared with expected discharges from the facilities to determine the potential for impacts on surface waters.

Groundwater Quality. Potential groundwater quality impacts associated with effluent discharges and other contaminant releases during facility construction or modifications and operations were examined. Available engineering estimates of contaminant concentrations were weighed against applicable Federal and state groundwater quality standards, effluent limitations, and drinking water standards to determine the impacts of each alternative. Also evaluated were the consequences of groundwater use and effluent discharge on other groundwater conditions at each site, as appropriate.

B.4.2.3 Waterways and Floodplains

The locations of waterways (e.g., ponds, lakes, streams) and delineated floodplains or zones were identified from maps and other existing documents to assess the potential for impacts resulting from proposed new facility construction and facility modification and operations, including direct effects on hydrologic characteristics. No construction or other activities would occur within a floodplain at any site. Although the Kansas City Plant is located within a mapped floodplain, the area is protected by engineered floodwalls to ensure compliance with Executive Order 11988, *Floodplain Management*. Therefore, preparation of a floodplain assessment is not required, pursuant to "Compliance with Floodplain and Wetland Environmental Review Requirements" (10 CFR 1022).

B.5 METEOROLOGY, AIR QUALITY, AND NOISE

B.5.1 Meteorology and Air Quality

B.5.1.1 Description of Affected Resources

Meteorology is the science that deals with the atmosphere. For the purposes of this EIS, the conditions that exist near the surface of the Earth, especially as they would have an effect on the dispersion of air pollutants or the design of a storage facility, are of primary importance. For each candidate mercury storage site, historical information on wind, temperature, precipitation, and meteorological events was obtained and summarized. Historical meteorological data for candidate sites were summarized, where available, and supplemented with data from nearby National Climatic Data Center stations, as necessary. Information on meteorological events from the National Climatic Data Center storm events database was summarized; data on tornadoes, hailstorms, snowfall, thunderstorms, high winds, and hurricanes were included.

Air pollution refers to the introduction, directly or indirectly, of any substance into the air that could endanger human health and harm living resources and ecosystems, as well as material property, and impair or interfere with the comfortable enjoyment of life and other legitimate uses of the environment. For the purposes of this *Mercury Storage EIS*, only outdoor air pollutants were addressed. They may be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) or secondary pollutants (those produced in the air by interaction between two or more primary pollutants or by reaction with normal atmospheric constituents that may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. The ambient air quality standards established by Federal and state agencies allow an adequate margin of safety for the protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards are considered acceptable.

Pollutants of concern are primarily those for which Federal and state ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds.

Criteria air pollutants are listed in "National Primary and Secondary Ambient Air Quality Standards" (40 CFR 50). Hazardous air pollutants and other toxic compounds are those listed in Title I of the Clean Air Act, as amended (42 U.S.C. 7401 et seq.); those regulated by the National Emission Standards for Hazardous Air Pollutants (40 CFR 61); and those that have been proposed or adopted for regulation by the applicable state or are listed in state guidelines. States may set ambient standards that are more stringent than the National Ambient Air Quality Standards (NAAQS). The more stringent of the Federal or state standards are used in this EIS.

Areas with air quality better than the NAAQS for criteria air pollutants are designated as "attainment," while areas with air quality worse than the NAAQS for such pollutants are designated as "nonattainment." Areas may be designated as "unclassified" when sufficient data for attainment-status designation are lacking. Attainment-status designations are assigned by county, metropolitan statistical area, consolidated metropolitan statistical area or portions thereof, or air quality control regions. Air quality control regions designated by the U.S. Environmental Protection Agency (EPA) are listed in "Designation of Areas for Air Quality Planning Purposes" (40 CFR 81).

For locations within an attainment area for criteria air pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new or modified sources and establish allowable increments of pollutant concentrations. Three Prevention of Significant Deterioration classifications are specified using the criteria established in the Clean Air Act. Class I areas include national wilderness areas; memorial parks larger than 2,020 hectares (5,000 acres); national parks larger than 2,430 hectares (6,000 acres); and areas that have been redesignated as Class I. Class II areas include all areas not designated as Class I. No Class III areas have been designated (42 U.S.C. 7472 et seq.).

The ROI for air quality encompasses an area surrounding a site that is potentially affected by air pollutant emissions caused by implementation of the alternatives. The air quality impact area normally evaluated is the area in which concentrations of criteria pollutants would increase more than a significant amount in a Class II area (based on the averaging period and pollutant: 1 microgram per cubic meter for the annual average for sulfur dioxide, nitrogen dioxide, and particulate matter with an aerodynamic diameter less than or equal to 10 micrometers [PM_{10}]; 5 for the 24-hour average for sulfur dioxide and PM_{10}; 500 for the 8-hour average for carbon monoxide; 25 for the 3-hour average for sulfur dioxide; and 2,000 micrograms for the 1-hour average for carbon monoxide (40 CFR 51.165). Generally, this ROI covers a few kilometers downwind from the source. Further, for sources within 100 kilometers (60 miles) of a Class I area, the air quality impact area evaluated would include the Class I area if the increase in concentration of any air pollutants for which there are Prevention of Significant Deterioration increments is greater than 1 microgram per cubic meter (24-hour average). The area of the ROI depends on emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For the purpose of this analysis, impacts were evaluated qualitatively based on estimated emissions from construction, operation, and shipping.

Baseline air quality is typically described in terms of pollutant concentrations modeled for existing sources at each potential site and background air pollutant concentrations measured near the sites. For this analysis, concentrations for existing sources were obtained from existing source documents such as preliminary assessments, site investigations, EISs, annual environment reports, and the EPA database for nearby monitoring sites. These concentrations were compared with Federal and state standards or guidelines.

B.5.1.2 Description of Impact Assessment

Potential air quality impacts of pollutant emissions from facility construction or modification and normal operations were evaluated for each of the alternatives (see Table B–6). All of the alternatives considered had minor emissions from onsite activities, which were discussed qualitatively. Transportation emissions were estimated for truck and rail shipments of mercury.

Table B–6. Air Quality Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Criteria air pollutants and other regulated pollutants[a]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at site location	Emission rate (kilograms per year) of air pollutants from facility site; source characteristics	Alternative emissions of each pollutant quantified and potential impacts discussed qualitatively
Toxic and hazardous air pollutants[b]			

[a] Criteria pollutants and ozone precursors that would be emitted under the alternatives evaluated include carbon monoxide, nitrogen oxides, particulate matter with an aerodynamic diameter less than or equal to 10 micrometers, particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers, sulfur dioxide, and volatile organic compounds.

[b] Clean Air Act, Section 112, hazardous air pollutants: pollutants regulated under the National Emissions Standards for Hazardous Air Pollutants and other state-regulated pollutants. Hazardous air pollutants emitted from construction equipment that were evaluated include ammonia, benzene, 1-,3-butadiene, formaldehyde, toluene, and xylene.

The Clean Air Act, as amended, requires that Federal actions conform to the host state's "state implementation plan." A state implementation plan provides for the implementation, maintenance, and enforcement of NAAQS for the six criteria pollutants: sulfur dioxide, PM_{10}, carbon monoxide, ozone, nitrogen dioxide, and lead. Its purpose is to eliminate or reduce the severity and number of violations of NAAQS and to expedite the attainment of these standards. No department, agency, or instrumentality of the Federal Government shall engage in or support in any way (i.e., provide financial assistance for, license or permit, or approve) any activity that does not conform to an applicable implementation plan. The final rule for "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (40 CFR 51.850–51.860) took effect on January 31, 1994. Areas currently designated as attainment for criteria air pollutants are not affected by the provisions of the conformity rule. Applicability of the conformity rule was assessed for each site. Because all the candidate sites are in attainment areas, no additional conformity analysis is required.

Emissions of potential stratospheric ozone-depleting compounds such as chlorofluorocarbons were not evaluated because no emissions of these pollutants were identified in the mercury storage alternatives. However, emissions of pollutants thought to contribute to global climate change were evaluated.

B.5.2 Noise

B.5.2.1 Description of Affected Resources

Sound results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleeping), damage hearing, or diminish the quality of the environment.

Noise-level measurements used to evaluate the effects of nonimpulsive sound on humans are adjusted by an A-weighting scale that accounts for the hearing response characteristics (i.e., frequency) of the human ear. Noise levels are expressed in decibels (dB) or, in the case of A-weighted measurements, decibels A-weighted (dBA). EPA has developed noise-level guidelines for different land use classifications (EPA 1974). The EPA guidelines identify a 24-hour average exposure level (energy-equivalent sound level) of no more than 70 dBA of intermittent environmental noise to prevent hearing loss. Likewise, day-night average levels of 55 dBA outdoors and 45 dBA indoors are identified as the limits to prevent activity interference and annoyance. State and local noise regulations were identified for each candidate site.

Noise from facility operations and associated traffic could affect human and animal populations. The ROI for each candidate site includes the site and surrounding area, including transportation corridors, where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few miles of the site boundary that carry most of the site's employee and shipping traffic.

Noise-level data representative of site environs were obtained from existing reports. The acoustic environment was further described in terms of existing noise sources for the proposed locations and traffic noise levels along access routes.

B.5.2.2 Description of Impact Assessment

Noise impacts associated with the alternatives may result from facility construction or modification and operations, including increased traffic (see Table B–7). Impacts of proposed mercury storage activities at each site location were assessed according to the types of noise sources and the facility site locations relative to the site boundary and noise-sensitive receptors. Potential traffic noise impacts were assessed based on the likely increase in traffic volume. The increase in employee and truck traffic from the discussion of local traffic presented in Chapter 4 were compared with existing average traffic volume. For the purpose of comparison among the alternatives, the increase in traffic noise level in dBA can be estimated as 10 times the logarithm of the ratio of the projected traffic volume to the existing traffic volume. Possible impacts on wildlife were evaluated based on the possibility of sudden loud noises occurring during site activities under each alternative.

Table B–7. Noise Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Noise	Identification of sensitive offsite receptors (e.g., nearby residences, nearby threatened and endangered wildlife habitat); description of noise levels and noise sources in the site vicinity	Description of noise sources; shipment and workforce traffic estimates	Increase in day-night average sound level at sensitive receptors

B.6 ECOLOGICAL RESOURCES

B.6.1 Description of Affected Resources

Ecological resources include terrestrial and aquatic resources (plants and animals), threatened and endangered species, and wetlands that could be affected by the mercury management alternatives. The ROI used for habitat impacts encompassed the areas that could potentially be disturbed by proposed facility construction or modification and operations.

Terrestrial resources are defined as those plant and animal species and communities that are most closely associated with the land; aquatic resources are those associated with a water environment. Wetlands are defined by the U.S. Army Corps of Engineers and EPA as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

Endangered species are defined under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) as those in danger of extinction throughout all or a large portion of their range. Threatened species are defined as those species likely to become endangered within the foreseeable future. The U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration propose the addition of species to the lists of threatened and endangered species. They also maintain a list of "candidate" species for which they have evidence that listing may be warranted, but for which listing is currently precluded by the need to list species more in need of Endangered Species Act protection. Candidate species do not receive legal protection under the Endangered Species Act but should be considered in project planning in case they are listed in the future. Critical habitat for threatened and endangered species is designated by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service. Critical habitat is defined as a specific area that contains physical and biological features essential to the conservation of species and that may require special management consideration or protection. States may also designate species as endangered, threatened, sensitive, in need of management, of concern, monitored, or of special concern.

B.6.2 Description of Impact Assessment

The proposed alternatives could involve land disturbance during facility modifications. Accordingly, the ROI evaluated for ecological impacts encompassed those areas on the candidate mercury storage sites that could potentially be disturbed by facility construction or modification and operations.

Impacts on ecological resources may occur as a result of land disturbance, water use, human activity, and noise from construction, modification or expansion, and operation of mercury storage facilities (see Table B–8). Night lighting may also impact site ecology. Each of these factors was considered when evaluating the potential impacts of the proposed activities. Terrestrial resources could be directly affected through destruction or modification of habitat. Likely impacts include increased direct mortality and susceptibility to predation. Activities associated with each alternative (e.g., human intrusion and noise) could also cause wildlife to move to adjacent areas with similar habitat. If the receiving areas were already supporting the maximum sustainable number of individuals, competition for limited resources and habitat degradation could result in the loss of some individuals. Therefore, analysis of impacts on terrestrial wildlife was based largely on the extent of plant community loss or modification. Indirect impacts of factors such as human disturbance, noise, and night lighting were evaluated qualitatively.

Facility construction, expansion, or modification and operations could directly affect aquatic resources through increased runoff and sedimentation, increased flows, and the introduction of chemical changes to the water. Impacts on nonsensitive terrestrial and aquatic ecosystems from water use and air and water emissions were evaluated based on the results of analyses conducted for air quality and water resources. The ecological risk assessment protocol is described in Appendix D. However, various mitigation techniques should minimize facility modification impacts, and discharges of contaminants to surface waters and air from routine operations are expected to be limited by engineering control practices.

Project activity impacts on threatened and endangered species, as well as other special status species, and their habitats were determined in a manner similar to that used to evaluate impacts on other terrestrial and aquatic resources and habitats. A list of sensitive species that could be present at each site was compiled. Informal consultations were initiated with the appropriate U.S. Fish and Wildlife Service offices and state-equivalent agencies as part of the impact assessment for sensitive species (see Chapter 5).

Most facility modification impacts on wetlands are related to the displacement of wetlands by filling, draining, or dredging activities. Loss of wetlands resulting from modification of the facilities was addressed by comparing data on the location and areal extent of wetlands in the ROI with the land area requirements for the alternative mercury storage sites. Operational impacts on wetlands could result from effluents, surface-water or groundwater withdrawals, or creation of new wetlands.

Table B–8. Ecological Resources Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Terrestrial resources	Terrestrial vegetation and wildlife within the vicinity of the site location	Area disturbed by facility site activities, air emissions, wastewater discharges, and noise	Loss of or disturbance to species and their habitats; emissions and noise values above levels shown to cause impacts on terrestrial resources
Aquatic resources	Aquatic resources within the vicinity of the site location	Facility area air emissions, water source and quantity, and wastewater discharge locations and quantities	Discharges above levels shown to cause impacts on aquatic resources
Wetlands	Wetlands within the vicinity of the site location	Area disturbed by facility site activities, air emissions, and wastewater discharge locations and quantities	Loss of or disturbance to wetlands
Threatened and endangered species	Threatened and endangered species, as well as their habitats, within the vicinity of the site location	Area disturbed by facility site activities, air emissions, noise, water sources and quantities, and wastewater discharge locations and quantities	Similar to measures used in evaluating other terrestrial and aquatic resources and habitats

B.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

B.7.1 Description of Affected Resources

Cultural resources are indications of human occupation and use of property as defined and protected by a series of Federal laws, regulations, and guidelines. For this *Mercury Storage EIS*, potential impacts were assessed separately for each of the cultural resource categories: prehistoric resources, historic resources, and American Indian resources. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geologic age and may be sources of information on ancient environments and the evolutionary development of plants and animals. Although not governed by the same historic preservation laws as cultural resources, paleontological resources could be affected by the proposed actions in much the same manner and have been assessed as appropriate.

Prehistoric resources are the physical remains of human activities that predate written records. They generally consist of artifacts that may either alone or collectively yield information about the past. Historic resources consist of physical remains that postdate the emergence of written records. In the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492. Ordinarily, sites less than 50 years old are not considered historic, but exceptions are made for properties of particular importance such as structures associated with World War II or Cold War themes. American Indian resources include sites, areas, and materials considered important to American Indians for religious or heritage reasons. Such interests may include geographic features, plants, animals, cemeteries, battlefields, trails, and environmental features. The ROI for the cultural and paleontological resource analysis encompasses the candidate mercury storage site locations that could potentially be disturbed by facility construction or modification and other activities and occupied during the operations of facilities for long-term mercury storage.

B.7.2 Description of Impact Assessment

The analysis of impacts on cultural and paleontological resources addressed potential direct and indirect impacts at each site location (see Table B–9).

Table B–9. Cultural and Paleontological Resources Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Prehistoric and historic resources	Prehistoric and historic resources within the vicinity of the site location	Location of facility on the site and facility acreage requirements	Potential for loss, isolation, or alteration of the character of prehistoric and historic resources; neglect of resources listed or eligible for listing in the National Register of Historic Places
American Indian resources	American Indian resources within the vicinity of the site location		Potential for loss, isolation, or alteration of the character of American Indian resources
Paleontological resources	Paleontological resources within the vicinity of the site location		Potential for loss, isolation, or alteration of paleontological resources

Potential indirect impacts include those associated with reduced access to a cultural resource site, as well as those associated with increased traffic and visitation to sensitive areas. Direct impacts include those resulting from mercury storage facility placement. Consultations were conducted with the appropriate State Historic Preservation Officers to comply with Section 106 of the National Historic Preservation Act (16 U.S.C. 470 et seq.). Correspondence offering consultation was sent to American Indian tribes local to each candidate site, as appropriate (see Chapter 5).

B.8 SITE INFRASTRUCTURE

B.8.1 Description of Affected Resources

Site infrastructure includes the physical resources and aspects composing the ground transportation and utility systems required to support mercury storage activities at each candidate site evaluated for long-term mercury storage. It specifically comprises the capacities of the (1) onsite road networks; (2) electric power transmission and distribution system; (3) natural gas and liquid fuel (i.e., fuel oil, diesel fuel, and gasoline) storage and conveyance systems; and (4) water supply system.

The ROI is generally limited to the boundaries of the candidate sites. However, should infrastructure requirements exceed site capacities, the ROI would be expanded (for analysis) to include the sources of additional supply. For example, if electrical demand (with added facilities) exceeded site availability, the ROI would be expanded to include the likely source of additional power (i.e., the electric power pool currently supplying the site).

B.8.2 Description of Impact Assessment

In general, utility infrastructure impacts were assessed by evaluating the requirements of each alternative, including associated activities and facility demands, against site capacities. Impacts were assessed for each utility infrastructure resource (electricity, fuel, and water) for the various alternatives (see Table B–10). Tables reflecting site availability and infrastructure requirements were developed for each alternative. Data for these tables were obtained from documentation describing the existing infrastructure at the candidate storage locations and from responses to information requests prepared to support this EIS.

Table B–10. Site Infrastructure Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Electricity (energy consumption) (megawatt-hours)	Site or facility area capacity and current usage	Activity and facility requirements	Additional requirement (with added facilities) exceeding site or facility area capacity
Fuel (natural gas, gasoline, diesel fuel[a]) (liters)			
Water (liters)			

[a] Includes No. 2 diesel fuel (road diesel) and heating fuel oil.

Any projected demand for infrastructure resources exceeding site availability can be regarded as an indicator of impact. Whenever projected demand approaches or exceeds capacity, further analysis of that resource is warranted. Often, design changes can mitigate the impact of additional demand for a given resource. For example, substituting fuel oil for natural gas (or vice versa) for heating or industrial processes can be accomplished at little cost during the design of a facility provided the potential for impact is identified early. Similarly, a dramatic “spike” in peak demand for electricity can sometimes be mitigated by changes to operational procedures or parameters.

Although ground transportation infrastructure is part of the physical infrastructure, incremental demands associated with the alternatives (e.g., new roadways to support project activities) were not separately quantified, but were assessed as part of the land use impacts analysis (see Section B.1.1.2). Note that the methodology for assessing local roadway traffic impacts, which are related to projected changes in facility site employment and local population, is described in Section B.11.2.

B.9 WASTE MANAGEMENT

B.9.1 Description of Affected Resources

Both hazardous and nonhazardous wastes can be expected to be generated in the process of storing and maintaining mercury over the long term. Certain mercury-bearing wastes are regulated as hazardous wastes under the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.) and would need to be managed in accordance with RCRA regulations. Other waste materials that would be generated could be classified as nonhazardous or hazardous waste. Definitions of these waste types are as follows:

- Hazardous – Under RCRA, a waste that, because of its characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes appear on special EPA lists or possess at least one of the following characteristics: ignitability, corrosiveness, reactivity, or toxicity.

- Nonhazardous – Discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations or community activities.

The mercury storage alternatives could have an impact on existing site waste management facilities. Thus, the ROI for waste management comprises the on- or offsite waste management facilities that could be impacted by waste generation at each mercury storage site. With the exception of some sanitary waste and possibly some construction waste, if suitable facilities exist on site, waste management activities and facilities are limited to collection and temporary storage of waste for offsite recycling, treatment, or disposal. Depending on the mercury storage facility location, leach fields, onsite treatment facilities, or municipal sewage treatment facilities would be used for sanitary sewage.

B.9.2 Description of Impact Assessment

As shown in Table B–11, impacts were assessed by comparing the projected waste stream volumes generated from the proposed activities at each candidate mercury storage site with that site's waste management capacities and generation rates. Projected waste generation rates for the proposed activities were compared with each site location's capacity to manage the waste, either on or off site.

Table B–11. Waste Management Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Waste management capacity Hazardous waste Nonhazardous waste	RCRA status Annual generation rate at facility location (cubic meters per year) for each waste type Offsite shipments (cubic meters per year) for each waste type Site location management capacities (cubic meters) or rates (cubic meters per year) for potentially affected management facilities for each waste type	RCRA status Annual generation rates from site activities associated with each candidate site for each waste type	Do additional hazardous waste generation or treatment activities change RCRA status? Combination of waste generation volumes from site activities and other site generation volumes in comparison with the capacities of applicable waste management facilities

Key: RCRA=Resource Conservation and Recovery Act.

B.10 SOCIOECONOMICS

B.10.1 Description of Affected Resources

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the proposed actions could affect regional employment, income, and expenditures. Job creation is generally characterized by two types: (1) construction-related jobs, which are transient in nature and limited in duration, and thus less likely to have a long-term socioeconomic impact and (2) operations-related jobs in support of the facility's mission, which are required for a longer period of time and have a greater potential for permanent socioeconomic impacts in the ROI. To accurately reflect the economic impacts of the proposed alternatives, the region that is supplying the direct requirements must be considered. The best gauge of the direct requirements is the region in which the workforce resides. Therefore, the ROI for socioeconomics comprises the counties in which approximately 90 percent of the site workers live. In cases where employee residential data by county are unavailable for the candidate site, a labor shed analysis of the area was performed using the U.S. Census Bureau's Local Employment Dynamics to determine where the majority of employees reside. The counties that define the socioeconomic ROI must also be contiguous due to the requirements set by the U.S. Bureau of Economic Analysis for developing regional input-output multipliers.

The socioeconomic environment generally includes regional economic indicators, demographic characteristics, and community services available in the area. Economic indicators include employment, the civilian labor force, and unemployment rates. Demographic and community service characteristics include population, housing, and local transportation information.

B.10.2 Description of Impact Assessment

For each county in the ROI, data were compiled on current socioeconomic conditions, including employment, the civilian labor force, and unemployment. Census Bureau data were compiled for population and housing. Census Bureau population estimates for the ROIs were combined with overall estimated workforce requirements for each alternative to determine the extent of impacts on regional economic and demographic (population) characteristics and local transportation impacts (see Table B–12).

Table B–12. Socioeconomics Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Regional Economic Characteristics			
Employment	Latest available employment estimates from the U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics	Estimated construction and operations activity staffing requirements and timeframes	Potential change in employment compared with the regional workforce
Demographic Characteristics			
Population and housing	Latest available estimates by county from the U.S. Census Bureau, Population Division, and the *American Community Survey*	Estimated effect on population as a result of employment	Potential effects on population
Local Transportation			
Traffic—number of vehicles	Latest available information on traffic volumes on each facility site's access roads, intrasite roads, and local regional transportation networks	Estimated number of commuter and truck vehicle trips to and from the site	Projected change in traffic conditions

A qualitative assessment was also conducted of the potential impact of facility siting on real estate property values. There are many obstacles in attempting to estimate the impact on residential property values of homes in communities surrounding any industrial or hazardous waste storage facility. What little data exist on the subject suggest it is difficult to make generalizations, and impacts of the magnitude and direction of property values are highly dependent on the individual characteristics of each type of facility. There have been several studies that attempt to analyze the impacts on property values of "Superfund" sites under the Comprehensive Environmental Response, Compensation, and Liability Act. These have yielded mixed results. In some cases, analysis has shown that the stigma created from such sites has caused property values closer to the site to decrease, some have shown an increase in value due to the potential for well-paying jobs, while many others have shown there to be no impact. DOE has worked with the public throughout the EIS process to facilitate understanding of the potential risks presented by the elemental mercury storage alternatives so that opinions can be formulated based on facts rather than perception. The primary factor in determining the impact on property values from a facility is the perceived risk to human health imposed on residents of a property in close proximity to that facility. As presented in the "Occupational and Public Health and Safety" sections of Chapter 4, normal (routine) operations of a mercury storage facility would result in little risk of environmental contamination due to the design and safety parameters put in place. Similarly, the human health risk to the offsite population would be negligible. Furthermore, DOE, the U.S. Department of Defense, and private companies have safely stored mercury for more than 50 years. The mercury storage facility(ies) would have the appearance of a warehouse(s), so there would be little visible evidence of hazardous waste storage activities.

B.11 ENVIRONMENTAL JUSTICE

B.11.1 Description of Affected Resources

Environmental justice assesses the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations resulting from implementation of the alternatives in this *Mercury Storage EIS*. The Census Bureau publishes annual population estimates through the *American Community Survey*: 1-year estimates and 3-year estimates for geographic areas with population thresholds of 65,000 and 20,000, respectively. The most recent demographic data available are presented for the counties surrounding each candidate storage location. When attempting to identify disproportionately high minority and low-income populations residing in the ROI, 2000 decennial census data are used to provide greater spatial resolution, as discussed below. In assessing the impacts, the following definitions of minority individuals and populations and low-income populations were used.

- Minority individuals are identified as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, or two or more races.

- Minority populations are identified where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

- Low-income populations are identified in an affected area using the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P60 on Consumer Income, *Poverty in the United States: 1999*, No. P60-210 (DOC 2000). For example, the poverty threshold in 1999 for one individual was $8,501. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another or a set of individuals (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect.

- The ROI for the environmental justice analysis was defined as those minority and low-income populations residing within a 16-kilometer (10-mile) radius centered on the candidate mercury storage sites. The radius was selected to provide a comparative basis for analysis across all sites, including all DOE sites where a smaller radius might not capture members of the public off site. An additional ROI of those residing within an approximately 3.2-kilometer (2-mile) radius of each candidate site was used as a subset of the 16-kilometer (10-mile) ROI in order to guard against inadvertently diluting represented minority and low-income populations most likely to experience any potentially adverse impacts associated with mercury storage. In areas where a disproportionately high number of minority or low-income individuals were identified, environmental justice concerns were considered in greater detail. In these areas, additional efforts were made to identify potentially susceptible populations. Such populations may include children, the elderly, and the medically underserved.

Tables B–13 and B–14 present the thresholds used for identifying minority and low-income populations surrounding the candidate mercury storage sites. These thresholds were developed consistent with CEQ guidance (CEQ 1997:25) for identifying minority populations, as described above, using either the 50 percent threshold or another percentage deemed "meaningfully greater" than the percentage of minority or low-income individuals in the general population. "Meaningfully greater" is defined here as 20 percentage points higher than the percentage of minority or low-income individuals in the general population. The general population percentage of minority or low-income individuals is defined in this analysis as the lower of the average percentage of minority or low-income individuals living in the counties that are at least partially included within the ROI or living in the state(s) in which the ROI lies. The geographic area with the lower percentage of minority or low-income individuals is used to provide for greater conservatism. As the tables show, the thresholds of the two ROIs differ in some cases due to changes in the geographic areas included in the general population percentage, as defined above. Sites not included in Tables B–13 and B–14 have no such populations within the specified radius of the site.

Table B–13. Site-Specific Thresholds for Identification of Minority and Low-Income Populations Within the 16-Kilometer (10-Mile) Region of Influence

Population	Grand Junction Disposal Site	Hawthorne Army Depot	Idaho National Laboratory	Kansas City Plant	Savannah River Site	Waste Control Specialists, LLC	Y–12 National Security Complex
Minority population	33.2%	49.9%	32.0%	36.5%	50.0%	50.0%	30.4%
Low-income population	29.3%	30.5%	31.8%	29.2%	33.4%	35.6%	32.7%

Note: The highlighted thresholds indicate the state(s) as the lower general population percentage.

Table B–14. Site-Specific Thresholds for Identification of Minority and Low-Income Populations Within the 3.2-Kilometer (2-Mile) Region of Influence

Population	Grand Junction Disposal Sites	Kansas City Plant	Waste Control Specialists, LLC	Y–12 National Security Complex
Minority population	33.0%	36.2%	50.0%	27.3%
Low-income population	29.3%	31.7%	35.6%	33.1%

Note: The highlighted thresholds indicate the state(s) as the lower general population percentage.

B.11.2 Description of Impact Assessment

The environmental justice analysis focused on potential health risks resulting from normal operations and accidents that could occur during activities associated with implementation of the alternatives for mercury storage. Low-income and minority populations-at-risk are composed of the low-income and minority sub-populations identified within the general population subject to mercury exposures that could result from such accidents. The consequences and risks of postulated accidents are identical to those used in the human health impacts analysis.

The CEQ issued its guidance for evaluation of environmental justice in December 1997, *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997). The CEQ's guidance was used as the basis for this evaluation of environmental justice (see Table B–15).

The analysis of environmental justice used block group spatial resolution. Demographic data are aggregated by the Census Bureau in a variety of ways that include states, counties, census tracts, block groups, and blocks. Block groups provide the finest spatial resolution available for evaluation of low-income populations. The boundaries of block groups generally do not coincide with boundaries of the potentially affected area. As a result, some block groups will lie partially inside and partially outside of the potentially affected area. To estimate the at-risk population residing in partially included blocks groups, it was assumed that the population of partially included block groups is uniformly distributed. Thus, if “X” percent of a block group lies within the potentially affected area, then it is assumed that “X” percent of the population of that block group is at risk.

Table B–15. Environmental Justice Impact Assessment Protocol

Resource	Required Data: Affected Environment	Measure of Impact
Minority populations	Latest baseline demographic data with block group resolution from the U.S. Census Bureau’s 2000 decennial census, Summary File 1 (DOC 2009a).	Disproportionately high and adverse impacts on minority and low-income populations are identified where health effects, measured in risks and rates, are significant or above generally accepted norms, and where the risk or rate of hazard exposure to a minority or low-income population appreciably exceeds the risk or rate to the general population. Impacts are determined based on the results from the occupational and public health and safety risk analysis, land use, cultural and paleontological resources, socioeconomics, and other resource area impact analyses, as appropriate.
Low-income populations	Latest baseline demographic data with block group resolution from the U.S. Census Bureau’s 2000 decennial census, Summary File 3 (DOC 2009b).	

B.12 CUMULATIVE IMPACTS

B.12.1 Description of Affected Resources

The cumulative impacts analysis discusses potential impacts resulting from other facilities, operations, and activities that, in combination with the potential impacts of each proposed alternative, may contribute to cumulative impacts. Cumulative impacts are impacts on the environment that result from the incremental impact of each proposed alternative when added to other past, present, and reasonably foreseeable future actions, regardless of the agency (Federal or non-Federal) or person that undertakes other such actions (40 CFR 1508.7). Although uncertainties may exist with respect to identifying reasonably foreseeable future actions, CEQ regulations allow for the inclusion of uncertainties in the analysis provided that the agency preparing the EIS makes it clear that incomplete or unavailable information was used in the analysis (40 CFR 1502.22). A “reasonably foreseeable future action,” as used in this analysis, includes those actions with a high probability of being implemented.

Because cumulative impacts accrue to resources, the analysis of impacts must focus on specific resources or impact areas as opposed to merely aggregating all of the actions occurring in and around the proposed facilities and attempting to form conclusions regarding the effects of the many unrelated actions. Narrowing the scope of the analysis to resources that are likely to accrue impacts from the proposed action and other past, present, and reasonably foreseeable actions also supports the intent of the National Environmental Policy Act process, which is “to reduce paperwork and the accumulation of extraneous background data; and to emphasize real environmental issues and alternatives” (40 CFR 1500.2(b)).

B.12.2 Description of Impact Assessment

The cumulative impacts analysis for this *Mercury Storage EIS* involved combining the impacts of the action alternatives on each resource area with the impacts of other present and reasonably foreseeable activities within a 16-kilometer (10-mile) ROI. Potential contributions to cumulative impacts at non-DOE mercury storage sites under the No Action Alternative were not evaluated because potential locations of and impacts at mercury storage sites are highly speculative. DOE's Y–12 National Security Complex was not evaluated since, under the No Action Alternative, no change is expected to occur at the site relative to mercury management and storage.

The general approach to the analysis involved the following process:

- Baseline impacts from past and present actions were identified (i.e., these are the baseline conditions described in Chapter 3).
- The potential impacts produced by the management and storage alternatives were identified (as described in Chapter 4, Sections 4.3 through 4.9).
- Reasonably foreseeable future actions were identified.
- Cumulative impacts of the proposed action at the candidate mercury storage sites were estimated.

Reasonably foreseeable future actions that may contribute to cumulative impacts include on- and offsite projects conducted by government agencies, businesses, or individuals that are within the 16-kilometer (10-mile) ROI considered in this *Mercury Storage EIS*. Information on these actions was gathered based on a review of local (i.e., city and county) and Federal government information, as well as any known plans in the private sector. Additionally, National Environmental Policy Act documents were reviewed to determine if the actions they describe could affect the cumulative impacts analysis.

In keeping with CEQ regulations (40 CFR 1500.7), those resource areas that were predicted to be impacted in at least a minor way were evaluated for their potential to contribute to cumulative impacts within the ROI. Where impacts were predicted not to occur or were negligible, cumulative impacts were generally not analyzed since there would be either no, or only a very small incremental increase in impacts on the resource within the ROI. One additional criterion used to determine whether impacts could be cumulative was new construction, that is, if there would be new land disturbance.

Finally, a qualitative assessment was performed to consider the mercury storage alternatives' potential incremental contributions to the public's exposure to small amounts of mercury vapor, to ozone depletion, and to global climate change.

B.13 REFERENCES

CEQ (Council on Environmental Quality), 1997, *Environmental Justice Guidance Under the National Environmental Policy Act*, Executive Office of the President, Washington, D.C., December 10.

DOC (U.S. Department of Commerce), 2000, Current Population Reports, Series P60 on Consumer Income, *Poverty in the United States: 1999*, No. P60-210, U.S. Census Bureau, Washington, D.C., September.

DOC (U.S. Department of Commerce), 2009a, *United States Census 2000, Summary File 1 (SF 1*), U.S. Census Bureau, accessed through http://www.census.gov/Press-Release/www/2001/sumfile1.html.

DOC (U.S. Department of Commerce), 2009b, *United States Census 2000, Summary File 3 (SF 3*), U.S. Census Bureau, accessed through http://www.census.gov/Press-Release/www/2002/sumfile3.html.

DOE (U.S. Department of Energy), 2004, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, 2nd ed., Office of NEPA Policy and Compliance, Washington, D.C., December.

DOI (U.S. Department of Interior), 1986, *Visual Resource Contrast Rating*, BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, D.C., January 17.

EPA (U.S. Environmental Protection Agency), 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, Office of Noise Abatement and Control, Washington, D.C., March.

Petersen, M.D., et al., 2008, *2008 United States National Seismic Hazard Maps*, U.S. Geological Survey Fact Sheet 2008–3018, April, accessed through http://pubs.usgs.gov/fs/2008/3018/pdf/FS08-3018_508.pdf.

USGS (U.S. Geological Survey), 2009a, *Earthquake Hazards 201 — Technical Information, What is probabilistic ground motion?, A Simple Description of Seismic Hazard Maps*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/research/hazmaps/haz101/faq/psha01.php, January 29.

USGS (U.S. Geological Survey), 2009b, *Earthquake Hazards 201 — Technical Information, What is probabilistic ground motion?, Uses for the Seismic Hazard Maps*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/research/hazmaps/haz101/faq/psha02.php, January 29.

USGS (U.S. Geological Survey), 2009c, *2008 United States National Seismic Hazard Maps, 2008 NSHM Figures (Static Maps)*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/research/hazmaps/products_data/2008, April 14.

USGS (U.S. Geological Survey), 2009d, *FAQ Measuring Earthquakes, What are the earthquake magnitude classes?, What is intensity?, What is the Modified Mercalli Intensity Scale?, What is the difference between intensity scales and magnitude scales?, What are the different magnitude scales, and why are there so many?*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/learning/faq/?categoryID=2, June 9.

USGS (U.S. Geological Survey), 2009e, *Earthquake Topics – Intensity, Magnitude/Intensity Comparison*, Earthquake Hazards Program, Earthquake Topics Page, accessed through http://earthquake.usgs.gov/learning/topics/mag_vs_int.php, February 18.

Wald, D.J., V. Quitoriano, T.H. Heaton, and H. Kanamori, 1999, *Earthquake Spectra*, "Relationships Between Peak Ground Acceleration, Peak Ground Velocity and Modified Mercalli Intensity in California," Vol. 15 (3), pp. 557–564, accessed through www-socal.wr.usgu.gov/shake/pubs/regress/regress.html.

Code of Federal Regulations

7 CFR 657.5, U.S. Department of Agriculture, "Identification of Important Farmlands."

7 CFR 658.2, U.S. Department of Agriculture, "USDA Assistance with Federal Agencies' Reviews of Policies and Procedures."

7 CFR 658.3, U.S. Department of Agriculture, "Applicability and Exemptions."

10 CFR 1022, U.S. Department of Energy, "Compliance with Floodplain and Wetland Environmental Review Requirements."

33 CFR 328.3, Army Corps of Engineers, U.S. Department of the Army, "Definition of Waters of the United States."

40 CFR 50, U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR 51.165, U.S. Environmental Protection Agency, "Permit Requirements."

40 CFR 51.850–51.860, U.S. Environmental Protection Agency, "Determining Conformity of General Federal Actions to State or Federal Implementation Plans."

40 CFR 61, U.S. Environmental Protection Agency, "National Emission Standards for Hazardous Air Pollutants."

40 CFR 81, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes."

40 CFR 1500–1508, U.S. Environmental Protection Agency, "Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act."

United States Code

7 U.S.C. 4201 et seq., Farmland Protection Policy Act of 1981.

16 U.S.C. 470 et seq., National Historic Preservation Act of 1966.

16 U.S.C. 1531 et seq., Endangered Species Act of 1974.

33 U.S.C. 1251 et seq., Clean Water Act of 1972.

42 U.S.C. 300(f) et seq., Safe Drinking Water Act of 1974.

42 U.S.C. 6901 et seq., Resource Conservation and Recovery Act of 1976.

42 U.S.C. 7401 et seq., Clean Air Act of 1970.

42 U.S.C. 7472 et seq., Prevention of Significant Deterioration of Air Quality.

Executive Order

Executive Order 11988, *Floodplain Management*, May 24, 1997, as amended.

U.S. Department of Energy Guides, Orders, and Standards

DOE Order 420.1B, *Facility Safety*, December 22, 2007.

DOE Guide 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*, March 28, 2000.

DOE Standard 1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, January 2002.

DOE Standard 1023-95, *Natural Phenomena Hazards Assessment Criteria*, April 2002.

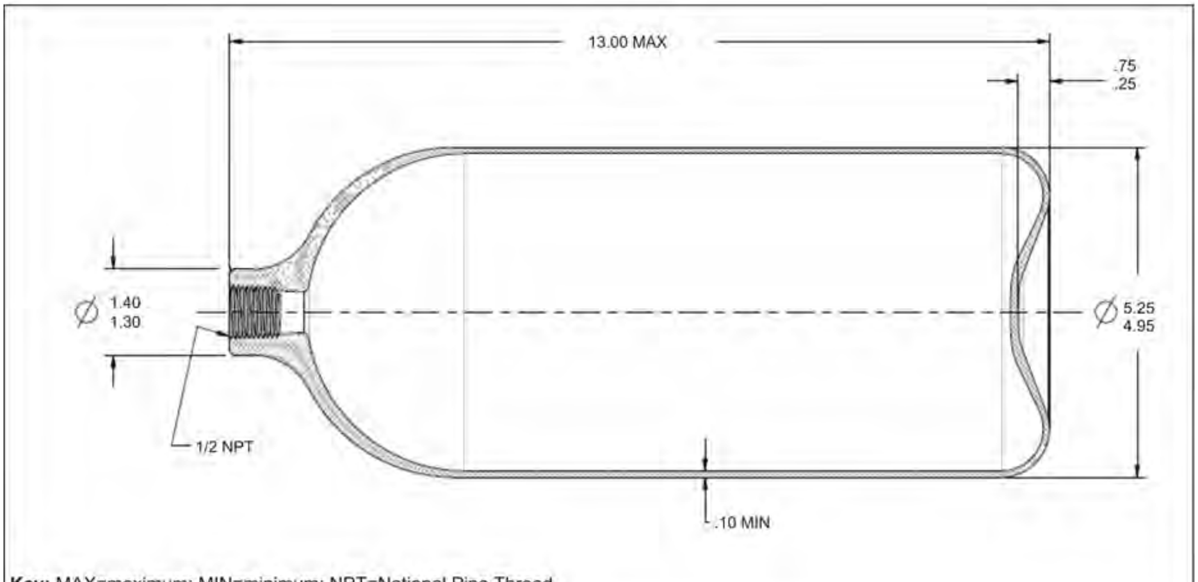
APPENDIX C
STORAGE FACILITY CONSTRUCTION AND OPERATIONS DATA

This appendix presents data on construction and operations of a mercury storage facility analyzed in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement*. Section C.1 provides data related to the transportation of elemental mercury to the storage facility. Section C.2 provides background information regarding design criteria, a general description of physical characteristics, and construction and operations data for new and existing facilities that would be used to store mercury at each site.

C.1 TRANSPORTATION REQUIREMENTS

Two acceptable container types for the mercury storage facility are 3-liter (3-L) (34.6-kilogram [76-pound]) flasks and 1-metric-ton (1-MT) (1.1-ton) containers. Figure C–1 illustrates the dimensions of a typical 3-L flask and Figure C–2 illustrates the dimensions of a typical 1-MT container. Other containers may be accepted for storage on a case-by-case basis. All containers are subject to U.S. Department of Transportation regulations regarding the transportation of mercury.

The 3-L flasks would be transported in pallets; such pallets may have a built-in spill tray. Each pallet would contain up to a maximum of 49 3-L flasks in a 7- by 7-flask configuration, not to exceed 1.4 meters (4.7 feet) on a side. The 3-L flasks could also be shipped in quantities of less than 49 per pallet. Full-size pallets (containing 49 3-L flasks) would be shipped “ready” for storage upon passing inspection and satisfying acceptance criteria. Smaller loads (pallets containing less than 49 3-L flasks) would be consolidated in the Handling Area at the U.S. Department of Energy (DOE) facility for efficient storage. Noncombustible (i.e., metal) or fire-resistant wooden pallets are recommended as a best management practice over non-fire-resistant wooden pallets (DOE 2009a). An example of typical shipment of a full-size pallet of 49 3-L flasks is provided in Figure C–3.



Key: MAX=maximum; MIN=minimum; NPT=National Pipe Thread.
Note: To convert inches to centimeters, multiply by 2.54.

Figure C–1. Dimensions of a Typical 3-Liter Flask (inches)

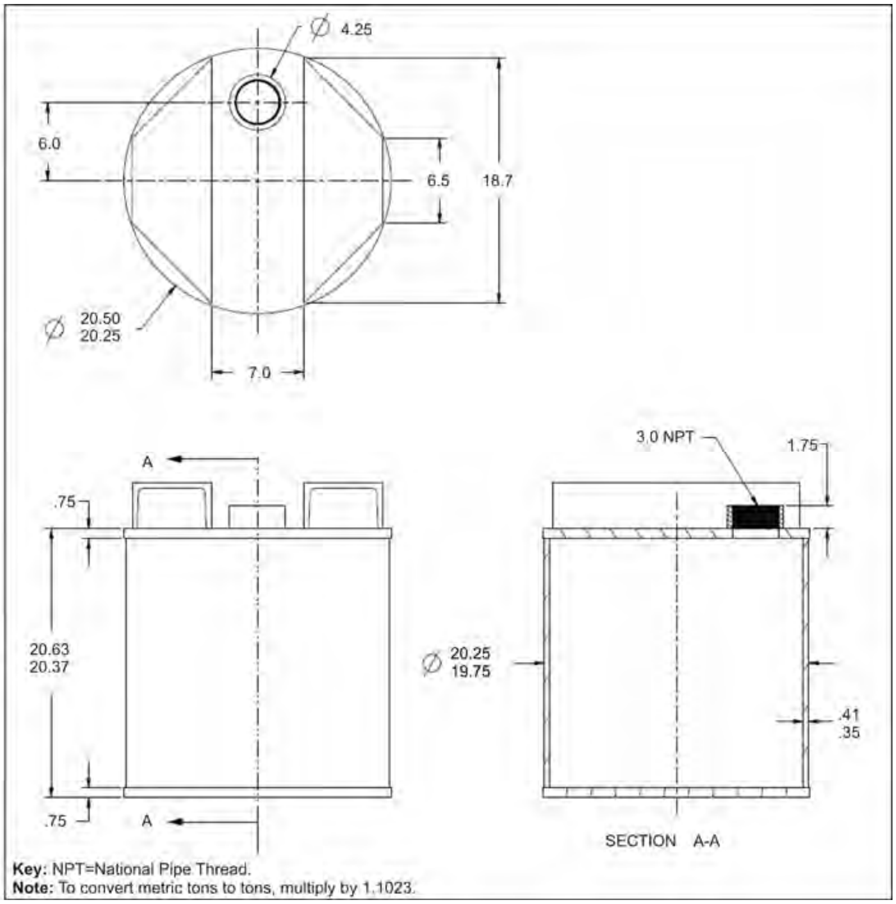


Figure C–2. Dimensions of a Typical 1-Metric-Ton Container (inches)

Figure C–3. Example Box Pallet for Shipping 3-Liter Flasks in a 7-Flask by 7-Flask Configuration

The 1-MT containers would also be shipped on box pallets; however, there would be only one container per pallet. Each pallet would be constructed of wood or metal, similar to the 3-L flask pallets. Once received and visually inspected for integrity, the 1-MT containers would be removed from their shipping pallets and placed in a spill tray in long-term storage. The transportation pallets would be returned to the generator for reuse, if requested. Each spill tray would accommodate eight 1-MT containers in a 2-container by 4-container configuration (DOE 2009a).

DOE makes the following assumptions regarding the availability of surplus mercury for storage:

- All or a portion of DOE's surplus mercury inventory of approximately 1,200 metric tons (1,300 tons) currently in storage at the Y–12 National Security Complex (Y–12) is being considered for transfer to the long-term mercury storage facility.
- The remaining chlor-alkali facilities would close by 2020, yielding approximately 1,100 metric tons (1,210 tons) of mercury that would be shipped to the long-term mercury storage facility.
- Shipments from mining would yield approximately 4,900 metric tons (5,400 tons) of mercury that would be shipped to the long-term mercury storage facility.
- Shipments from reclamation and recycling facilities would yield approximately 2,800 metric tons (3,090 tons) of mercury that would be shipped to the long-term mercury storage facility.

DOE makes the following assumptions regarding the quantities of mercury and when this mercury would be shipped to the long-term mercury storage facility:

- Years 2013–2014: A total of approximately 950 metric tons (1,050 tons) would be delivered per year from Y–12 (if the decision is made to transfer the Y–12 mercury inventory to the new storage facility), chlor-alkali facilities, mines, and reclamation and recycling facilities.
- Years 2015–2019: A total of approximately 350 metric tons (390 tons) would be delivered per year from chlor-alkali facilities, mines, and reclamation and recycling facilities.
- Years 2020–2052: A total of approximately 190 metric tons (210 tons) would be delivered per year from mines and reclamation and recycling facilities.

DOE makes the following assumptions regarding the transportation of mercury:

- A fully loaded truck can carry 9 pallets of 49 3-L flasks or 14 1-MT containers, and a fully loaded railcar can carry 24 pallets of 49 3-L flasks or 54 1-MT containers.
- Y–12 mercury would be shipped in 3-L flasks, mercury from chlor-alkali facilities would be shipped in 1-MT containers, and mercury from mines and reclamation and recycling facilities would be shipped in 3-L flasks and/or 1-MT containers.

Based on the above-mentioned assumptions and assuming fully loaded trucks or railcars, the number of shipments that would be required are listed below. However, it can be reasonably expected that some shipments would be smaller and not necessarily on fully loaded trucks or railcars.

- Years 2013–2014: It is expected that 63 truck or 24 rail deliveries would be made per year from Y–12, chlor-alkali facilities, mines, and reclamation and recycling facilities.
- Years 2015–2019: It is expected that 23 truck or 9 rail deliveries would be made per year from chlor-alkali facilities, mines, and reclamation and recycling facilities.
- Years 2020–2052: It is expected that 13 truck or 5 rail deliveries would be made per year from mines and reclamation and recycling facilities.

C.2 MERCURY STORAGE FACILITIES

C.2.1 Introduction

The *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury (Interim Guidance)* (DOE 2009a) serves as a basis for developing the design and operational parameters for a new mercury storage facility or existing building structures. For some criteria, construction and operations data for similar storage facilities were used to supplement the information taken from the *Interim Guidance*. In locations where existing facilities are proposed, data are evaluated against the description of a generic facility to determine what, if any, modifications or upgrades are likely to be required and whether sufficient long-term storage space can be provided.

The DOE mercury storage facility would include the following four major physical areas that would provide the necessary functions for receipt, inspection, and long-term storage of mercury (DOE 2009a):

- **Receiving and Shipping Area.** This area would include dedicated space(s) for the receipt, inspection, and handling of mercury containers. It would allow for truck docking, offloading, inspection, and transfer of received mercury to the facility. It would also allow for inspection, packaging, marking, manifesting, and truck docking and loading for shipments of secondary waste out of the DOE storage facility. It would be adjacent to the Handling and Storage Areas.

- **Handling Area.** This area would include dedicated space(s) for acceptance/verification of incoming containers and for work involving potential contamination, including (1) safely handling and cleaning of palletized or individual containers that have external mercury contamination, and/or (2) repackaging of mercury from containers that have failed inspection. This area is needed for non-routine and emergency response activities for leaking flasks and/or containers. The area would be enclosed and have filtered ventilation. All exhausted air would be filtered (e.g., sulfur) to remove mercury vapors.

- **Storage Area.** This area would include dedicated space for the storage of mercury containers. Composing the bulk of the facility, this enclosed area would have ample storage and aisle space for careful, tracked placement and retrieval of all containers (e.g., 3-L and 1-MT capacity). The area would be well lit, with appropriate ventilation, spill containment, and fire protection measures. Although sufficient forced ventilation would be provided in all Storage Areas, conditioned air would not be required. Note that the Storage Area(s) may be constructed in a modular fashion to accommodate mercury inventories as they become available for storage.

- **Office Administration Area.** This area would include the management, operations, training, and all other administration functions supporting the overall mercury program. Examples include the storage and maintenance of records, waste verification documents, shipping papers, and databases. It should not be located within a hazardous area and would preferably be separated from the other three facility areas.

Key features of a Resource Conservation and Recovery Act (RCRA)–permitted facility used for the storage of elemental mercury include the following:

- **Location and Siting.** The selection of siting for construction of a new facility or evaluation of an existing facility would consider environmentally sensitive locations or conditions such as the existence of floodplains, wetlands, groundwater, seismic zones, karst soils or other unstable terrain, local weather phenomena, or incompatible land use.

- **Security.** At a minimum, facility security would meet the requirements for a DOE Property Protected Area, as outlined in DOE Manual 470.4-2A, *Physical Protection*. The facility would be located in an area under the control and authority of DOE and would prevent inadvertent or deliberate unauthorized access to the facility and the Storage Area(s). The facility would have a perimeter barbed-wired fence to control unauthorized access. Remote surveillance may also be employed, where necessary.

- **Containment.** The Storage Areas of the facility would be designed to properly contain any release of mercury. This would include the use of spill trays, properly sloped floors, and floors constructed to be impervious to liquid mercury releases. The facility walls and ceiling would be constructed of sufficient quality and design to shield the stored mercury from weather elements and ensure that mercury is not entrained in stormwater runoff.

- **Ventilation.** The Handling Area would be ventilated through the use of a high-negative draw system for removing high-concentration vapors from mercury "sources" (e.g., container residues, open containers, small spills). The exhaust air would pass through a mercury vapor filter (e.g., sulfur) and be discharged to the outside. A wall-mounted air conditioning unit would be available for maintaining interior temperatures below 70 degrees Fahrenheit during times when mercury is being handled to keep its volatility low. The Storage Area would be ventilated using low-vacuum, high-volume, industrial-sized roof- or wall-mounted fans sized to provide multiple air exchanges over a short period of time and to evacuate low-concentration vapors that may accumulate in the storage spaces over time. These fans would operate on an as-needed basis prior to and during occupancy.

- **Fire Protection.** The facility would be outfitted with fire detection systems such as smoke and heat detectors, as well as a permanent fire suppression system. The fire suppression system would be a conventional wet- or dry-charge water sprinkler system augmented with readily accessible fire extinguishers.

- **Emergency Response.** The Handling Area would be designed for responding to small spills that might occur or for transferring mercury from corroding or leaking containers or from containers that have failed inspection upon arrival at the facility to new containers prior to placing them in storage. Emergency response procedures would be developed for larger releases of mercury.

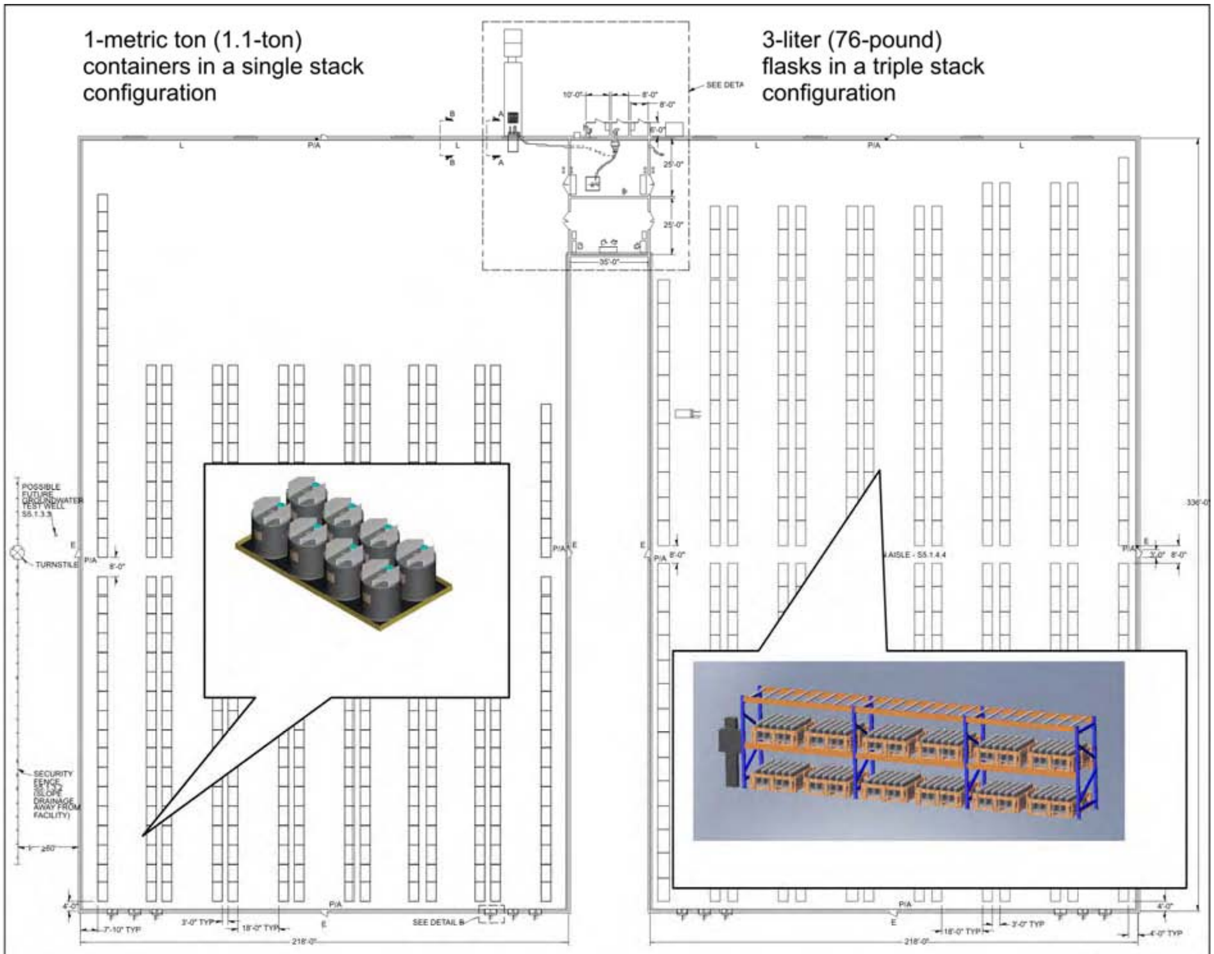
- **Monitoring.** The facility would conduct mercury vapor monitoring for the detection of any unplanned releases of mercury or deterioration of flask or container integrity. Weekly inspections of containers in long-term storage would incorporate air sampling.

- **Record-Keeping.** Training records, waste receipts, inspection reports, laboratory analysis, response plans, monitoring data, etc., would be maintained in the Office Administration Area.

C.2.2 Physical Description

Construction of a new storage facility is being evaluated at the following locations: (1) the Grand Junction Disposal Site, (2) the Central Waste Complex in the 200-West Area at the Hanford Site, (3) the Idaho Nuclear Technology and Engineering Center at Idaho National Laboratory, (4) E Area at the Savannah River Site, and (5) the main facilities area at Waste Control Specialists, LLC.

Figure C–4 provides a potential conceptual layout for a generic, full-size new mercury storage facility. Figure C–5 provides detail for the Receiving and Shipping Area and Handling Area.



Source: DOE/ORNL 2009. **Note:** Not to scale.

Figure C–4. Conceptual Layout for a New Mercury Storage Facility

Existing facilities that are being evaluated for storage of mercury include (1) the Transuranic Storage Area in the Radioactive Waste Management Complex at Idaho National Laboratory, (2) the Central Magazine Area at Hawthorne Army Depot, and (3) the Main Manufacturing Building at the Kansas City Plant.

The Waste Control Specialists, LLC, Container Storage Building, an RCRA-permitted facility for the storage of hazardous waste, could be used on an interim basis to store a limited amount of mercury pending construction of a new facility. The Container Storage Building would be capable of storing approximately 2,000 metric tons (2,200 tons) of mercury, if necessary.

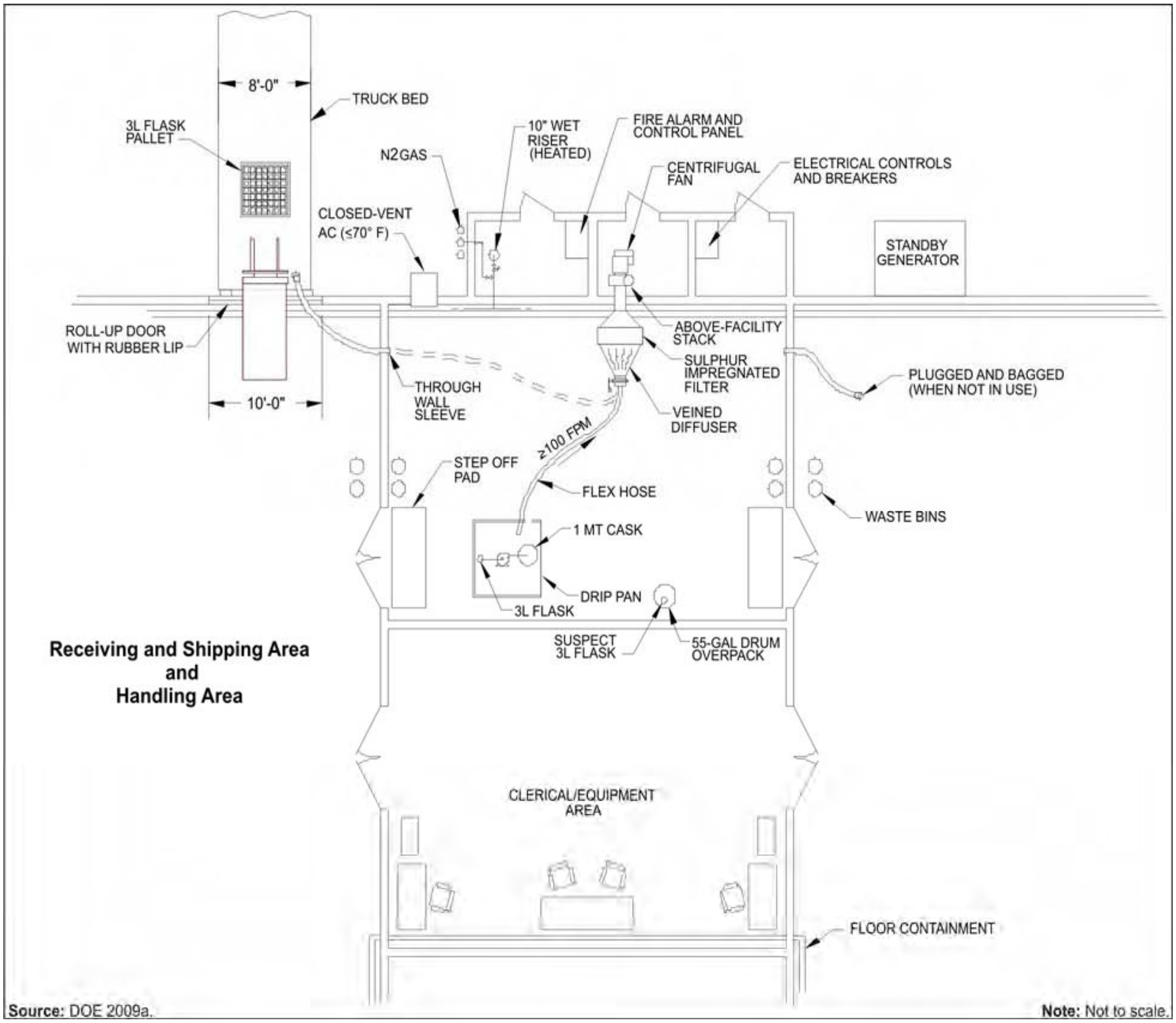


Figure C–5. Conceptual Schematic for Receiving and Shipping Area and Handling Area of a New Mercury Storage Facility

Table C–1 provides general physical data for the construction of a generic, new facility or the existing facility options for the storage of elemental mercury.

Table C–1. Data for a Mercury Storage Facility – New Construction and Existing Buildings

Parameter	New Facility[a]	RWMC - INL	HWAD	KCP	CSB - WCS[b]
Facility Footprint	20,500 square meters (220,600 square feet)	Within existing DOE complex.	Within existing DoD complex.	Within existing DOE complex.	Within existing commercial complex.
RCRA Permitted for Storage of Hazardous Waste	Yes; would be permitted.	Yes; currently permitted for storage of mixed transuranic waste.	No	No; currently regulated as RCRA large-quantity generator.	Yes
Building Dimensions (length × width)	154×102 meters (506×336 feet)	61×43 meters (200×140 feet) (each facility)	61×15 meters (200×50 feet) (each facility)	Contiguous storage space is within a larger manufacturing building.	58×51 meters (90×166 feet)
Ceiling Height	6.1 meters (20 feet)	7.3 meters (24 feet)	4.5 meters (14 feet, 8 inches)	9.8 meters (32 feet)	7.6 meters (25 feet)
Number of Buildings	1	Up to 7	Up to 29	1	1
Total Space Dedicated to Storage	13,610 square meters (146,500 square feet)	Up to 19,000 square meters (205,000 square feet)	Up to 26,940 square meters (290,000 square feet)	14,000 square meters (150,000 square feet) Note: Additional space could be available if current tenants relocate as planned.	2,650 square meters (28,500 square feet)
Building Construction	Structural steel frame on reinforced-concrete slab and sheet metal shell; epoxy-sealed floor.	Prefabricated modular buildings (uninsulated) on curbed-concrete slab; sheet metal roof and siding, epoxy-sealed floor.	Concrete floor, walls, and support columns with steel roof trusses and transite roofing.	Structural steel and concrete masonry unit with reinforced-concrete floors, brick exterior façade, and mopped and gravel roof system.	Enclosed, commercial-grade metal building erected on a reinforced-concrete foundation with 60-centimeter-diameter (24-inch-diameter) piers.
Floor Thickness	30 centimeters (12 inches)	20 centimeters (8 inches)	15 centimeters (6 inches)	30 centimeters (12 inches)	15 centimeters (6 inches)
Rail Access	Yes, with exception of Grand Junction Disposal Site location.	Yes	Yes	Yes	Yes

Table C–1. Data for a Mercury Storage Facility – New Construction and Existing Buildings *(continued)*

Parameter	New Facility[a]	RWMC - INL	HWAD	KCP	CSB - WCS[b]
Access/Security	Security measures would prevent inadvertent or deliberate unauthorized access to the facility and Storage Area(s). Examples would include physical barriers such as perimeter barbed-wire fence, remote interior and exterior surveillance, and/or security personnel.	Facility is located within a restricted area with perimeter fence used to restrict access and personnel security 24 hours per day, 7 days a week.	Facility is located within a restricted area with perimeter fence used to restrict access and personnel security 24 hours per day, 7 days per week.	Perimeter fence and security gates; current tenants are expected to relocate by 2014.	Facility is located within a larger hazardous waste storage complex with perimeter fence and gated access.
Required Building Modifications	New facility would be designed and built to desired specifications.	• Reapply epoxy sealant to floor. • Service rail spur into RWMC, if transportation by rail is used.	• Potentially reinforce floor. • Apply epoxy sealant or geomembrane liner to floor. • Install spill control curbing. • Install and provide utilities. • Service rail spur to Central Magazine Area, if transportation by rail is used.	• Reapply sealant to floor. • Upgrade ventilation systems. • Service rail spur into KCP, if transportation by rail is used.	• No notable modifications expected to be required.

[a] Data for new facility construction would be similar regardless of location and would include the Grand Junction Disposal Site, the 200-West Area at the Hanford Site, Idaho Nuclear Technology and Engineering Center at INL, E Area at the Savannah River Site, and WCS in Andrews County, Texas.

[b] The CSB at WCS could store approximately 2,000 metric tons (2,200 tons) of mercury on an interim basis, if necessary, until construction of a new facility is completed.

Key: CSB=Container Storage Building; DoD=U.S. Department of Defense; DOE=U.S. Department of Energy; HWAD=Hawthorne Army Depot; INL=Idaho National Laboratory; KCP=Kansas City Plant; RCRA=Resource Conservation and Recovery Act; RWMC=Radioactive Waste Management Complex; WCS=Waste Control Specialists, LLC.

Source: DLA 2004; DOE 2009a, 2009b; SAIC 2009a, 2009b.

C.2.3 Construction Data

Resource commitments for new facility construction at the Grand Junction Disposal Site, 200-West Area at the Hanford Site, Idaho Nuclear Technology and Engineering Center at Idaho National Laboratory, E Area at the Savannah River Site, or at Waste Control Specialists, LLC, would be similar regardless of location and are presented in Table C–2. DOE expects that construction of a new mercury storage facility would require approximately 6 months to complete. Construction resource commitments for modifications to existing buildings at the Radioactive Waste Management Complex at Idaho National Laboratory, the Hawthorne Army Depot, the Kansas City Plant, and Waste Control Specialists, LLC (i.e., Container Storage Building), are assumed to be minor and would require negligible resources when compared with those required for new facility construction. Specific modifications that may be required for each proposed existing building were previously described in Table C–1.

Table C–2. Resource Commitments for Construction of a New Mercury Storage Facility[a]

Resource	Quantity
Land Use	
Land disturbance	3.1 hectares (7.5 acres)
Labor	
Man hours	18,500
Materials	
Concrete	4,755 cubic meters (6,220 cubic yards)
Gravel (crushed stone)	3,875 cubic meters (5.070 cubic yards)
Asphalt	670 cubic meters (872 cubic yards)
Steel	2,700 metric tons (2,970 tons)
Epoxy sealant	2,400 liters (6,330 gallons)
Utilities	
Water (non-potable)	1,270,000 liters (325,000 gallons)
Water (potable)	40,900 liters (10,800 gallons)
Diesel	193,000 liters (51,000 gallons)
Gasoline	0 liters (0 gallons)
Electricity	0 megawatt-hours
Waste	
Nonhazardous construction debris	270 cubic meters (355 cubic yards)
Nonhazardous liquid waste (sanitary wastewater)	9,850 liters (2,600 gallons)

[a] Duration of construction would be 6 months.
Source: DOE 2009a; SAIC 2009b.

The construction of a new facility would generate air emissions from the use of heavy equipment and the disturbance of soils from grading and site preparation. Typical heavy equipment that might be used would include dump trucks, cement trucks, dozers, graders, spreaders, compactors, cranes, etc. Air emissions from vehicle exhaust would be dependent on frequency of use, fuel efficiency, and fuel type. Particulate air emissions would be dependent on the amount of exposed land and the duration of exposure. Based on the relevant factors and an estimated construction period of 6 months, expected air emissions are listed in Table C–3.

Table C–3. Air Emissions During Construction of a New Mercury Storage Facility[a]

Pollutant	Total Emissions (metric tons)	Total Emissions (tons)
Carbon monoxide	3.01	3.32
Nitrogen dioxide	14.0	15.4
Sulfur dioxide	0.00475	0.00524
Particulate matter (with a diameter of 10 micrometers or less)	16.6	18.3
Carbon dioxide	520	573
Total organic compounds	1.14	1.26
Ammonia	0.022	0.0242
Benzene	0.00296	0.00326
1,3-Butadiene	0.0001124	0.000137
Formaldehyde	0.00374	0.00412
Toluene	0.00130	0.00143
Xylene	0.000903	0.000995

[a] Duration of construction would be 6 months.
Source: SAIC 2009b.

Minimal site excavation would be required for the construction of a new facility. Excavation up to 60 centimeters (24 inches) may be required for site preparation and pouring the concrete foundation. Small trenches may also be required for installation of utilities or connection with existing utilities and installation of concrete footers. Any excess soil would be incorporated and contoured into the existing landscape. It is assumed that any new construction would take place in an uncontaminated area.

C.2.4 Operations Data

Resource commitments for operations of a mercury storage facility are expected to be similar across all alternatives for the storage of up to 10,000 metric tons (11,000 tons) of elemental mercury in either a new facility or an existing facility; projected resource commitments are presented in Table C–4. However, infrastructure capacities may differ from one site to the next, especially for existing buildings. The one notable exception would be for labor resources. It is conservatively assumed that security personnel would guard the facility 24 hours per day, 7 days per week, although this level of security may not be necessary. Based on this assumption, site security for a standalone facility is estimated to be 350,400 man hours over the 40-year period of analysis. Several candidate sites would operate within the confines of an already secure and federally controlled complex that have continuing missions beyond mercury storage. In these cases, dedicated security for the storage facility may not be required. Security personnel would only be required during normal working hours for receipt and handling of mercury shipments and would be reduced to 83,200 man hours over the 40-year period of analysis.

The long-term mercury storage facility will not treat or process mercury. The facility will only be designed to store mercury in high-integrity, tight containers. However, it may become necessary to respond to small spills or repackage mercury from failed containers. The Handling Area, where repackaging mercury into new containers would be performed, would be negatively ventilated and the exhaust air would be filtered to remove airborne mercury emissions. The binding chemical that would most likely be used to remove mercury from the air would be sulfur. Filters would be replaced on a regular schedule to maintain optimum mercury removal efficiency. Therefore, air emissions vented from the Handling Area to the outside air are expected to be negligible. Mercury vapor might accumulate in the Storage Area(s) during normal operations from storage containers or residual surface contamination and could subsequently be vented to the outside air through the exhaust fans. However, as discussed in

Appendix D, Section D.4.1, air emissions from normal operations are projected to remain well below actionable concentrations for human health exposure.

Table C–4. Resource Commitments for Operation of a New or Existing Mercury Storage Facility[a]

Resource	Quantity
Land Use	
Land occupied	3.1 hectares (7.5 acres)
Labor	
Man hours	482,220 (215,020)[b]
Utilities	
Water (non-potable)	Negligible
Water (potable)	3,540,000 liters (935,000 gallons)
Diesel	24,200 liters (6,400 gallons)
Gasoline	Negligible
Electricity	10,100 megawatt-hours
Waste	
Hazardous solid waste (55-gallon drums)	910
Nonhazardous liquid waste (sanitary wastewater)	2,360,000 liters (623,000 gallons)

a Values presented are totals for the 40-year period of analysis.

b Parenthetical value represents reduced security personnel for those candidate sites that already reside within a secure Federal complex (i.e., Idaho National Laboratory, Hawthorne Army Depot, the Hanford Site, and the Savannah River Site).

Source: DOE 2009a; SAIC 2009b.

C.3 REFERENCES

DOE (U.S. Department of Energy), 2009a, *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury*, Oak Ridge, Tennessee, November 13.

DOE (U.S. Department of Energy), 2009b, "*Mercury Storage EIS*" *Expressions of Interest*.

DLA (Defense Logistics Agency), 2004, *Final Mercury Management Environmental Impact Statement*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

SAIC (Science Applications International Corporation), 2009a, *Data Call Responses for Existing Facility Data*, Germantown, Maryland.

SAIC (Science Applications International Corporation), 2009b, *Data Package for Construction of New Storage Facility*, Germantown, Maryland.

U.S. Department of Energy Manuals

DOE Manual 470.4-2A, *Physical Protection*, July 23, 2009.

APPENDIX D

Human Health and Ecological Risk Assessment Analysis

Appendix D
Units of Measure

1-MT	1-metric-ton
3-L	3-liter
°C	degrees Celsius
°F	degrees Fahrenheit
μg/L	micrograms per liter
cal/s	calories per second
K	Kelvin
kg/kg-mol	kilograms per kilogram-mole
kg/m^2	kilograms per square meter
kg/m^3	kilograms per cubic meter
kg/s	kilograms per second
$kg\text{-}m/s^2$	kilogram-meters per square second
KW/m^2	kilowatts per square meter
L/kg	liters per kilogram
m/s	meters per second
$m^2\ s^{-1}$	meters squared per second
mg/kg	milligrams per kilogram
mg/kg BW/day	milligrams per kilogram of body weight per day
mg/m^3	milligrams per cubic meter
mg/s	milligrams per second
mm/hr	millimeters per hour
ng/m^3	nanograms per cubic meter

APPENDIX D
HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT ANALYSIS

This appendix provides the detailed health and ecological risk assessments that support the *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement*.

D.1 INTRODUCTION

As described elsewhere in this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement (Mercury Storage EIS)*, the Mercury Export Ban Act of 2008 (P.L. 110-414) requires that, no later than January 1, 2010, the Secretary of Energy designate a facility or facilities of the U.S. Department of Energy (DOE) (which shall not include the Y–12 National Security Complex [Y–12] or any other portion or facility of DOE Oak Ridge Reservation) for the purpose of long-term management and storage of elemental mercury generated within the United States. The facility or facilities designated shall be operational and shall accept custody of elemental mercury for the purpose of long-term management and storage by January 1, 2013.

The alternatives that are analyzed in this appendix are listed below.

- No Action Alternative
- New construction at the Grand Junction Disposal Site (GJDS)
- New construction at the Hanford Site (Hanford) in the 200-West Area
- Existing storage buildings at the Hawthorne Army Depot in the Central Magazine Area
- New construction at Idaho National Laboratory's (INL's) Idaho Nuclear Technology and Engineering Center (INTEC)
- Existing storage buildings at INL's Radioactive Waste Management Complex (RWMC)
- Existing building at the Bannister Federal Complex's Kansas City Plant (KCP)
- New construction at the Savannah River Site (SRS) E Area
- New construction at Waste Control Specialists, LLC (WCS) (including interim storage in the existing Container Storage Building)

For further description of these alternatives, see Chapter 2, Section 2.4, and Appendix C of this environmental impact statement (EIS).

Mercury would be received as 99.5 percent or greater pure elemental mercury from a variety of sources, tabulated in Table D–1.

Table D–1. Dispatching Sites, Years, and Quantities of Elemental Mercury

Site	Years of Shipments	Total Mass (metric tons)
Y–12 National Security Complex	2013–2014	1,206
Chlor-Alkali Facilities		
Ashta Chemical, Ashtabula, Ohio	2013–2019	108
PPG, New Martinsville, West Virginia	2013–2019	244
Olin, Charleston, Tennessee	2013–2019	478
Olin, Augusta, Georgia	2013–2019	271
Reclamation and Recycling Facilities, Mining, Shipments from Peru		
Mining (Carlin, Nevada)	2013–2052	3,687
Mining (Peru, via Port of New York)	2013–2052	1,236
Philadelphia region (Bethlehem Apparatus)	2013–2052	1,939
Chicago region (D.F. Goldsmith)	2013–2052	831
Total	2013–2052	10,000

Note: To convert metric tons to tons, multiply by 1.1023.
Key: Bethlehem Apparatus=Bethlehem Apparatus Company, Inc.; D.F. Goldsmith=D.F. Goldsmith Chemical and Metal Corporation.

The starting point for Table D–1 is Chapter 1, Table 1–1, of this EIS, which provides an estimate of between 8,500 and 9,700 metric tons (8,000 and 10,700 tons) for the total amount of mercury that may be shipped to the chosen receiving site based on a 40-year period of analysis. For the purposes of this analysis, the amount was rounded up to 10,000 metric tons (11,000 tons). This is consistent with the *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury (Interim Guidance)* (DOE 2009a).[1] However, the data in Table D–1 should not be interpreted as commitments on DOE's part (e.g., to accept mercury from Peru via New York or to move mercury from Y–12 or to the exact dates of shipments from Y–12 and the chlor-alkali facilities). They are merely intended to be a reasonable set of numbers that can be used in a screening risk assessment. The data in Table 1–1 are not as detailed as those in Table D–1. The differences between the two tables are as follows:

- 1,206 metric tons at Y–12 (in Table D–1) vs. 1,200 metric tons (in Table 1–1): The amount is rounded down in Table 1–1.
- Table 1–1 provides only the total amount of mercury available at chlor-alkali facilities (1,100 metric tons), whereas Table D–1 breaks the amounts down by individual sites, as follows:
  - The Chlorine Institute provided an estimate of a total of 1,950 metric tons of mercury in seven chlor-alkali facilities in 2007 (Chlorine Institute 2008).
  - The total inventory of 1,950 metric tons was allocated to the seven facilities based on the number of mercury cells at each facility. This is consistent with previously used methods (Brown 2009). For the three facilities for which the number of mercury cells was not reported, the balance of the mercury inventory was equally distributed.
  - Three of the facilities were scheduled to shut down chlor-alkali operations and disposition their mercury before the new storage facility begins operation. This leaves the four in Table D–1, which are also those for which data on the number of mercury cells were available in Brown (2009).

[1] The analysis in this appendix is intended to be consistent with the *Interim Guidance*.

- The amount of mercury produced as a byproduct of gold mining from 2013 to 2053 was predicted by extrapolating a linear regression analysis of gold production based on U.S. Geological Survey historical data and multiplying by a mercury byproduct ratio of 0.4. The byproduct ratio was obtained by averaging actual byproduct data from Nevada (Brooks and Matos 2006; Jones and Miller 2005; Nevada Bureau of Mines 2005).

- Nevada accounts for greater than 80 percent of the gold production in the United States (NMA 2009). Therefore, as a simplifying assumption, Nevada was taken to be the source of all gold in the United States, with Carlin, Nevada being taken as the representative dispatching point.

- On average, approximately 30 metric tons per year of elemental mercury has been exported to the United States via the Port of New York from U.S.-owned gold mines in Peru (Brooks et al. 2007). It was assumed that this activity would continue for the period of this analysis (40 years).

- The balance of the mercury required to make up 10,000 metric tons, 2,770 metric tons, was assumed to come from reclamation and recycling (R&R) facilities. It was apportioned between Bethlehem Apparatus Company, Inc. (Bethlehem Apparatus) and D.F. Goldsmith Chemical and Metal Corporation (D.F. Goldsmith) according to the amount of mercury handled at each site per year, a ratio of 70:30, to give 1,939 and 831 metric tons, respectively.

The rationale for this assumption is as follows. In 2008, six companies in the United States accounted for the majority of secondary mercury reclamation and production. The six R&R companies are as follows (USGS 2009):

1. Bethlehem Apparatus in Hellerton, Pennsylvania
2. D.F. Goldsmith in Evanston, Illinois
3. Mercury Waste Solutions, Inc. in Union Grove, Wisconsin (headquartered in Mankato, Minnesota)
4. AERC, Inc., in Allentown, Pennsylvania
5. Onyx Environmental Services (a division of Veolia ES Technical Solutions, LLC) in Lombard, Illinois
6. Clean Harbors Environmental Services, Inc., headquartered in Braintree, Massachusetts

More than 50 smaller companies collect mercury-bearing products for recycling and ship them to the larger companies for retorting and purification, prior to reintroduction of the mercury back into the commercial market (USGS 2009). Bethlehem Apparatus is one of the world leaders in the recycling of a wide variety of solid- and liquid-mercury bearing wastes as it operates the world's largest mercury recycling facility with 29 advanced high-vacuum mercury waste retorts, two continuous-feed fluorescent lamp retorts, eight quadruple-distillation systems, and a calomel processing plant (European Commission 2004). In addition to being the major purchaser of mercury byproduct from gold mining, Bethlehem Apparatus is estimated to control approximately 40 percent of the secondary recycling market share. Virtually all mercury used in the United States is supplied by Bethlehem Apparatus or D.F. Goldsmith. Bethlehem Apparatus is estimated to supply about 70 percent of the mercury demand, and D.F. Goldsmith accounts for almost all the remaining mercury sales to end users in the United States (EPA 2005). In conclusion, almost all retorting or purification of mercury occurs in the greater Philadelphia or Chicago regions.

Therefore, for the purpose of conducting a representative analysis for the transportation of surplus elemental mercury from R&R facilities to a long term storage facility, it is assumed that 70 percent would come from the Philadelphia region and 30 percent would come from the Chicago region.

Mercury from Y–12 and the chlor-alkali facilities would be sent directly to the chosen storage facility. Mercury from domestic gold mines would also go directly to the chosen storage facility. For the purposes of simplification, all of the byproduct gold-mining mercury is assumed to originate from Nevada. In addition, approximately 30 metric tons (33 tons) per year of elemental mercury from U.S.-owned gold mines in Peru would continue to be shipped through New York City. Mercury from byproduct recycling and waste recovery would first go to one of the reclamation and recycling (R&R) facilities. The options for transporting the mercury include road or rail, with the mercury in either 3-liter (3-L) (0.8-gallon) (34.6-kilogram [76-pound]) or 1-metric-ton (1-MT) (1.1-ton) containers. The assumptions about how the mercury is assigned to the various transportation and container options are described in Section D.2.7.

This risk assessment provides an evaluation of potential releases, exposures, and human and ecological consequences and risks related to activities involved in the transportation and storage of elemental mercury described above, including potential accidents associated with those activities. This information is used in this EIS to facilitate comparisons between several alternatives for storage of the surplus elemental mercury.

For a discussion of the toxicological properties of various forms of mercury, see Sections D.3.1, D.3.2, and D.3.3.

D.1.1 Risk Assessment Scope

This appendix focuses on the human health and ecological risks that might arise under normal operating conditions and from storage- and transportation-related accidental releases. The work in this appendix draws upon the *Final Mercury Management Environmental Impact Statement (MM EIS)* that was prepared for the Defense National Stockpile Center (DNSC) of the Defense Logistics Agency (DLA 2004a). Where appropriate, the methodology of the 2004 report has been adopted as is. However, every calculation in that report has been reviewed skeptically, and modifications have been made to incorporate recent changes to input parameters, or where conservatisms can legitimately be removed or, occasionally, if the original analysis seems to be non-conservative.

When considering accidental releases of mercury in this report, risk is expressed as a function of the frequency of occurrence of an accident and the magnitude of the consequences. Most of this risk assessment is concerned with how to estimate those frequencies and consequences for a variety of potential or hypothetical accident sequences that might occur anytime during the 40-year period of analysis considered in this EIS.

In both the human health and ecological risk assessments, the approach to risk assessment is to use a risk matrix such as that shown in Figure D–1.

In Figure D–1, the frequency has been assigned to four broad categories: frequency levels (FLs) IV (high), III (moderate), II (low), and I (negligible). The consequences have been assigned to four severity levels (SLs), I, II, III, and IV, with the presumption being that SL-I may be characterized as negligible to very low and that SL-IV is the most consequential. Unlike the frequency assignments, the SL assignments are different for different receptors: thus, the levels may be defined differently for workers or the public, for acute- or chronic-inhalation exposure, for human health effects resulting from deposition of mercury onto the ground, or for ecological receptors. Discussion of these assignments is provided in Section D.1.1.2.

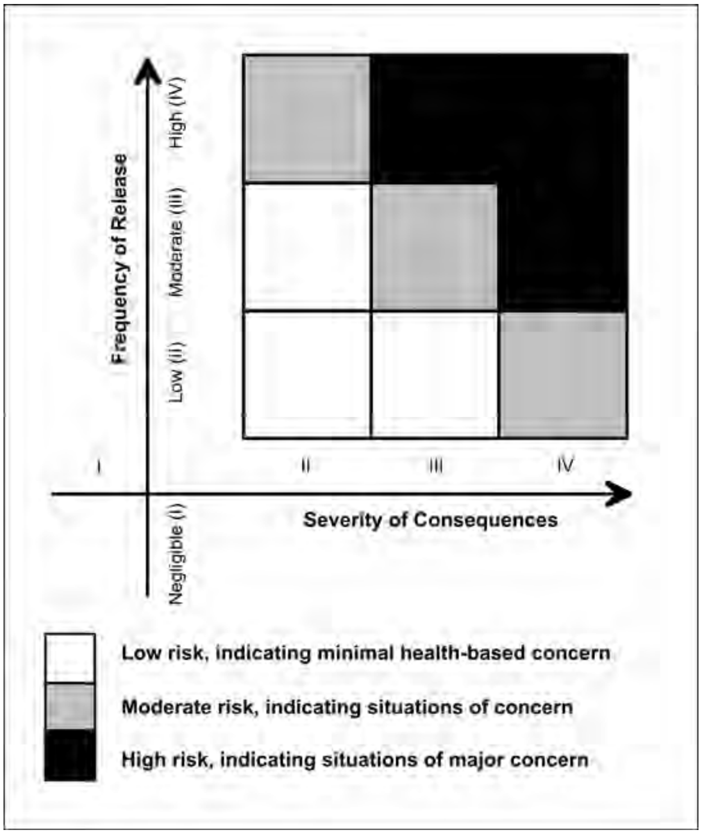


Figure D–1. Risk (Frequency and Consequence) Ranking Matrix

This kind of semi-quantitative risk assessment is appropriate for high-level screening activities such as the current one of comparing potential storage sites for elemental mercury. Both industry and government make use of such semi-quantitative or similar qualitative schemes, as evident in the following publications:

- The *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses* (DOE Standard 3009-94) presents a matrix that is very similar to that in Figure D–1.

- In 1987, the U.S. Environmental Protection Agency (EPA) published *Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances* (EPA 1987) and presented a matrix very similar to that in Figure D–1 as appropriate for making judgments about the relative risks posed by chemicals that can have potentially lethal effects on humans.

- The Center for Chemical Process Safety published *Guidelines for Hazard Evaluation Procedures* (CCPS 1992), which provides examples of high, moderate, low, or negligible health effects; definitions of roughly equivalent frequency bands; and an illustrative risk matrix like that in Figure D–1.

- In 2001, the Center for Chemical Process Safety published a book devoted to *Layer of Protection Analysis* (also known as LOPA, a simplified method of process risk assessment; CCPS 2001). This is an increasingly popular method of supplementing tried and tested methods of process hazards analysis with simple probabilistic analyses. The Center for Chemical Process Safety recommends the matrix method as one acceptable approach to using risk information as input to decisionmaking.

Many other examples could be cited. The following sections define the meaning of the frequency and consequence assignments in Figure D–1.

D.1.1.1 Frequency Assessment

The assessment of frequencies in this report is not complex and is generally based on rate statistics from industry or professional judgment. Once the frequency (*f*) has been calculated, it is then assigned to a high, moderate, low, or negligible category as follows:

- High – more than or equal to once in 100 years ($f \geq 10^{-2}$ per year)
- Moderate – less than once in 100 years to once in 10,000 years (10^{-2} per year > $f \geq 10^{-4}$ per year)
- Low – less than once in 10,000 years to once in 1 million years (10^{-4} per year > $f \geq 10^{-6}$ per year)
- Negligible – less than once in 1 million years ($f < 10^{-6}$ per year)

The frequency bands are similar to those in Table 3–4 of DOE Standard 3009-94, the *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. This definition of frequency bands applies to all the risks considered in this EIS: human health risks by inhalation or ingestion and risks to ecological receptors.

D.1.1.2 Consequence Assessment

The assessment of consequences is considerably more complex. The source term is defined by various factors, such as the rate at which mercury vapor is released to the atmosphere, the height of release, or the heat content of the release. These characteristics are needed to calculate the atmospheric dispersion of mercury transported downwind. The predicted airborne concentrations encountered by workers and members of the public are then estimated and used as the consequence part of the estimate of health consequences via inhalation. In addition, the dispersion model is used to predict how much mercury would be deposited on the ground or on the surface of a body of water. Once this has been done, the concentration of mercury in soil, sediment, or water can be estimated and used as the basis for the calculation of the magnitude of the health effects incurred by humans and the magnitude of adverse consequences incurred by sensitive ecological receptors.

The consequences of exposure to mercury depend on the chemical form of the mercury. For a primer on the forms of mercury found in environmental media, see GreenFacts (2009).

For the purposes of this risk assessment, it is clearly important to consider exposure to elemental mercury, because that is the form of mercury in storage. Elemental mercury is sometimes written as Hg^0. The term "elemental mercury" is what is usually used in this report, but in some places elemental mercury and Hg^0 are used interchangeably.

It is next necessary to consider how elemental mercury can be converted into other forms. Mercury can exist in three oxidation states (EPA 1997b): Hg^0 (metallic), Hg_2^{2+} (mercurous), and Hg^{2+} (mercuric-Hg(II), otherwise known as divalent mercury; whenever the term "divalent mercury" appears in this risk assessment, it is synonymous with Hg^{2+}). The properties and chemical behavior of mercury; strongly depend on the oxidation state. Mercurous and mercuric mercury can form numerous inorganic and organic chemical compounds; however, mercurous mercury is rarely stable under ordinary environmental conditions. In this risk assessment, use of the term "inorganic mercury" is used as shorthand for compounds of divalent and mercuric mercury. The mercuric salts most frequently found in all environmental media except the atmosphere are mercuric chloride ($HgCl_2$), mercuric hydroxide ($Hg [OH]_2$), and mercuric sulfide (HgS).

Inorganic/divalent mercury can be formed from elemental mercury if the latter is involved in a fire. More discussion of this phenomenon is provided in Section D.7.3.3. This is important because, as is also discussed in Section D.7.3.3, divalent mercury has a much larger dry deposition velocity than elemental mercury. Therefore, in practice, the only accident scenarios considered in this risk assessment that can cause deposition of mercury are those involving fires, in which case inorganic mercury would be deposited on the ground or water bodies.

Organomercuric compounds are the other form of mercury commonly formed in environmental media. Organomercuric compounds are defined by the presence of a covalent carbon-mercury (C-Hg) bond (that is, a bond in which pairs of electrons are shared between atoms). The organomercuric compounds most likely to be found under environmental conditions are the methylmercury compounds methylmercuric chloride (CH_3HgCl) and methylmercuric hydroxide (CH_3HgOH), and, in small fractions, other organomercuric compounds (i.e., dimethylmercury and phenylmercury). In this risk assessment, methylmercury is used a shorthand for "methylmercury compounds."

Methylmercury would not be present in the storage facilities, nor would it be formed in a fire. It would be formed subsequent to deposition on to the ground or into water and mixing with soil or sediment. In dry soil, it is assumed that 2 percent of the inorganic mercury would be converted to methylmercury. In wet soil or sediment, the assumed percentage is 15. See Section D.7.3.3 for further discussion. This conversion is taken account of in considerations of the effects of deposited mercury on humans and ecological receptors.

In its *Mercury Study Report to Congress*, EPA largely confined its analysis of mercury in the environment and mercury's health effects to consideration of three forms: elemental mercury, inorganic mercury, and methylmercury (EPA 1997d). In the case of inorganic mercury, many of the considerations are based on mercuric chloride, which is the most toxic of the mercuric salts found in environmental media. Methylmercury is taken as a surrogate for all organomercuric compounds, but in practice methylmercury compounds are by far the most prevalent. This practice—of limiting consideration to elemental mercury, inorganic mercury, and methylmercury—is followed in this risk assessment.

Exposures can be either short term (i.e., "acute") or long term (i.e., "chronic"). Exposures are classified as acute or chronic depending on the duration of the exposure. Although there is no precise consensus on the definitions of these terms, EPA defines acute exposures as those lasting up to or less than 24 hours, while exposures lasting a significant portion of a lifetime are defined as occurring on a chronic basis. This risk assessment includes acute exposures arising during accidents and chronic exposures resulting from residual environmental contamination after accidents. Other exposures that could arise from small, chronic releases during normal operating conditions are also discussed.

D.1.1.2.1 Acute-Inhalation Exposure to Elemental Mercury, Consequences to Public Receptors

This section focuses on the consequences of accidents in which elemental mercury becomes airborne and is subsequently inhaled over a short period of time. "Classical" risk assessments of hazardous materials often focus on the calculation of predicted fatalities—either as individual risk (expressed as the chance per year of fatality) or as societal risk (often presented as "f-n" or frequency-number lines). Examples include the *Reactor Safety Study* (NRC 1975), which also included a chlorine fatality risk assessment for comparison with the reactor risk, and an early but influential study of chemical facilities in the Netherlands (COVO 1976). In fact, it is in the Netherlands that possibly the most sophisticated risk-based approach to the regulation of hazardous chemicals has been adopted, making use of "location-based" (individual) risk and societal risk (VROM 2006).

Per VROM (an acronym for the Netherlands Ministry of Housing, Spatial Planning and the Environment), location-based risk is defined as the risk to individuals in a particular place, expressed as the annual probability of dying in the vicinity of an establishment where dangerous substances are (legally) present as a direct result of an onsite accident involving those substances. The Dutch External Safety Establishments decree sets environmental quality standards in the form of limit values for location-based risk, e.g., 10^{-6} per annum for vulnerable objects and for sites in the process of remediation. Where the location-based risk to an existing vulnerable object is between 10^{-5} and 10^{-6} per annum, a "standstill" provision applies: i.e., the establishment concerned may not be modified in any way that will have the effect of increasing that risk. Societal risk takes account of population density in the vicinity of a high-risk activity and expresses the probability of a given minimum number of fatalities occurring as a result of a single accident involving dangerous substances. The focus is on large-scale mortality in case of an accident.

Another regulatory body that focuses on the risk of fatality as input to decisionmaking is the United Kingdom Health and Safety Executive (HSE). In a safety report on chlorine (UKHSE 2009), for example, HSE states the following:

> "If quantitative arguments are used the methods, assumptions and the criteria adopted for decision making should be explained. For example in the case of fatality risks to people off-site it is common [HSE] practice for the maximum tolerable level of individual fatality risk to be set at 10^{-4} per year and for the broadly acceptable level to be set at 10^{-6} per year. The corresponding figures for workers are 10^{-3} and 10^{-6}. There are no commonly agreed criteria for lower severity levels, however, HSE have published harm criteria for [Land Use Planning] purposes for a variety of substances, i.e., the 'dangerous dose' level, which is equivalent to a 1% chance of fatality when a healthy person receives the dose."

To judge mercury against these sorts of risk and fatality standards, it is necessary to have data on such health effects measures as the LC_{50}, or a probit that expresses the probability of fatality as a function of airborne concentration and exposure time. For mercury, these data are simply not available. For example, in the Agency for Toxic Substances and Disease Registry's 676-page *Toxicological Profile for Mercury* (ATSDR 1999), the LC_{50} is only mentioned in the glossary and acronym list, and probit is not mentioned at all.

One can gain some understanding of where the LC_{01} might lie by considering EPA's method for deriving Acute Exposure Guideline Levels (AEGLs). There are three AEGLs (see Table D–19). AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. It is believed that the recommended exposure levels protect the general population, including infants and children and other individuals who may be susceptible. However, although the AEGL values represent threshold levels for the general public, it is recognized that individuals, subject to unique or idiosyncratic responses, could experience the effects described at concentrations below the corresponding AEGL. The three AEGLs have been defined as follows:

AEGL-1 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL-2 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Airborne concentrations below AEGL-1 represent exposure levels that can produce mild and progressively increasing but transient and nondisabling odor, taste, and sensory irritation or certain asymptomatic, nonsensory effects.

AEGLs are discussed in Table 2.15 of EPA's *Graphical Arrays of Chemical-Specific Health Effect Reference Values for Inhalation Exposures* (EPA 2009a). The "point of departure" for AEGL-3 is an exposure of 26.7 milligrams per cubic meter (mg/m^3) for 1 hour, for which no fatalities were observed in rats, and 27.0 mg/m^3 for 2 hours, which caused lethality in 20 of 32 rats. The 1-hour AEGL-3 is 8.9 mg/m^3 (i.e., one-third of the above-cited 1-hour experimental concentration). It is clear from the procedures that govern the derivation of AEGLs (NRC 2001) that AEGL-3 is intended to be a conservative threshold for the onset of fatalities.

The observation that AEGL-3 is expected to be a threshold below which fatalities are not expected is pertinent to an assessment of the risks associated with elemental mercury transportation and storage. As shown in Table D–50 of this appendix (based on work published by the National Institute of Standards and Technology [NIST]), at the temperature assumed for accidental spillages of elemental liquid mercury (20 degrees Celsius [°C] or 68 degrees Fahrenheit [°F]), the saturated vapor density is 14 mg/m^3. This is less than twice AEGL-3 for a 1-hour release (8.9 mg/m^3). In practice, what this means is that the airborne concentration may already be below the LC_{01} and, even if it is not, it would very rapidly be diluted below that level by the action of atmospheric turbulence, either in the wake of the building adjacent to which it is released (as is the case for several of the scenarios in this EIS; see Section D.4) or by the action of the ambient atmospheric turbulence in the open. That is, for evaporating elemental mercury spills, it is highly unlikely that people would be exposed to airborne concentrations that exceed the LC_{01}.

The implications of this are that a risk assessment of the type discussed above, as utilized in the risk studies or by the regulatory agencies cited, in which individual and/or societal risks of fatality are used to judge the acceptability of some course of action involving a hazardous chemical, would lead to the prediction of essentially zero risk from elemental mercury storage and transportation because the frequency side of the risk equation (risk = (frequency) × (consequence)) is, for all intents and purposes, zero. This is an important insight that places the risks of mercury transportation in the context of the risks associated with other hazardous chemicals. That is, a priori one would expect that risks to individuals from spillages of elemental mercury should be negligible, measured on the kind of risk scale that is commonly used to assess the acceptability of activities involving hazardous chemicals (as described above).

That having been said, one cannot conclude that the risk associated with acute human inhalation of elemental mercury is actually negligible or very small in the absolute sense, because there are severe effects at concentrations as low as a few tenths of a milligram per cubic meter (see Table D–19). A suggested way of binning acute-inhalation exposures, in a way similar to that done for frequencies, is summarized in Table D–2.

The rationale for Table D–2 is as follows: AEGL-3 represents a threshold above which there is a distinct change in the expected nature of the consequences in that, as airborne concentrations increase above AEGL-3, there is increasing likelihood of fatality, whereas below AEGL-3 but above AEGL-2, there is potential for nonlethal, albeit potentially severe, health effects. Below AEGL-2, there is the potential for reversible health effects.

Table D–2. Definition of Consequence Severity Bands for Acute Inhalation of Elemental Mercury, Public Receptors[a]

Acute-Inhalation Consequence Severity Level	Corresponding Airborne Concentrations of Elemental Mercury	Expected Health Effects
Inhalation Severity Level IV	≥ AEGL-3	Potential for lethality as concentration increases above AEGL-3
Inhalation Severity Level III	< AEGL-3 and ≥ AEGL-2	Potential for severe, sublethal, irreversible health effects
Inhalation Severity Level II	< AEGL-2 and ≥ 0.1×AEGL-2[b]	Potential for reversible health effects
Inhalation Severity Level I	< 0.1×AEGL-2[b]	Potential for minor irritation, equated with negligible-to-very-low consequences

[a] Exposure period up to 8 hours.

[b] Ideally, this should be tied to some multiple or fraction of AEGL-1. However, AEGL-1 has not been defined for elemental mercury.

Key: ≥=greater than or equal to; <=less than; AEGL=Acute Exposure Guideline Level.

SL-I represents a range of concentrations in which there are negligible to at most minor health effects. This could, in principle, be bounded by AEGL-1 or some multiple or fraction of AEGL-1. However, there is no AEGL-1 for elemental mercury. DOE (2009b) has a Subcommittee on Consequence Assessment and Protective Actions that maintains a list of *Protective Action Criteria for Chemicals – Including AEGLs, ERPGs, & TEELs*. Definitions of AEGLS have been provided previously. ERPGs, Emergency Response Planning Guidelines, are precursors of AEGLs and are approximately equivalent to the 1-hour AEGLs. TEELs, Temporary Emergency Exposure Limits, are intended as interim equivalents to ERPGs. TEEL-3, -2, and -1 for elemental mercury are 4.10 mg/m^3, 2.05 mg/m^3, and 0.3 mg/m^3, respectively. The first two of these have been superseded by AEGL-3 and AEGL-2, which, for a duration of exposure of 1 hour, are 8.9 mg/m^3 and 1.7 mg/m^3, respectively. TEEL-1 for elemental mercury is somewhat more than 10 percent of the 1-hour AEGL-2, so setting the upper bound of SL-I in Table D–2 equal to 0.1 × AEGL-2 seems to be a reasonable compromise.

DOE also provides a TEEL-0, 0.025 mg/m^3, below which airborne concentrations are considered to be negligible. There is no ERPG or AEGL equivalent to this level.

The definition of consequence bins in Table D–2 is consistent with the *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses* (DOE Standard 3009-94). Table 3–1 of that reference characterizes an offsite exposure to less than ERPG-2 as "low," an exposure to ERPG-2 as "medium," and an exposure to ERPG-3 as "high."

D.1.1.2.2 Acute-Inhalation Exposure to Elemental Mercury, Consequences to Workers

Throughout the human health risk assessment, consideration is given to two classes of workers: "involved workers" and "noninvolved workers." The involved workers are those actually working in the storage facility or on other mercury-related operations, such as unloading flasks or 1-MT containers and transferring them to storage. The noninvolved workers are those who are engaging in other activities on the site. For the purposes of this analysis, they are assumed to be within 50 meters (approximately 160 feet) of the mercury storage facility.

For workers, the National Institute for Occupational Safety and Health (NIOSH) has published a benchmark for acute exposures that are immediately dangerous to life or health (IDLH) (CDC 2002). For mercury, this is 10 mg/m^3; see Table D–18. The Occupational Safety and Health Administration (OSHA) defines an IDLH value in its hazardous waste operations and emergency response regulation as follows: "An atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere" (29 CFR 1910.120). EPA, in its *Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances* (EPA 1987), states that "The IDLH concentration represents the maximum concentration of a substance in air from which healthy workers can escape without loss of life or irreversible health effects under conditions of a maximum 30-minute exposure time."

In principle, it would be possible to develop an SL scheme tied to the IDLH, similar to that in Table D–2. Unfortunately, there are no IDLH equivalents of the three AEGLs. However, the IDLH approximately equals AEGL-3 for a 30-minute exposure (11 mg/m^3; see Table D–19). It therefore seems reasonable to adopt the same acute-inhalation SLs for workers as for members of the public. One could make a case that this is conservative because workers are generally expected to be healthy while the AEGLs are crafted to include susceptible members of the public. Therefore, Table D–2 applies to workers as well as to the public.

D.1.1.2.3 Acute-Inhalation Exposure to Divalent Mercury, Consequences to Public Receptors

In the event of a fire, airborne mercury would be converted into divalent mercury. Section D.7.3.3 explains that, for the purposes of this analysis, it is conservatively assumed that 100 percent of the elemental mercury would be converted to divalent mercury. In the atmosphere, this is most likely to manifest itself as mercuric oxide, for which there are no AEGLs.

For mercuric oxide, TEEL-3 is 10.8 mg/m^3, TEEL-2 is 1.08 mg/m^3, TEEL-1 is 0.15 mg/m^3, and TEEL-0 is 0.027 mg/m^3. As noted above, the corresponding TEEL-3, -2, -1, and -0 for elemental mercury are 4.10 mg/m^3, 2.05 mg/m^3, 0.3 mg/m^3, and 0.025 mg/m^3. The first two of these have been superseded by AEGL-3 and AEGL-2, which, for a duration of exposure of 1 hour, are 8.9 mg/m^3 and 1.7 mg/m^3, respectively. It would seem that, within the range of uncertainty in assigning values to AEGLs, ERPGs, and TEELs, it is reasonable to assume that AEGL-3 and -2 for mercuric oxide are, for all intents and purposes, the same as those for elemental mercury. Therefore, Table D–2 is taken to apply to divalent mercury as well as to elemental mercury.

D.1.1.2.4 Chronic-Inhalation Exposures to Elemental Mercury, Consequences to Public Receptors and Noninvolved Workers

This section is intended to address low-level exposures to elemental mercury that might take place over many years as a result of chronic releases during normal operations. In this case, the choice of benchmark is relatively simple. EPA has published a chronic-inhalation exposure reference concentration (RfC), valid for durations of exposure between 7 and 70 years, of 3.0×10^{-4} mg/m^3 (EPA 2009a; from IRIS [Integrated Risk Information System]). Concentrations below this level are considered to be negligible. The analysis in Section D.4.1 shows that all predicted concentrations outside the building during normal operations are below this reference level, so there is no need to build a range of severity categories analogous to that in Table D–2.

D.1.1.2.5 Chronic-Inhalation Exposures to Elemental Mercury, Consequences to Involved Workers

The general industry permissible exposure limit (PEL) for mercury vapor established by OSHA is 0.1 mg/m^3 (29 CFR 1910.1000), the same as the 8-hour time-weighted average (TWA) (see Table D–21). The PEL is a ceiling limit not to be exceeded at any time. The NIOSH-recommended exposure limit is 0.05 mg/m^3 on an 8-hour TWA basis, with a ceiling limit of 0.1 mg/m^3. OSHA references the American Conference of Governmental Industrial Hygienists' (ACGIH's) 8-hour TWA/threshold limit value (TLV) for mercury vapor as being 0.025 mg/m^3 (OSHA 2009). Hence, the limit for chronic effects on workers is taken as the most conservative of these values, 0.025 mg/m^3. The analysis in Section D.4.1 shows that all predicted concentrations inside the building during normal operations are below this reference level, so there is no need to build a range of severity categories analogous to that in Table D–2.

D.1.1.2.6 Mercury Deposited on the Ground, Chronic Exposures Through Soil Pathway

For evaluation of chronic effects related to exposures to residual contamination in soil after deposition via air, the starting point is the EPA soil screening levels (SSLs). These are health-based values for total organic or inorganic mercury in soil. They are considered to be protective of ingestion exposures to members of the public. See **Section D.7.3.3** for an explanation of why it is expected that mercury deposited on the ground will be in the inorganic form.

The generic SSL for inorganic mercury in soil, based on mercuric chloride, is 23 milligrams per kilogram (mg/kg). However, this generic value can be supplemented by an extensively studied real-life case, that of the remediation of East Fork Poplar Creek in Oak Ridge, Tennessee, and its floodplain (ATSDR 2009a, 2009b; ORNL 2009). Mercury was discharged into the creek from 1950-1963 as a result of separations of lithium isotopes at Y–12 in support of the hydrogen bomb project. Note that this discharge was not a result of elemental mercury storage at Y–12. The Agency for Toxic Substances and Disease Registry made a finding, based on mercuric chloride (with the same 23 mg/kg SSL), that a cleanup level of 180 mg/kg is protective of public health. This is based on a "worst-case" scenario involving young children who live close to East Fork Poplar Creek and play in the East Fork Poplar Creek floodplain. This case scenario is considered the worst case because it involves the most sensitive population (young children) exposed to the most highly absorbable forms of inorganic mercury (mercuric chloride and elemental mercury). The most probable route of exposure to inorganic mercury would be swallowing dust and dirt.

Based on the foregoing, it is judged that the boundary between SL-I (negligible-to-very-low consequences) and -II (onset of adverse consequences due to ingestion of contaminated soil) is 180 mg/kg of inorganic mercury. Beyond that, no guidance has been found as to what level would cause irreversible health effects or fatalities. In practice, this does not matter because none of the scenarios analyzed in this EIS would lead to deposited concentrations of mercury at levels exceeding 180 mg/kg in soil.

A mercury speciation study of the East Fork Poplar Creek floodplain soil showed that the distribution of mercury is 84–98 percent inorganic (mercuric sulfide), 3–8 percent elemental, and 0.003–0.01 percent organic (methylmercury) (ATSDR 2009b). As noted above, the initial deposit of mercury onto the ground is expected to contain at most a very small proportion of elemental mercury. In addition, the results quoted by the Agency for Toxic Substances and Disease Registry show that, at least in the specific environmental conditions that apply in the East Fork Poplar Creek floodplain, the conversion of inorganic mercury into elemental mercury is very small. Therefore, modifying the 180 mg/kg threshold for methylmercury content is not necessary.

D.1.1.2.7 Ecological Receptors

As discussed in Section D.5.4.1, the inhalation exposure route is generally insignificant for ecological receptors when compared with the ingestion exposure route. Section D.5 explains the selection of a short list of receptors that are considered representative of those found along the transportation routes, including plants and soil invertebrates, terrestrial animals, and aquatic and sediment-dwelling biota. These representative receptors are listed below:

- Plants
- Soil invertebrates
- The short-tailed shrew
- The American robin
- The red-tailed hawk

- The great blue heron
- The river otter
- Aquatic biota
- Sediment-dwelling (i.e., benthic) biota

For each of the representative receptors, ecologically based benchmarks were derived; see Sections D.5.2 and D.5.3. These are the toxicity reference values (TRVs) that, if exceeded in an environmental medium, may produce toxic effects in ecological receptors exposed to that medium. Therefore, by analogy with Table D–2, a TRV for a particular receptor is equivalent to the upper bound for SL-I. According to the 2004 *MM EIS* (DLA 2004a), 10 times the TRV is the boundary between SL-II and -III, and SL-IV lies above 20 times the TRV.

The TRVs are converted to ecological screening values, which are either in mg/kg, for soil or sediment, or micrograms per liter (µg/L) for water (taking due account of the likely chemical forms of mercury, such as inorganic compounds or methylmercury). The ecological screening values are then converted to equivalent deposited screening values (in kilograms per square meter [kg/m^2]), which can then be directly compared with the output of atmospheric dispersion models, (see Table D–35).

D.1.1.2.8 Summary of Severity Levels

Table D–3 summarizes the discussion of SLs for human and ecological receptors.

D.1.2 Organization of This Appendix

This appendix is organized as follows: Section D.2 describes the accident scenarios considered and the frequencies of each scenario. Any scenario for which the frequency is determined to be negligible is screened out at this stage. Section D.3 is an assessment of the toxicity of mercury exposure to humans. Section D.4 presents the exposure assessment and the human health consequences and risks per Figure D–1.

Section D.5 presents the ecological risk assessment (ERA). It describes the general aspects of the toxicity of mercury exposure to ecological receptors and the derivation of benchmarks for each receptor, expressed as concentration in soil, sediment, or water. The consequences associated with the alternatives and the results of the frequency analysis are used to assess ecological risks. Section D.6 is the assessment of uncertainties. Section D.7 describes the technical details of the atmospheric dispersion and deposition models.

Table D–3. Summary of Definitions of Consequence Severity Levels

Severity Level	Acute-Inhalation Exposures – Involved and Noninvolved Workers and Public Receptors[a]		Chronic-Inhalation Exposures – Involved Workers[b]		Chronic-Inhalation Exposures – Noninvolved Workers and Public Receptors[b]		Exposure to Deposited Mercury – All Human Receptors		Ecological Receptors	
	Level Definition	**Consequence**	**Level Definition**	**Consequence**	**Level Definition**	**Consequence**	**Level Definition**	**Consequence**	**Level Definition**	**Consequence**
IV	≥ AEGL-3	Potential for lethality as concentration increases above AEGL-3	N/A	N/A	N/A	N/A	N/A	N/A	≥ 20×SV[c]	Lethality
III	< AEGL-3 and ≥ AEGL-2	Potential for severe, sublethal, irreversible health effects	N/A	N/A	N/A	N/A	N/A	N/A	< 20×SV and ≥ 10×SV	Severe, nonlethal health effects
II	< AEGL-2 and ≥ 0.1 ×AEGL-2	Potential for reversible health effects	N/A	N/A	N/A	N/A	N/A	N/A	< 10×SV and ≥ SV	Minor health effects
I	< 0.1 ×AEGL-2	Potential for minor irritation, equated with negligible-to-very-low health consequences	< ACGIH's 8-hour TWA/TLV 0.025 mg/m^3	Negligible	< EPA RfC 0.0003 mg/m^3	Negligible	< ATSDR -approved cleanup level (180 mg/kg) for East Fork Poplar Creek	Negligible	< SV	Negligible

[a] Applies to both elemental mercury vapor and inorganic mercury.

[b] Elemental mercury vapor inhalation.

[c] Ecological receptor screening value from Table D–35.

Key: ≥ =greater than or equal to; < =less than; ACGIH=American Conference of Governmental Industrial Hygienists; AEGL=Acute Exposure Guideline Level; ATSDR=Agency for Toxic Substances and Disease Registry; EPA=U.S. Environmental Protection Agency; kg=kilograms; mg=milligrams; mg/kg=milligrams per kilogram; mg/m^3=milligrams per cubic meter; N/A=not applicable; RfC=reference concentration; SV=screening value; TLV=threshold limit value; TWA=time-weighted average.

D.2 ONSITE AND OFFSITE RELEASE EVENTS AND THEIR FREQUENCIES

The purpose of this section is to describe the accident scenarios that were considered for this risk assessment and to provide estimates of their frequencies. The frequencies are then assigned to a high, moderate, low, or negligible category, as described in Table D–4. The event frequencies are used to determine whether a particular event scenario should be evaluated further in the risk assessment or dismissed as having negligible risk on the basis of frequency alone. The consequences and associated risks of those scenarios with non-negligible frequency are discussed in Section D.4 ("Exposure Assessment and Human Risk Analysis") and Section D.5 ("Ecological Risk Assessment").

Table D–4. Frequency Categories for Accidental Events

Frequency Category	Estimated Annual Frequency (*f*) of Occurrence	Description
High	$f \geq 1\times10^{-2}$	Incidents that may occur several times during the design life of the facility. (Incidents that commonly occur.) Accidents of this frequency range are evaluated further.
Moderate	$1\times10^{-2} > f \geq 1\times10^{-4}$	Accidents that are not anticipated to occur during the design life of the facility. Natural phenomena of this probability class include design-basis earthquake, 100-year flood, and maximum wind gust. Accidents of this frequency range are evaluated further.
Low	$1\times10^{-4} > f \geq 1\times10^{-6}$	Accidents that would probably not occur during the design life of the facility. This class includes most design-basis accidents. Although unlikely, accidents of this frequency range are evaluated further.
Negligible	$f < 1\times10^{-6}$	Accidents that are not credible and are not evaluated further.

The frequency category is used with the estimated human and ecological effect consequences to derive a subsequent estimate of the overall risk.

Potential releases are divided into three types, as follows:

- Releases that might take place on site at the storage locations during normal operations
- Releases that might take place on site at the storage locations during accidents
- Releases that might take place during offsite transportation accidents

D.2.1 Assumption About the Mercury Storage Facility

The Mercury Export Ban Act of 2008 does not indicate specific features required for the storage facility (or facilities) that would be used to store elemental mercury. Such buildings may be either newly constructed or existing structures. However, per Section 5, the *Interim Guidance* (DOE 2009a) establishes the basic requirements for safe storage of mercury, including preliminary design elements of a suitable new or existing facility. The analysis in this EIS assumes that all structures, existing or new, would be constructed or modified so as to be consistent with the *Interim Guidance*, which envisages that a storage facility would consist of the following four areas (not necessarily all in the same building):

- Receiving and Shipping Area—This physical area would include dedicated space(s) for the receipt, inspection, acceptance, handling, and shipment of containers.

- Handling Area—This physical area would include dedicated space(s) for work involving potential contamination, including (1) safely handling and cleaning palletized or individual flasks that have external mercury contamination and/or leaking mercury, (2) reflasking failed 3-L flasks identified during the inspections for acceptance, and (3) safely managing leaking 1-MT containers. This area is needed for non-routine and emergency response activities in the event of leaking flasks and containers.

- Storage Area—This physical area would include dedicated space(s) for the storage and monitoring of mercury containers.

- Office Administration Area—This physical area would include dedicated space(s) for the storage and maintenance of records, waste acceptance criteria, accountability criteria, shipping papers, and databases.

The *Interim Guidance* further assumes that any DOE mercury storage facility (or facilities) would have the following characteristics:

- Resource Conservation and Recovery Act–regulated and –permitted to receive discarded elemental mercury generated in the United States
- Naturally ventilated (that is, not air conditioned)
- Adaptable to a modular design
- Operated for DOE by a contractor

The *Interim Guidance* also provides the following: (1) a conceptual scale view of the overall operational area needed for storage of up to 10,000 metric tons (11,000 tons) of elemental mercury, based on a rough assessment of a 60:40 percent breakdown by approximately 6,000 1-MT and 116,000 3-L flasks, respectively, with 3-L flasks on pallets and racks and (2) an estimate of up to 14,000 square meters (150,000 square feet) for a "comfortably sized layout."

The storage facility would have features that would reduce the risk to the environment and maximize the efficiency of container inspection, including at least three boundaries between the mercury and the environment. These features would include the following:

- *The container*: all containers accepted into the facility would meet DOE acceptance criteria to ensure structural integrity.

- *The spill containment tray* that is under all the containers (see Section D.2.2 for details). If a container fails, the mercury would be contained and should be quickly discovered and cleaned up.

- *The solid concrete floor*, which would be coated so as to be impermeable to mercury and water. Therefore, there is negligible risk that spillages inside the storage building would penetrate the floor and enter groundwater.

- *Perimeter curbing* or other building design features that would prevent spilled mercury from flowing out of the building.

D.2.2 Assumption About Mercury Containers

Mercury received into the storage facility would be in elemental form with a purity of 99.5 volume percent or greater. The mercury would be free of any radiological components. The remaining 0.5 percent content should not be capable of corroding carbon steel or stainless steel (elemental mercury has been proven not to corrode carbon steel or stainless steel) (DOE 2009a).

The mercury is expected to arrive at the facility in either 3-L (0.8-gallon) (34.6-kilogram [76-pound]) or 1-MT (1.1-ton) sizes. The following are assumptions about the storage containers:

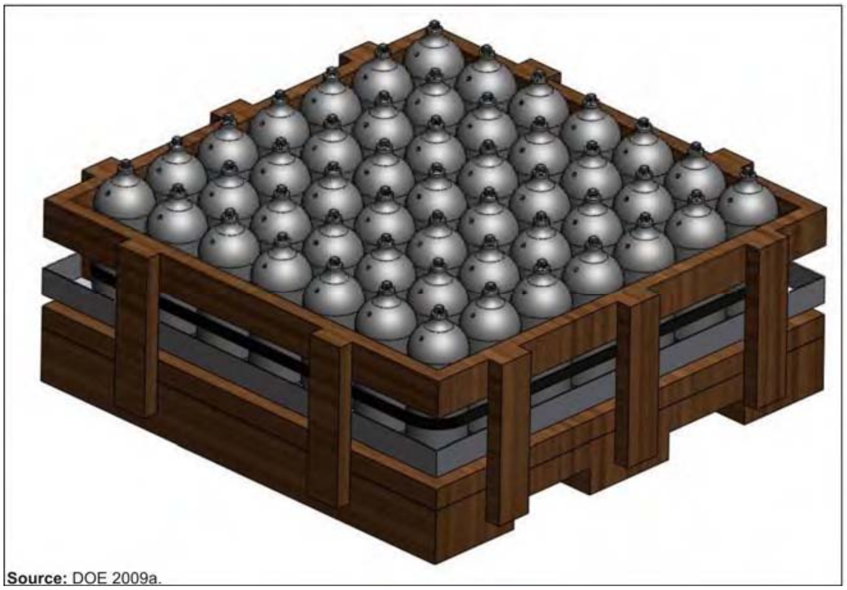
- After the containers are accepted, they would be separated in the facility by size (3-L or 1-MT).

- The 3-L flasks would each contain 34.6 kilograms (76 pounds) of elemental mercury.

- The 3-L flasks would not contain welds.

- Although the *Interim Guidance* discusses several different types of 3-L flasks, varying in empty mass between 3.4 and 6.3 kilograms (7.5 and 13.9 pounds), a representative mass of 4.1 kilograms (9.0 pounds) has been assumed for the present analysis. See Section D.6.1.3 for a discussion of the sensitivity of the results to this assumption.

- The 3-L flasks would be both transported and stored in box pallets that contain an array of 7 × 7 flasks, as shown in Figure D–2; the dimensions of each pallet would be 1.44 by 1.44 meters (56 by 56 inches).



Source: DOE 2009a.

Figure D–2. 7 × 7 Array of 3-Liter Flasks

- The *Interim Guidance* states, "The 3-L containers are preferred to be sent in box pallets that comply with the following: …(4) the pallet may be constructed of painted steel, untreated hardwood with fire protective paint applied, treated hardwood, or other materials that have equivalent load capacity, fire resistance, degradation rate (e.g., expected life), and would not require disposal as hazardous waste." The case chosen for study in this *Mercury Storage EIS* is use of wooden pallets because this case conservatively maximizes the amount of flammable material that would be available to vaporize elemental mercury in the event of a fire.

- The 7 × 7 pallets of 3-L flasks would stand in a metal spill tray capable of holding the contents 10 percent (approximately five) of the flasks in the pallet.

- In the facility, the 3-L flasks in box pallets may be placed onto seismically rated storage racks and stacked two or three high. The height of the rack would not exceed 3.7 meters (12 feet). See Figure D–3.

- The racks would require a 3-degree slope towards the aisle to allow leaked mercury to flow towards the edge of the spill tray to assist in quickly locating failed flasks. The walls of the spill tray would be sufficiently high to contain the contents of five flasks at the indicated angle.

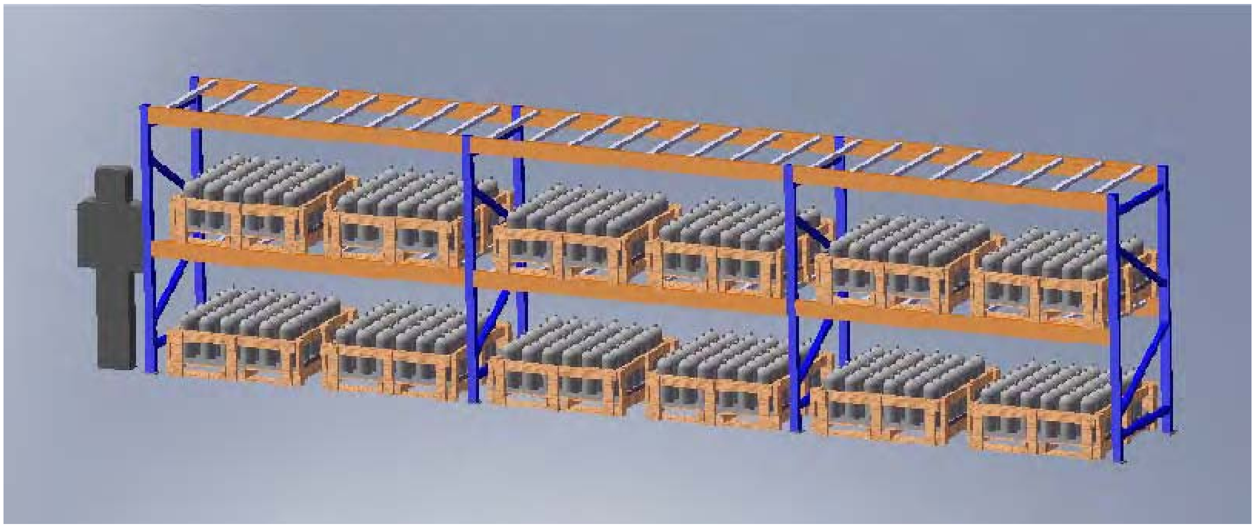


Figure D–3. 3-Liter Flasks in Box Pallets on a Seismically Rated Rack

- The *Interim Guidance* states that overpacking the 3-L flasks into drums is not recommended for transportation or long-term storage.

- The 1-MT container should not be filled with more than approximately 1.1 metric tons (1.2 tons) (1,090 kilograms [2,400 pounds]) of liquid mercury and must provide a minimum head space of 15 percent after maximum fill. The gross weight of the full container should not exceed 1.25 metric tons (1.4 tons) (1,250 kilograms [2,750 pounds]). For the purposes of this analysis, it is assumed that each 1-MT container contains exactly 1 metric ton (about 1.1 tons) (about 1,000 kilograms [2,200 pounds]) of elemental mercury and weighs 1.16 metric tons (about 1.3 tons) (1,160 kilograms [2,550 pounds]). A typical 1-MT container with Resource Conservation and Recovery Act labeling is shown in Figure D–4.

- The 1-MT containers are expected to be sent on pallets, one container per pallet. The pallet should have a built-in spill tray capable of containing 1 metric ton of mercury. The spill tray side walls should be approximately 10 centimeters (4 inches) lower than the height of the container to allow for a forklift to remove the container.

- Upon arrival at the storage facility, the 1-MT containers would be removed from their pallets and set into spill trays on the floor of the facility.

- The 1-MT containers could be stored single or double stacked on the floor in spill trays; Figure D–5 shows a single-stack configuration with eight 1-MT containers. The spill tray would be designed to contain the full contents of one 1-MT container. The single-stack configuration was assumed for the purposes of analysis.

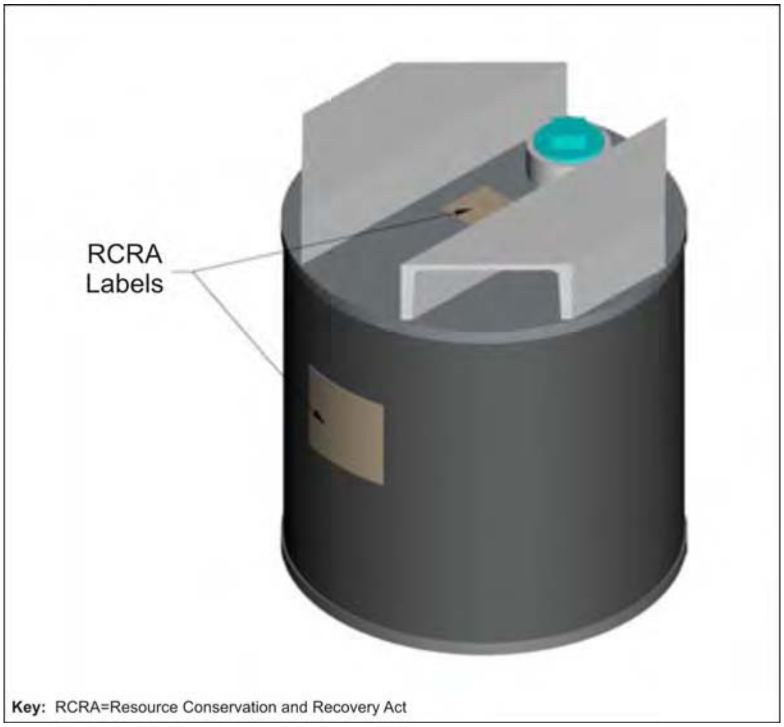


Figure D–4. 1-Metric-Ton Container

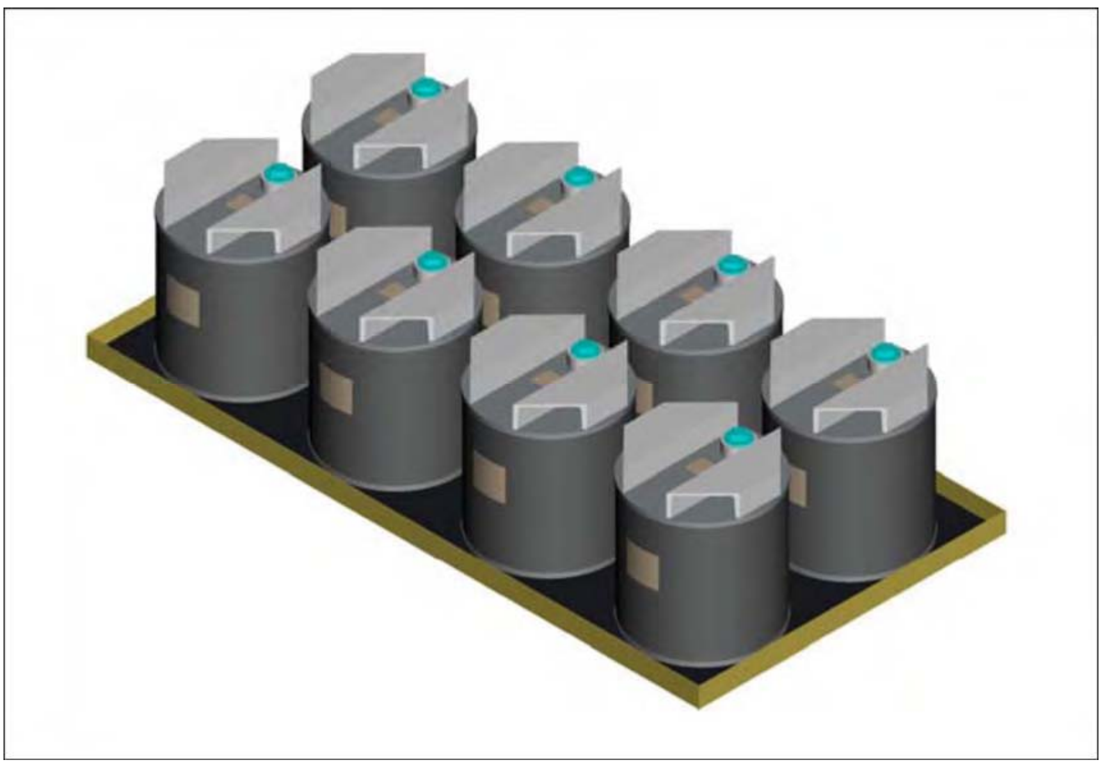


Figure D–5. 1-Metric-Ton Containers in a Spill Tray

D.2.3 Releases During Normal Operations

There is a long history of mercury storage at sites holding the DNSC inventory. Currently, 4,436 metric tons (4,890 tons) are held at three depots: New Haven, Indiana; Somerville, New Jersey; and Warren, Ohio. Formerly, 699 metric tons (770 tons) of this inventory was held at Y–12, but this portion was moved to the Warren Depot in early 2005 (Munger 2005).

Information made available by DNSC shows the most recent purchase of large quantities of mercury was in 1977 (approximately 2,000 3-L flasks); about 54,000 3-L flasks were purchased in 1964. No large purchases of mercury were made between 1964 and 1977, and there was no sale of mercury during that period. The DNSC inventory contained about 200,000 containers after the purchase in 1964; sales between 1977 and 1995 reduced the inventory to the present level of approximately 128,600 containers. Consequently, the containers in the DNSC inventory have been in static storage for at least 30 years, some for substantially longer.

Oak Ridge National Laboratory examined 3-L flasks removed from the DNSC inventory (DOE 2009a). It is known that mercury does not react with steel containers at ambient temperatures; this was confirmed by metallurgical analysis of 3-L flasks from the DNSC inventory. Thus, containers in static storage in a well-maintained facility should have a long lifetime.

In the course of preparation of the *MM EIS* (DLA 2004a, 2004b), information was gathered from site visits, phone calls, and various documents. The inspection reports for the mercury storage areas were reviewed for information about past releases of mercury. No mercury has reportedly escaped from any of the warehouses, and there is no known member of the public that has been affected at any of the existing storage locations.

Decades of experience in maintaining the stockpile of mercury indicate that spills of mercury resulting in environmental contamination have not occurred, and that that normal (accident-free) operating conditions should be maintained at the storage facilities. The storage facilities are built to ensure containment of the mercury under most conditions. Spilled mercury is not known to penetrate the concrete floors and reach any surface-water or groundwater sources before cleanup occurs.

During normal operations, the possibility that there could be small vapor releases from the stored mercury remains. The most obvious potential candidate is a leaking flask or 1-MT container. In 1996, 16 kilograms (36 pounds) of mercury were found in a spill tray beneath flasks at the New Haven Depot. Subsequent analysis of the flask indicated an improperly constructed weld, rather than a degraded weld (as noted above, metallurgical analysis of flasks from the DNSC inventory showed that mercury does not degrade the containers). The *Interim Guidance* (DOE 2009a) provides a summary of more-recent investigations into the condition of the DNSC stockpile. From 1999 through the present, DNSC identified 3 3-L flasks out of approximately 128,000 that leaked a relatively large amount of mercury, 0.5 kilograms (1 pound) or more (approximately 33 milliliters [1.1 fluid ounces]). This means that, over the last 10 years, there has been a historically observed leakage rate of 3-L flasks of 1 in 1.3 million flask-years (7.8×10^{-7} leaks per flask per year). This is probably a conservative estimate of what one might expect the leakage rate of new flasks sent to DOE's new storage facility to be.

The *Interim Guidance* envisages that 40 percent of the assumed 10,000 metric tons (11,000 tons) of elemental mercury would be flasked. Thus, at the end of the 40-year period assumed for analysis purposes, there would be approximately 120,000 flasks in storage, for which the frequency of occurrence of a leak would be 0.09 per year (once in approximately 11 years). Over the full 40 years, the average number of flasks in the facility any one year would be about 60,000, and the average frequency of a leak would be approximately 0.045 per year (once in approximately 22 years). This scenario is further discussed in Section D.4.1, where, for the purposes of bounding the effects of releases on the noninvolved worker and the public during normal operations, it is assumed that the entire contents of a flask leak into the spill tray beneath the pallet and remain undetected (a highly conservative assumption) for a long period.

The risk to the involved worker is also considered in Section D.4.1, but not by analyzing the consequences of an undetected pool of mercury in a spill tray. Instead, it is shown that safety procedures, ventilation, and monitoring are expected to keep the airborne concentration below the ACGIH's 8-hour TWA/TLV of 0.025 mg/m^3 while involved workers are in the building, thus reducing the involved workers' risk to negligible proportions.

D.2.4 Onsite Accidents and Release Scenarios

These releases apply to all storage alternatives. No mercury has reportedly escaped from any of the warehouses currently used for elemental mercury storage by the Defense Logistics Agency or by DOE (at Y–12), and there is no known member of the public that has been affected at any existing storage location.

As discussed in Section D.2.3, decades of experience in maintaining DNSC's stockpile of mercury indicate that spills of mercury resulting in environmental contamination have not occurred and that normal (accident-free) operating conditions should be maintained at the storage facilities. The U.S. Department of Defense's existing storage facilities are built to ensure containment of the mercury under most conditions. Spilled mercury has not been known to reach any surface-water or groundwater sources before cleanup occurs. For these reasons, the only pathway considered for potential accidental releases from the candidate storage buildings is via air, with the possible exception of the No Action Alternative: it is not known whether all facilities that are used to store mercury or commercial sites are designed and built to the same standards.

D.2.4.1 Single-Flask Spill

This scenario assumes that a single flask is dropped during handling, resulting in the breach of the flask, which is a highly conservative assumption for flasks of such robust construction.

There are three plausible scenarios for handling flasks. One is that they are found to be leaking, in which case they would be moved individually to the Handling Area for remediation activities and then back to the Storage Area. In Section D.3 it is shown that the estimated frequency of leaking flasks in the storage facility is approximately 0.045 per year. With two movements associated with this leak, the estimated frequency of movement of individual flasks would be approximately 0.09 per year.

The second scenario is that flasks are found to be leaking on arrival. According to the transportation analysis below, an average of 59 pallets, containing approximately 2,900 flasks would arrive each year. Conservatively assuming that 1 flask in 1,000 is leaking on arrival each year, 3 flasks per year may need to be moved to and from the handling area, a total of six movements per year, which far exceeds the predicted number in the previous paragraph.

The third possibility is that partially full pallets would arrive and need to be consolidated. It is not known how many partially full pallets would arrive each year. For example, if 10 percent of the pallets (6) arrive half full and are consolidated, then approximately 25 flasks would be moved from each of 6 pallets into 6 other pallets, a total of 150 individual flask movements per year. Thus, consolidation of pallets is likely to be the major source of individual flask movements.

Some insight into how likely these flasks are to be dropped can be gleaned from the experience of overpacking flasks at DNSC depots in 2001 and 2002. As noted above, DNSC has approximately 128,600 flasks, all of which were successfully overpacked without incident. Therefore the probability that an individual flasked will be dropped while being moved is less than 10^{-5}. Thus, the estimated frequency of which a flask might be dropped would be less than $150 \times 10^{-5} = 0.0015$ per year. This is a moderate (FL-III) frequency. By the time it is multiplied by some probability (less than 1) of a rupture given a drop, it would likely be even lower. However, conservatively, the estimated frequency of a single-flask drop is taken to be 0.0015 per year (FL-III: moderate).

D.2.4.2 Single-Pallet Spill

Pallets would be handled as they arrive. An average of 59 pallets per year (see Table D–9) would be moved from the truck or railcar to the storage racks, which are stacked three pallets high. At the proposed storage sites, a pallet could be dropped from a height as great as 3.7 meters (12 feet), the height of the top shelf of the rack. The predicted probability that a pallet would be dropped is 2.1×10^{-5} per handling event.[2] This would give a moderate (FL-III) frequency of approximately 0.001 per year. It is assumed that movement of pallets while in storage would at most add a small percentage to this frequency. Conservatively, it is assumed that all of the flasks in a pallet dropped from a height of 3.7 meters (12 feet) would be breached. At the storage sites, the flasks are in 7 × 7 arrays on the pallets.

D.2.4.3 Triple-Pallet Spill

As a conservative and hypothetical scenario, a portion of the racks holding the flask storage pallets is assumed to collapse (possibly as a result of a collision involving a forklift), resulting in the collapse of three pallets in a stack and the release of liquid mercury onto the floor. It is unlikely that the entire contents of three pallets would be spilled from a single stack onto the floor. This event is considered to be no more likely than a single-pallet drop and has a moderate (FL-III) frequency with the assumption that the full contents of the 147 3-L flasks in the three pallets would be spilled.

D.2.4.4 1-Metric-Ton Container Spill

The transportation analysis indicates that the facility would receive approximately 150 1-MT containers per year (see Table D–9). This means that the frequency of a drop from a forklift is $150 \times 2.1 \times 10^{-5}$, or approximately 0.003 per year (FL-III). There is no reason to lift the 1-MT containers more than a few feet from the ground—after passing initial inspection, the 1-MT containers would be lifted out of their crates and moved into the Handling Area for waste acceptance criteria testing. If a container is found to be leaking, it would be remediated there. The containers that pass the acceptance and verification process would be placed onto spill trays in the Storage Area. For the purposes of this analysis, it is assumed that 1-MT containers are never lifted above the height of the drop test specified in Title 49 of the *Code of Federal Regulations*, Section 178.810, for containers required to meet Packaging Group III specifications, namely 1.55 meters (approximately 5 feet). Therefore, it is unlikely that a 1-MT container would be breached by a drop. Conservatively, it is assumed that no more than 1 in 100 dropped containers would be breached. This gives a predicted frequency of 3.0×10^{-5} per year, a low (FL-II) frequency. However, if the container is breached, it is conservatively assumed that 1 metric ton (about 1.1 tons) of mercury would spill onto the floor.

It is assumed that only one 1-MT container would be moved at a time. In addition, since it is assumed that 1-MT containers would be single stacked, there is no equivalent of the triple-pallet collapse.

D.2.4.5 Forklift Fire

The *Interim Guidance* suggests an electric Yale ERC-055-VG as a nominal commercial forklift for consideration. It has power steering, a high-visibility mast that can be lifted to the 3.7-meter (12-foot) recommended maximum height of stacks, and cushioned tires (approximately 10- by 25-centimeter [4- by 10-inch) wetted floor area on load). It has an approximately 2,490-kilogram (5,500-pound) capacity (at approximately 61-centimeter [24-inch] center), which is acceptable for the suggested 1.44- by 1.44-meter

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[2] As a point of reference, the *Revised Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center* (DOE and NYSERDA 2008:I-32) identifies a waste package handling and drop accident frequency with a resultant puncture from the drop of 2.10×10^{-6} to 2.1×10^{-5} per package handling. For this *Mercury Storage EIS*, the upper range of 2.1×10^{-5} per waste package was multiplied by the number of packages handled annually. The accident frequency does not specify handling by a forklift, just handling, in general, but this is judged to be a viable source for a frequency value.

(56- by 56-inch) 3-L flask pallet or for moving 1-MT containers. The electric forklift would contain no fuel. Therefore, a forklift fire is not a credible scenario and has a negligible (FL-I) frequency.

D.2.4.6 Building Fire

This scenario assumes that a severe fire occurs involving combustible materials associated with mercury storage operations. These include wood storage pallets and miscellaneous materials, such as plastic sheeting, paper, cardboard, and flammable construction materials. Potential ignition sources include electrical control panels, distribution circuits, and fixtures. The amount of combustible material in the Storage Areas would be maintained at as low a level as feasible.

The 2004 *MM EIS* (DLA 2004a) observed that loading materials at the Warren Depot are minimally combustible (other than wooden pallets), and there are limited ignition sources there. There is no wood in the structure of the warehouse itself. In addition, the EIS determined that, the installed fire suppression system would reduce the likelihood of building fires that could result in the breach of the flasks. Therefore, building fires over the course of time during storage were assigned to the negligible (FL-I) frequency category.

It is assumed that the structure of the mercury storage building at DOE's chosen storage site and other factors that might contribute to a fire would make the predicted frequency of a fire with mercury release no greater than that estimated for the Warren Depot in 2004.

D.2.5 External Events

Onsite accidents that are initiated by external events may occur at any of the candidate sites under consideration for the mercury storage facility. External events that are considered are listed below.

- Wildfires
- Earthquakes
- High winds or tornadoes
- Floods
- Lightning
- Snow loads
- Aircraft crashes
- Vehicle crashes
- Nearby facility fires or explosions

Each event is considered in terms of its likelihood of occurrence and its potential impact in terms of a mercury release from the flasks and 1-MT storage containers. The potential magnitude of these events varies significantly between the candidate sites due to the wide spectrum of climate, topography, seismology, and collocated site facilities that exist at each location. The structures proposed for mercury storage at the candidate sites vary from existing buildings with known designs to a hypothetical standard design for a new facility. The relevant building codes at each candidate site may also vary due to local or state requirements. These facility designs could potentially react differently to postulated external events; reactions would range from structural failure and concomitant mercury release to no damage and no mercury release. In this evaluation of external events, it is conservatively assumed that the storage facility at each candidate site would react to each external event with the largest postulated degree of damage and mercury release. For all external events, no credit is taken for emergency response actions of onsite personnel, which, in reality, could preclude or ameliorate mercury releases to the environment. Other than fires or explosions, the release of mercury to the environment from spills would occur over a relatively long time period, in which cleanup and confinement by onsite workers would significantly mitigate offsite releases.

D.2.5.1 Wildfires

The propensity for wildfires at each site is a function of the climate, the presence of combustible vegetation, and the historic incidence of such events. A dry or hot climate or one that is subject to a high frequency of lightning has a greater potential for initiating wildfires, given the presence of combustibles. In addition, anthropogenic ignition sources, including cigarettes, fireworks, exhaust heat sources, and camp fires may cause such fires. Grasses, brush, shrubs, and trees all constitute potentially combustible material around each site. The initiation of a wildfire would be exacerbated by significant winds, which tend to spread the fire rapidly without mitigation measures by firefighters. Wildfires have occurred near some of the candidate sites (Albin, McBaugh, and May 2009; DLA 2004a:2-4, 2-5). With the exception of KCP, all the candidate sites are located in rural areas with the potential for wildfires. The KCP site is in an urban location surrounded by an area that consists of buildings and paved roads with little open natural combustible material.

The expected frequency of a wildfire in the area around the mercury storage facility, coupled with the conditional probability that the wildfire would impinge on the facility and cause a significant mercury release, is considered to be negligible. A postulated wildfire event is bounded by the truck and railcar fire accident and intentional destructive act (IDA) fire scenarios; thus, a wildfire event is not evaluated further.

D.2.5.2 Earthquakes

Earthquake-produced ground motion is expressed in units of percent *g* (force of acceleration relative to that of Earth's gravity). The latest probabilistic peak ground acceleration (PGA) data from the U.S. Geological Survey are used in this EIS to assess seismic hazard among the various mercury storage candidate sites. The PGA values cited are based on a 2 percent frequency of exceedance in 50 years. This corresponds to an annual frequency (chance) of occurrence of about 1 in 2,500 or 4×10^{-4} per year. A comparison of these PGA values for each site is presented in Table D–5. This FL is moderate (FL-III).

Table D–5. Mercury Storage Site Peak Ground Acceleration

Mercury Storage Site	Peak Ground Acceleration (*g*)[a]
Grand Junction Disposal Site, Colorado	0.14
Hanford Site, Washington	0.18
Hawthorne Army Depot, Nevada	0.57
Idaho National Laboratory, Idaho	0.12
Kansas City Plant, Missouri	0.05
Savannah River Site, South Carolina	0.17
Waste Control Specialists, LLC, Texas	0.12
Y–12 National Security Complex, Tennessee	0.22

[a] This is the value that has a 1 in 2,500 (4×10^{-4} per year) annual frequency of exceedance, expressed in units of percent (*g*), or the force of acceleration relative to that of Earth's gravity.

This table shows that the Hawthorne Army Depot has the highest PGA, whereas KCP, INL, and WCS have the lowest. Structures at locations with higher PGAs would be designed, in accordance with the national and local building codes applicable at the time of construction, to withstand a larger-magnitude earthquake than those at locations with lower PGAs. However, since the structural design of each storage facility cannot be ascertained, an earthquake-initiated accident involving the release of mercury was postulated and analyzed.

In the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*, it was assumed that an earthquake would topple the top row of stored drums, which were stored in a configuration stacked three rows high (DOE 2008:D-31, D-32). This assumption was used in analyzing a seismic event for a radioactive waste storage facility. For an earthquake accident in this *Mercury Storage EIS*, it is conservatively assumed that all flasks would release their entire contents of mercury with no retention of any of the mercury within the flasks. In addition, it is conservatively assumed that the earthquake would cause the building roof to collapse and that the roof would then fall onto and breach all 1-MT mercury storage containers. As a result, a pool of mercury within the storage building would become the source of release to the environment. The following two alternative earthquake scenarios are considered in this EIS:

- The building remains sufficiently intact so that the spill can still be regarded as occurring inside the building.
- The building collapses and the spilled pool of mercury is, for all intents and purposes, in the open air.

No attempt was made to assess the relative conditional probabilities of these two scenarios, i.e., they are both assigned a moderate (FL-III) frequency.

The possibility that there could be a fire subsequent to the earthquake remains. In some EISs, a seismic event that then causes a fire is only considered when there a natural gas main, hydrogen, propane, or solvents in the building (DOE 1999:E-5.5, 2001A:D-82,D-83). In one EIS, the presence of a natural gas pipeline within a building that could be ruptured by an earthquake and cause a subsequent fire was not analyzed because the earthquake-induced damage to the building would result in a dilution of the released natural gas to below its flammability limit (DOE 2002a:C-11). Since none of the facilities evaluated in this EIS have fuel pipelines or stored fuels the frequency of an earthquake with subsequent fire would be negligible.

The storage buildings could have small quantities of chemicals, such as flammable solvents. It is assumed that, if these should catch fire, there would be negligible effect on the stored mercury.

D.2.5.3 High Winds or Tornadoes

Data on tornado occurrence frequency and severity, using the Fujita or "F" scale, for the seven sites considered for mercury storage and Y–12, are presented in Table D–6 (NOAA 2009). Tornadoes of severity F1 and F0 are not expected to cause storage building damage sufficient to result in any significant mercury release to the environment. Many well-constructed buildings would survive an F2 tornado without serious damage to the roof or walls. Tornadoes have occurred most often and have been most severe in the county(ies) surrounding KCP, SRS, and WCS. Conversely, tornadoes have occurred least often and have been least severe in the count(ies) surrounding Hanford and the Hawthorne Army Depot. Severity F4 and F5 tornadoes have only occurred in the county(ies) surround KCP, and F3 tornadoes have only occurred in the county(ies) surrounding KCP, SRS, and WCS.

Table D–6. Mercury Storage Candidate Site Tornado Frequency and Severity

Mercury Storage Site	Annual Tornado Occurrence Rate Total (≥ F2)[a]	Tornado Severity Distribution (Fujita Scale[b])	Predicted Annual Rate of Tornado (≥ F2) Strike on the Storage Facility[c]
Grand Junction Disposal Site, Colorado	0.135 (0.0)	13% F1, 87% F0	0
Hanford Site, Washington	0.0338 (0.0)	100% F0	0
Hawthorne Army Depot, Nevada	0.0 (0.0)	Not applicable	0
Idaho National Laboratory, Idaho	0.118 (0.0)	29% F1, 71% F0	0
Kansas City Plant, Missouri	0.523 (0.183)	2% F5, 3% F4, 8% F3, 18% F2, 27% F1, 42% F0	2.49×10^{-5}
Savannah River Site, South Carolina	0.81 (0.19)	2% F3, 21% F2, 27% F1, 50% F0	6.66×10^{-7}

Table D–6. Mercury Storage Candidate Site Tornado Frequency and Severity *(continued)*

Mercury Storage Site	Annual Tornado Occurrence Rate Total (≥ F2)[a]	Tornado Severity Distribution (Fujita Scale[b])	Predicted Annual Rate of Tornado (≥ F2) Strike on the Storage Facility[c]
Waste Control Specialists, LLC, Texas	0.388 (0.035)	9% F2, 24% F1, 66% F0	1.83×10^{-7}
Y–12 National Security Complex, Tennessee	0.0506 (0.034)	8% F3, 23% F2, 46% F1, 23% F0	2.69×10^{-8}

[a] Data collected from NCDC (2009) give tornado paths to within 4.0 kilometers (2.5.miles). The frequencies presented in column 2 of Table D–6 are for the annual rate of occurrence within a single county, if the facility is more than 4.0 kilometers (2.5 miles) from the county boundary, or within more than one county otherwise.

[b] Fujita Scale: F0, 40–72 mph; F1, 73–112 mph; F2, 113–157 mph; F3, 158–206 mph; F4, 207–260 mph; F5, 261–318 mph (NOAA 2009).

[c] Obtained by multiplying the ≥ F2 annual occurrence rate in column 2 by the ratio of the building area to the area of the county(ies) from which data were collected.

Key: mph=miles per hour.

Source: NCDC 2009, tornado data from January 1, 1950, to April 1, 2009 (sum of tornadoes reported for county(ies) around each site).

Table D–6 also provides an estimate of the frequency at which tornadoes of severity ≥ F2 would strike the storage building; F2 is conservatively assumed to be the lowest tornado severity level at which building damage could occur. Those frequencies are negligible (FL-I) except at KCP, where the result is driven by having conservatively used the footprint of the whole Bannister Federal Complex in the calculation of frequency (see footnote c to Table D–6). At KCP, the rate of building strikes is at FL-II. This is less than that for an earthquake, and the consequences would not be any more severe. Therefore, at KCP, the tornado risk is bounded by that of earthquakes.

D.2.5.4 Floods

All candidate sites may be subject to a flood, although the frequency of such an event would vary depending on the likelihood of floods at each location and the design and elevation relative to calculated floodplains of a specific storage facility.

The *Interim Guidance* (DOE 2009a) states the following:

> "40 CFR 270.14(b)(11) also refers to the seismic/floodplain requirements. An elemental mercury storage facility should not, if possible, be located in a listed 100-year floodplain. If the chosen facility site is within a 100-year floodplain, then it must be shown that there is either no impoundment area "washout," or the effect of "washout" is acceptable. The site should be examined and graded to avoid flooding. The upper lip of the facility's slab should be well above grade, and the 60-ft apron area should be contoured and landscaped so runoff will move away from the facility with minimal erosion [see also 40 CFR 264.175(b)(4) for design requirements for run-on prevention]. Further, runoff from neighboring upland areas should be intercepted (e.g., by ditching) before the 60-ft apron and directed away from the facility."

For the purposes of this analysis, it is assumed that either the storage facility would not be located within the 100-year floodplain or that engineered features would ensure that the frequency at which floodwater would enter the building is less than once in 100 years—i.e., a moderate FL (FL-III)—the same as that for an earthquake.

The magnitude of a flood event could range from water seepage into the building and exterior damage to large-scale water intrusion and high water levels inside the storage building. Flooding could compromise the water-resistant design of the building, cause a loss of electric power, and temporarily preclude access to the facility by normal ground transport vehicles. An extreme flood could cause toppling of stacked pallets and the failure of some storage flasks or containers. However, the number of flasks and containers assumed to fail and release mercury under the earthquake event would bound any such failures in an extreme flood event. The most likely impact of an extreme flood would be damage to the storage building and the deposition of soil and debris in the mercury storage area.

Since the earthquake event frequency and consequences bound those for floods, the earthquake scenario is considered to be bounding for floods.

D.2.5.5 Lightning

Severe weather could cause the storage building to be struck by lightning. The combined frequency of a lightning strike on the building, failure of the building's design to ground the lightning, initiation of a fire in the building from the lightning, and such a fire's causing the release of mercury is expected to be low. A fire of sufficient magnitude to cause failure of mercury containers is not expected to occur as a result of a lightning strike. Although some candidate sites are more likely to be subject to lightning based on their meteorological history, the storage facility at each site would be designed to properly ground lightning strikes and mitigate any lightning-induced fires before the confinement integrity of mercury storage containers could be breached. The truck and railcar fire accident scenarios in this section and in the IDA analysis involve large quantities of mercury and bound any lightning-induced fire at the facility. Therefore, this event is not evaluated further.

D.2.5.6 Snow Loads

The possibility of a large accumulating snowfall resulting in large structural loads on the roof of the mercury storage facility would be considered in the design of the facility for each site. Although the likelihood of a large snowfall event is larger at some candidate sites, the structure at each site would be designed to withstand the appropriate design snow load without releasing mercury to the environment. In the event that severe snow loads cause the collapse of the roof, the collapsed structure could result in release of mercury from some storage containers. The mercury releases associated with an extreme snow-load-induced roof collapse would be bounded by the earthquake accident scenario. Therefore, this event is not evaluated further.

D.2.5.7 Aircraft Crashes

Table D–7 presents a delineation of the relative location of all airports within the region of each of the candidate mercury storage sites, as well as the type of airport in terms of the aircraft that use these airports. This table shows that each site has a number of airports within a 50-mile (80-kilometer) distance. The Hawthorne Army Depot has the closest airport at 3 miles (5 kilometers) away, but this is a general aviation facility that accommodates small, private aircraft. Commercial airports that handle larger, jet aircraft are located 11 to 49 miles (18 to 79 kilometers) from the sites, with the closest near KCP and GJDS, followed by SRS E Area.

Table D–7. Location and Type of Airports Near Candidate Mercury Storage Sites

Mercury Storage Site	Airport	Type of Airport	Distance From Site (miles)
Grand Junction Disposal Site, Colorado	Crawford	General Aviation	40
	Blake Field	General Aviation	18
	WestWinds	General Aviation	15
	Grand Junction Regional	Commercial	17
	Mack Mesa	General Aviation	38
	Montrose Regional	Commercial	37
	Hopkins Field	General Aviation	47
	North Fork Valley	General Aviation	38

Table D–7. Location and Type of Airports Near Candidate Mercury Storage Sites *(continued)*

Mercury Storage Site	Airport	Type of Airport	Distance From Site (miles)
Hanford Site 200 Areas, Washington	Vista Field	General Aviation	30
	Desert Aire	General Aviation	16
	Grant County International	Commercial	47
	Moses Lake Municipal	General Aviation	45
	Othello Municipal	General Aviation	31
	Tri-Cities	Commercial	31
	Prosser	General Aviation	25
	Quincy Municipal	General Aviation	47
	Richland	General Aviation	23
	Sunnyside Municipal	General Aviation	22
	Warden	General Aviation	39
	Yakima Air Terminal/ McAllister Field	Commercial	43
Hawthorne Army Depot, Nevada	Gabbs	General Aviation	42
	Hawthorne Industrial	General Aviation	3
	Mina	General Aviation	30
	Rosaschi Air Park	General Aviation	44
	Yerington Municipal	General Aviation	43
Idaho National Laboratory, Radioactive Waste Management Complex, Idaho	Aberdeen Municipal	General Aviation	41
	American Falls	General Aviation	50
	Arco-Butte County	General Aviation	16
	Big Southern Butte	General Aviation	5
	Coxs Well	General Aviation	22
	Midway	General Aviation	12
	McCarley Field	General Aviation	40
	Carey	General Aviation	47
	Antelope Valley	General Aviation	31
	Howe	General Aviation	23
	Idaho Falls Regional	Commercial	48
	Copper Basin	General Aviation	46
	Mackay	General Aviation	40
	Hollow Top	General Aviation	30
	Bear Trap	General Aviation	39
	Mud Lake/W. Jefferson County	General Aviation	35
	Pocatello Regional	Commercial	46
	Rockford Municipal	General Aviation	33
Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center, Idaho	Aberdeen Municipal	General Aviation	45
	Arco-Butte County	General Aviation	20
	Big Southern Butte	General Aviation	11
	Coxs Well	General Aviation	29
	Midway	General Aviation	10
	McCarley Field	General Aviation	38
	Antelope Valley	General Aviation	35
	Howe	General Aviation	19
	Idaho Falls Regional	Commercial	43
	Copper Basin	General Aviation	48
	Mackay	General Aviation	41
	Hollow Top	General Aviation	37
	Bear Trap	General Aviation	46
	Mud Lake/W. Jefferson County	General Aviation	28
	Pocatello Regional	Commercial	49
	Rigby-Jefferson County	General Aviation	50
	Rockford Municipal	General Aviation	33

Table D–7. Location and Type of Airports Near Candidate Mercury Storage Sites *(continued)*

Mercury Storage Site	Airport	Type of Airport	Distance From Site (miles)
Kansas City Plant, Missouri	Triple R	General Aviation	38
	Kansas City International	Commercial	24
	Harry S. Truman Regional	General Aviation	26
	Butler Memorial	General Aviation	48
	Excelsior Spring Memorial	General Aviation	33
	East Kansas City	General Aviation	20
	Lawrence Smith Memorial	General Aviation	27
	Higginsville Industrial Municipal	General Aviation	49
	Charles B. Wheeler Downtown	General Aviation	11
	Lee's Summit Municipal	General Aviation	11
	Lexington Municipal	General Aviation	39
	Roosterville	General Aviation	24
	Midwest National Air Center	General Aviation	29
	Plattsburg Airpark	General Aviation	44
	Vinland Valley Aerodrome	General Aviation	34
	Sherman AAF	General Aviation	34
	Gardner Municipal	General Aviation	23
	Lawrence Municipal	General Aviation	35
	Cedar Air Park	General Aviation	17
	Johnson County Executive	General Aviation	12
	New Century Aircenter	General Aviation	19
	Ottawa Municipal	General Aviation	47
	Miami County	General Aviation	35
	Hillside	General Aviation	10
Savannah River Site E Area, South Carolina	Augusta Regional at Bush Field	Commercial	18
	Daniel Field	General Aviation	25
	Louisville Municipal	General Aviation	47
	Millen	General Aviation	33
	Plantation Airpark	General Aviation	44
	Burke County	General Aviation	26
	Wrens Memorial	General Aviation	42
	Aiken Municipal	General Aviation	24
	Allendale County	General Aviation	30
	Bamberg County	General Aviation	32
	Barnwell Regional	General Aviation	15
	Twin Lakes	General Aviation	27
	Hampton-Varnville	General Aviation	44
	Dry Swamp	General Aviation	44
	Orangeburg Municipal	General Aviation	48
	Lexington County at Pelion	General Aviation	42
	Edgefield County	General Aviation	32
Waste Control Specialists, LLC, Texas	Lea County Regional	General Aviation	19
	Lea County, Jal	General Aviation	22
	Lea County-Zip Franklin Memorial	General Aviation	40
	Andrews County	General Aviation	32
	Denver City	General Aviation	38
	Seagraves	General Aviation	46
	Gaines County	General Aviation	29

Table D–7. Location and Type of Airports Near Candidate Mercury Storage Sites *(continued)*

Mercury Storage Site	Airport	Type of Airport	Distance From Site (miles)
Y–12 National Security Complex, Tennessee	Crossville Memorial-Whitson Field	General Aviation	46
	Mark Anton	General Aviation	50
	Campbell County	General Aviation	24
	Jamestown Municipal	General Aviation	46
	Knoxville Downtown Island	General Aviation	22
	McGhee Tyson	Commercial	20
	Powell	General Aviation	15
	Monroe County	General Aviation	31
	Moore-Murrell	General Aviation	50
	Scott Municipal	General Aviation	37
	Rockwood Municipal	General Aviation	25
	Gatlinburg-Pigeon Forge	General Aviation	42
	McCreary County	General Aviation	49

Note: Commercial airports handle a range of aircraft up to and including large passenger and cargo aircraft. General aviation airports, which include air taxis, handle small aircraft. To convert miles to kilometers, multiply by 1.60934.

A number of evaluations have been made for aircraft crash accident frequency at the DOE Hanford, INL, SRS, and Y–12 sites. An assessment of aircraft crash frequency in the 200 Areas at Hanford (Chew 2003:16) used non-airport crash frequencies for five types of fixed-wing aircraft: general aviation, commercial air carrier, commercial air taxi, large military, and small military. These frequencies are in terms of the annual likelihood of occurrence per square mile of ground impact area. Although the generic mercury storage facility would have a building area of up to 14,703 square meters (158,256 square feet), an area of 18,581 square meters (200,000 square feet) was assumed to encompass proposed existing buildings at some of the sites. The frequency of a crash of a large commercial or military aircraft for this storage facility area would be 1.4×10^{-9} per year. If smaller commercial and military aircraft are included, the total aircraft crash frequency would increase to 7.3×10^{-7} per year. Over 98 percent of this total aircraft crash frequency is due to small general aviation aircraft. Thus, the total aircraft crash frequency in the Hanford 200 Areas would be less than 1×10^{-6} per year; this frequency is dominated by small aircraft that are not expected to cause significant damage to the storage building or mercury releases to the environment compared with accident scenarios that are analyzed in this section.

Analysis of small- and large-aircraft-crash probabilities per square mile of area was previously performed for INL (DOE 2000:F-13). Using the bounding mercury storage facility area, the large- and small-aircraft-crash frequency is determined to be 6.5×10^{-7} per year. The small-aircraft-crash frequency accounts for over 99 percent of this frequency.

Two previous EISs evaluated the annual frequency of an aircraft crash at SRS. The accident analysis of salt processing alternatives at the SRS S Area provided an aircraft impact frequency of 3.7×10^{-7} per year and a helicopter crash frequency of 4.8×10^{-7} per year (DOE 2001b:B-9). The sodium-bonded spent nuclear fuel aircraft crash analysis (DOE 2000:F-24) evaluated the SRS F Area and used data, in terms of frequency per square mile of impact area, for four types of aircraft: air carrier, air taxi, large military aircraft, and small military aircraft. Using the bounding storage facility area, the total aircraft crash frequency is calculated to be 2.4×10^{-8} per year. Small commercial and military aircraft account for 78 percent of this frequency.

An evaluation of an aircraft-crash-induced fire accident scenario was performed for the Y–12 site (DOE 2001a:D-73). Large-aircraft-crash accidents were not analyzed because their frequency was determined to be less than 1×10^{-7} per year, and small-aircraft-crash-induced fire scenarios were found to be bounded by other analyzed accidents.

An accident analysis was performed for a generic DOE low-level radioactive waste storage facility to assess differences in risks between sites (Roglans-Ribas et al. 1995). This analysis determined frequency categories for a range of accident scenarios, including large-aircraft impact and small-aircraft impact, at Hanford, SRS, and INL. The four frequency categories were (1) greater than 10^{-2} per year, (2) 10^{-2} per year to 10^{-4} per year, (3) 10^{-4} per year to 10^{-6} per year, and (4) less than 10^{-6} per year. For all the sites, both small- and large-aircraft-impact accident scenarios were placed in the less than 10^{-6} per year category (Roglans-Ribas et al. 1995:Tables I and II).

A summary of previously calculated aircraft crash frequencies at DOE sites is presented in Table D–8.

Table D–8. Summary of Aircraft Crash Frequencies – Studies Performed for U.S. Department of Energy Sites

Site	Small-Aircraft-Crash Frequency[a]	Large-Aircraft-Crash Frequency[a]	Total-Aircraft-Crash Frequency
Hanford Site 200 Areas	7.29×10^{-7} per year	1.4×10^{-9} per year	7.3×10^{-7} per year
Idaho National Laboratory	6.47×10^{-7} per year	3.0×10^{-9} per year	6.5×10^{-7} per year
Savannah River Site S Area	–	–	3.7×10^{-7} per year[b]
Savannah River Site F Area	1.9×10^{-8} per year	5.0×10^{-9} per year	2.4×10^{-8} per year
Y–12 National Security Complex	–	less than 10^{-7} per year	–
All sites	less than 10^{-6} per year	less than 10^{-6} per year	less than 10^{-6} per year

a Small aircraft are typically single- and twin-engine aircraft weighing less than 4,500 kilograms (10,000 pounds), whereas large aircraft have a greater weight and include jet, as well as propeller engines.

b In addition, a helicopter crash frequency of 4.8×10^{-7} per year was calculated for SRS S Area.

Source: Chew 2003:16; DOE 2000:F-13, F-24, 2001a:D-73, 2001b:B-9; Roglans-Ribas et al. 1995:Tables I and II.

The consequences of a postulated small aircraft crash into a building storing hazardous and radioactive waste in drums on pallets, each holding 4 drums and stacked two pallets high, was calculated by DOE (DOE 2005). A general aviation aircraft was conservatively assumed to penetrate the structure. Based on aircraft and engine size, as well as aviation fuel tank capacity, this analysis determined that 4 drums would fail catastrophically due to engine impact; 25 would be engulfed in the fuel fire, causing catastrophic failure of 5 of these drums; and 22 would experience lid seal failure due to their juxtaposition to the fire. Thus, the release from this aircraft crash accident would consist of the entire contents of 9 drums due to total failure and leakage from an additional 22 drums (DOE 2005). The drum and pallet geometry for this accident scenario is analogous to that of mercury flasks at the mercury storage facility. The seismic accident scenario analyzed for mercury storage assumes a much larger number of failed flasks than this aircraft crash event and also has a higher frequency.

All the candidate sites could be subject to an aircraft crash, but none are closer than 17 miles (27 kilometers) from a commercial airport that handles large aircraft. The small area of the buildings, type of aircraft in the airspace, and associated flight vectors make the predicted frequency of such an accident negligible. Calculated frequencies of aircraft crashes from previous analyses have all shown that such an event has a likelihood of less than 10^{-6} per year and, in some cases, less than 10^{-7} per year for DOE sites. Moreover, large-aircraft-impact frequency was calculated to be a factor of 10 to 100 smaller than that for all aircraft. The mercury releases associated with an aircraft impact would be bounded by the earthquake and fire accident scenarios. Therefore, this event is not evaluated further.

No mercury would be transported by air under the actions analyzed in this EIS.

D.2.5.8 Vehicle Crashes

All candidate sites are expected to have a range of vehicles in use, from automobiles to trains. A vehicle crash into the storage facility would not cause any release of mercury because of the location of 3-L flasks and 1-MT containers inside the building relative to the exterior walls and because it is assumed that there are restrictions on vehicle speeds on site. Some exterior wall damage might result, requiring subsequent repair. Therefore, this event is not evaluated further.

D.2.5.9 Nearby Facility Fires or Explosions

All candidate sites include facilities with small quantities of combustible material in the form of wood, paper, or liquid hydrocarbon products. The only site with explosives is the Hawthorne Army Depot, but these explosives would be stored at a sufficient distance from the mercury storage facility in specially designed structures so as to preclude any damage from an accidental detonation that could release mercury to the environment. Facility design and operational procedures at the Hawthorne Army Depot are designed specifically to prevent accidental detonation of explosives. Any nearby facility fire is not expected to impinge on the mercury storage facility, but if there were damage, the consequences of the truck, railcar, and IDA fire analyzed in this EIS would bound the consequences of a nearby facility fire. The frequency of an explosion or fire at a nearby facility of sufficient magnitude to cause the release of mercury is estimated to be negligible. Therefore, this event is not evaluated further.

D.2.6 Intentional Destructive Acts

In accordance with 2006 DOE National Environmental Policy Act guidance (DOE 2006), this section was developed to explicitly consider the potential impacts of IDAs on long-term storage of elemental mercury. A wide range of IDA scenarios involving the release of mercury can be postulated for the sites being considered for mercury storage. Each involves an action by intruders or insiders that affects mercury inventories either at the storage facility or during transportation to the storage facility. The human health impacts of an IDA are directly related to the magnitude of mercury available for disposition, as well as the means of dispersing it to the environment. Other factors that affect impacts include population density, distance to the population, and meteorology. IDA scenarios were selected based on the magnitude of mercury at the storage facility or in a transport vehicle. Other factors that were considered include the nature of the IDA event that would result in the highest dispersion of mercury to the environment. The likelihood or frequency of the IDA scenarios analyzed in this section cannot be quantified because of the dependence on intruder actions and security measures that would be employed by DOE. Each IDA scenario assumes multiple actions by intruders with no successful mitigation or protection measures by DOE. Conservative analytical assumptions are also imposed on the calculations. The results are presented in terms of consequences, but not annual risks, because of the lack of an annual probability or frequency for these IDA events.

The accident analyses in Section D.4 show that the largest airborne and ground mercury concentrations would result from scenarios in which a quantity of mercury in containers is exposed to a fire. The energy of a fire would exacerbate the mercury release rate and increase the plume release height. Since the accident analysis evaluates fire scenarios involving available fuel in a truck or railcar that contains mercury, the IDA scenarios were developed to incorporate larger quantities of flammable material in concert with mercury in containers on a truck or railcar. The largest easily accessible and mobile source of large quantities of flammable material is a gasoline tank truck, which may contain between 18,927 and 34,069 liters (5,000 and 9,000 gallons) of gasoline (LAFD 2009). The IDA scenario postulates that a group of individuals hijack a fully loaded 34,069-liter (9,000-gallon) gasoline tank truck, which they then drive into either a truck or railcar loaded with mercury being carried in either 3-L flasks or 1-MT (1.1 ton) containers. Another postulated scenario would involve two groups of armed intruders: one hijacking the loaded tanker truck and the other disabling the train or truck carrying mercury.

The postulated armed intruders would incapacitate any persons accompanying the shipment; release the gasoline in the tank truck on and around the mercury storage containers; and set the gasoline on fire, thereby engulfing the mercury cargo in an unmitigated fire. This IDA event may occur either in transit or at the unloading location at the mercury storage facility. The same quantity of gasoline and mercury are assumed to be available under both scenarios; these quantities would only be limited by the transport capacity of the truck or railcar. The most vulnerable large quantities of mercury were determined to be truck or railcar shipments either in transit or at the facility prior to unloading.

IDA scenarios involving an attack on the storage facility other than during unloading of a truck or railcar are predicted to be less likely because of the distribution of mercury within the facility, presence of security, and facility design features that would ameliorate mercury releases to the environment.

The above discussion does not apply to continued storage of DOE mercury at Y–12 because there would be no transportation of mercury to the site under the No Action Alternative. The mercury storage facility is located in a secure area with armed guards, a Perimeter Intrusion Detection and Alarm System, and daily patrols. This level of security and protection makes the mercury storage structure at Y–12 much less vulnerable to any postulated IDA scenario. The current mercury storage structure at Y–12 is composed of concrete block walls with steel I beams supporting a roof composed of gypsum and asphalt. Given the level of safety and security of this facility, as well as its construction and design, no additional IDAs that would result in human health consequences greater than those analyzed for accident events are postulated to occur.

D.2.7 Offsite Transportation Accidents and Releases

Offsite accidents could occur during transportation to the chosen storage site. The following are the assumptions governing the transportation analysis (some of these assumptions overlap those about the facility):

- The following three transportation scenarios are considered: (a) Truck Scenario 1: full truck shipments; (b) Truck Scenario 2: truck shipments are at 50 percent capacity (doubling the number of truck shipments) from R&R and mining facilities and from Peru, but full truck loads from Y–12 and chlor-alkali facilities; and (c) shipments by rail-full railcars. Truck Scenario 2 also accommodates the possibility that there may be shipments of pallets containing less than 49 flasks.

- This analysis addresses up to 10,000 metric tons (11,000 tons) of mercury being transported and stored at a DOE facility. This total would include 1,206 metric tons (1,330 tons) from Y–12 (11,000 tons), 1,101 metric tons (1,214 tons) from chlor-alkali facilities, 3,687 metric tons (4,064 tons) from domestic gold mining, 1,236 metric tons (1,362 tons) from U.S.-owned gold mines in Peru[3], and 2,770 metric tons (3,053 tons) from R&R facilities. The mercury from Y–12, chlor-alkali facilities, gold mining in the United States, and gold mining in Peru would be transported directly to the DOE facility without going to an R&R facility.

- All mercury from Y–12 would be transported in 3-L (0.8-gallon) (34.6-kilogram [76-pound]) flasks. Mercury from chlor-alkali facilities would be transported in 1-MT containers. The overall proportion of mercury in 1-MT containers to that in 3-L flasks would be 60:40 (DOE 2009a). Mercury from mining or R&R facilities in the United States could be transported in either 3-L flasks or 1-MT containers. Mercury from mining in Peru would be transported in 3-L flasks (Brooks et al. 2007).

[3] An estimate of this mercury was included in the quantity estimates as a conservative planning assumption regarding potential contributions to excess elemental mercury. However, the inclusion of an estimate of this mercury does not reflect or conclude that such mercury would be “generated in the United States” as that phrase is used in the Act.

- Packaging of the mercury at the point of origin, transportation to the R&R facilities or to a U.S. port, any processing and repackaging at the R&R facilities, and subsequent loading onto trucks or railcars are not analyzed in this *Mercury Storage EIS* on the grounds that all of these activities would be carried out anyway, irrespective of the final disposition of the elemental mercury. There is no direct rail access to GJDS, so transfer to trucks in the city of Grand Junction would be necessary. This is considered in Chapter 4, Section 4.3.9.

- Elemental mercury would be transported either by road or rail. No other mode of transportation would be considered.

- Y–12 shipments would occur in years 2013–2014. Chlor-alkali shipments would be spread across 7 years (2013–2019). R&R shipments would be spread across 40 years (2013–2052).[4] Shipments from Peru would be imported through the Port of New York and would also be spread across 40 years. For the purposes of analysis, it is assumed that all mercury from mining in the United States would be shipped from Carlin, Nevada. Carlin is located near most of the major gold mines in northern Nevada; the state generates approximately 80 percent of U.S.-mined gold.

- As stated above, mercury from Y–12 would be shipped to the DOE storage facility in 3-L (0.8-gallon) flasks containing 34.6 kilograms (76 pounds) of elemental mercury. In total, 1,206,000 kilograms in 34,906 flasks would be shipped.

- As noted above, each flask would contain 34.6 kilograms (76 pounds) of elemental mercury. In addition, the total mass of the empty flask could vary with flask type. The *Interim Guidance*, for example, lists flasks varying in weight from 3.4 to 6.3 kilograms (7.5 to 13.9 pounds). For the purposes of this analysis, container type T-13, with a mass of 4.1 kilograms (9.0 pounds), is taken to be representative. Therefore, the weight of a loaded flask would be 34.6 + 4.1, or 38.7 kilograms (about 85 pounds). For a discussion of the sensitivity of the analysis to this assumption, see Section D.6.1.3.

- Flasks would be transported in box pallets that each contain an array of 7 × 7 flasks. The dimensions of each pallet would be 1.44 by 1.44 meters (56 by 56 inches) (DOE 2009a). Therefore, one pallet would contain 34.6 × 49, or 1,695 kilograms (approximately 3,738 pounds), of elemental mercury. The total mass of the loaded flasks in a pallet would be 38.7 kilograms per flask × 49 flasks, or 1,896 kilograms (approximately 4,181 pounds). The mass of the pallet and a spill tray must be added to this figure. It is assumed that these would add 100 kilograms (about 220 pounds) to the weight of the flasks, so the total weight of a loaded pallet would be 1,996 kilograms, rounded up to 2,000 kilograms (4,400 pounds) or 2 metric tons (2.2 tons).

- A 1-MT container should not weigh more than 1,250 kilograms (2,750 pounds) when loaded with 1,100 kilograms (2,400 pounds) of mercury (DOE 2009a). Therefore, when loaded with 1 metric ton (about 1.1 tons) (about 1,000 kilograms [2,200 pounds]), it should not weigh more than 1,160 kilograms (2,550 pounds). During transportation, it would be sitting in a spill tray that can contain the full 1 metric ton of mercury; this tray would be approximately 10 centimeters (4 inches) less than the height of the container so that a forklift would be able to remove the 1-MT container using the lifts on top of it. The approximate dimensions of such a container are 0.62 by 0.62 by 0.41 meters (24 by 24 by 16 inches). The assembly of 1-MT container, spill tray, and pallet is assumed to weigh 100 kilograms (about 220 pounds) more than the container itself, i.e., 1,260 kilograms (2,770 pounds).

[4] The results of the risk analysis are not sensitive to the precise details of the temporal distribution of shipments. The analysis makes use of the annual average over 40 years only.

- It is assumed that the capacity of a truck is 18,180 kilograms (40,000 pounds) (DLA 2004a:Section 2.3.1.1). Therefore, one truck could ship either (18,180 kilograms/ 2,000 kilograms per pallet) = 9.09 (rounded down to 9) pallets of 49 flasks or (18,180 kilograms/ 1,260 kilograms per 1-MT container) = 14.4 (rounded down to 14) 1-MT containers. The effective floor area of a truck is 2.4 meters (8 feet) wide by 15 meters (48 feet) long. A pallet's dimensions (1.44 meters by 1.44 meters [56 by 56 inches or 4.67 by 4.67 feet]) would allow a row of pallets 1 wide and 10 long to be loaded into the truck, which is more than the weight limit of 9 pallets. The total of 14 1-MT containers that the truck would accommodate is also limited by weight rather than by area.

- The capacity of a railcar is approximately 68 metric tons (75 tons) (DLA 2004b). Therefore, the railcar could, in principle, ship up to (68,000 kilograms/2,000 kilograms per pallet) = 34 pallets of 49 flasks. However, the *MM EIS* (DLA 2004a:Section 2.3.1.1) shows that the effective usable floor area is 3 meters (10 feet) wide by 18 meters (59 feet) long, sufficient to accommodate two rows, each row with 12 pallets of 49 flasks, i.e., 24 pallets. Therefore, the railcar is limited by area to 24 pallets of 49 flasks. The railcar can accommodate (68,000 kilograms/1,260 kilograms per 1-MT container) = 54 1-MT containers; in this case, the total is not limited by available space.

- There are four chlor-alkali facilities in the United States: Ashta Chemical (Ashtabula, Ohio, 108 metric tons [about 120 tons]), PPG (New Martinsville, West Virginia, 244 metric tons [about 270 tons]), Olin (Charleston, Tennessee, 478 metric tons [about 530 tons]), and Olin (Augusta, Georgia, 271 metric tons [about 300 tons]). The total mercury from chlor-alkali facilities would be 1,101 metric tons (1,214 tons).

- It is assumed that 70 percent of R&R mercury would be shipped from the Philadelphia region (assuming geographic coordinates of Bethlehem Apparatus) and 30 percent from the Chicago region (assuming geographic coordinates for D.F. Goldsmith) to a DOE facility. See Section D.1 for an explanation of these percentages.

Table D–9 summarizes the amounts of mercury that would be transported from each of the locations listed in the assumptions above, with the corresponding total expected numbers of 7 × 7 pallets and 1-MT containers transported over 40 years.

In general, the probability of a transportation accident or fatality during a specified operation (such as transportation from one site to another) is calculated by multiplying the number of miles traveled during the operation by a standard factor derived from empirical statistics, which is expressed in terms of the number of accidents per mile, the number of fatalities per mile, or the number of releases of hazardous material per mile. This transportation risk assessment considers a series of assumptions for three types of accidents:

- *Accidents that cause a spill of mercury that subsequently evaporates (no fire):* The frequency of such accidents is derived from the above-mentioned empirical factor of releases per mile.

- *Accidents that cause a major fire that is sufficient to evaporate some of the mercury:* The frequency of such accidents is derived from the above-mentioned empirical factor of accidents per mile, multiplied by the probability that, given an accident, a major fire would occur.

- *Accidents that cause fatalities due to mechanical impact* (i.e., accidents that are unrelated to the fact that the cargo is mercury): The predicted frequency of such accidents is derived from the above-mentioned empirical factor of fatalities per mile.

Table D–9. Estimate of Amounts of Mercury to be Transported

Site	Years of Shipments	Total Mass (metric tons)[a]	No. of Pallets[b]	No. of 1-Metric-Ton Containers[c]	No. of Trucks	No. of Railcars
Y–12 National Security Complex	2013–2014	1,206	713	0	80	30
Chlor-Alkali Facilities						
Ashta Chemical, Ashtabula, Ohio	2013–2019	108	0	108	8	2
PPG, New Martinsville, West Virginia	2013–2019	244	0	244	18	5
Olin, Charleston, Tennessee	2013–2019	478	0	478	35	9
Olin, Augusta, Georgia	2013–2019	271	0	271	20	6
Reclamation and Recycling Facilities, Mining, Shipments from Peru – Truck Scenario 1 (full truck shipments)						
Mining (Carlin, Nevada)	2013–2052	3,687	526	2,798	259	74
Peru (via Port of New York)	2013–2052	1,236	731	0	82	31
Philadelphia region (Bethlehem Apparatus)	2013–2052	1,939	277	1,472	137	40
Chicago region (D.F. Goldsmith)	2013–2052	831	119	631	60	17
Reclamation and Recycling Facilities, Mining, Shipments from Peru – Truck Scenario 2 (50 percent capacity truck shipments), Railcar Scenario (full rail car shipments)						
Mining (Carlin, Nevada)	2013–2052	3,687	526	2,798	518	74
Peru (via Port of New York)	2013–2052	1,236	731	0	164	31
Philadelphia region (Bethlehem Apparatus)	2013–2052	1,939	277	1,472	274	40
Chicago region (D.F. Goldsmith)	2013–2052	831	119	631	120	17

[a] Average mass transported per year: 250 metric tons.
[b] Number of pallets shipped per year: 59.
[c] Number of 1-metric-ton containers shipped per year: 150.
Note: To convert metric tons to tons, multiply by 1.1023.
Key: Bethlehem Apparatus=Bethlehem Apparatus Company, Inc.; D.F. Goldsmith=D.G. Goldsmith Chemical and Metal Corporation.

To calculate the frequency of occurrence of transportation accidents, certain input data are required. The input data include the definition of the transportation route, the estimation of the number of miles traveled, and the empirical accident factors and conditional probabilities discussed above.

D.2.7.1 Data on Transportation Routes

This subsection considers transportation by road or rail. The truck routes considered are conventional commercial routes that have no hazardous material restrictions. The domestic truck and rail routes considered and their associated mileage were obtained using DOE's TRAGIS [Transportation Routing Analysis Geographic Information System] (Johnson and Michelhaugh 2003). Origination and destination points in TRAGIS are defined by nodes; therefore, the closest TRAGIS node to a given site was used for a particular origination or destination point.

D.2.7.2 Input Accident Probabilities

The basic probabilities applied in the transportation risk analysis for accident, fatality, and release rates for truck and rail were calculated using data obtained from the U.S. Department of Transportation Federal Motor Carrier Safety Administration and the Federal Railroad Administration, respectively. Both the truck and rail data are from the years 2004 to 2007. The rates calculated for rail are in terms of railcar miles. The conditional probability of a fire, given a truck accident, is less than 1 percent, and given a rail accident, is 1 percent; therefore, the bounding conditional probability for both of these cases is assumed to be 1 percent (NRC 1987). Table D–10 summarizes the basic probabilities used in the transportation analysis.

Table D–10. Basic Probabilities Used in the Transportation Risk Analysis

Description	Value
Truck accident with no mercury spill and no fire	6.5×10^{-7} per truck mile
Truck accident with mercury spill (no fire)	8.5×10^{-8} per truck mile
Probability of fire after truck accident	0.01[a]
Truck accident with fire and release of mercury	6.5×10^{-9} per truck mile
Truck accident with mechanically induced fatality (no fire)	2.3×10^{-8} per truck mile
Rail accident with no mercury spill and no fire	2.6×10^{-7} per railcar mile
Rail accident with mercury spill (no fire)	1.2×10^{-9} per railcar mile
Probability of fire after rail accident	0.01
Rail accident with fire and release of mercury	2.6×10^{-9} per railcar mile
Rail accident with mechanically induced fatality	1.6×10^{-8} per railcar mile

[a] To obtain the probability per mile of a mercury spill with fire, this factor of 0.01 is applied to the probability per mile of a truck accident with no mercury spill and no fire, not to the probability per mile of a truck accident with mercury spill (no fire). This is likely conservative.

Source: FMCSA 2006:39, 2007, 2008:49, 2009a, 2009b; FRA 2009; NRC 1987; Saricks and Tompkins 1999.

D.2.7.3 Results of Probabilistic Transportation Accident Analysis

The above data were used to calculate the predicted number of accidents per operation, as shown in Table D–11, for the specific example of truck transportation to GJDS in Colorado under Scenario 1. Data for other sites are similar.

Table D–11. Probabilistic Analysis of Truck Accidents, Scenario 1, Grand Junction Disposal Site

Dispatching Site	Trucks	Miles (one way)	Truck Miles	Mean No. of Accidents over 40 Years[a]	Mean No. of Accidents with Spills over 40 Years[a]	Mean No. of Accidents with Fires over 40 Years[a]	Mean No. of Accidents with Death over 40 Years[a]
Y–12 National Security Complex	80	1,570	125,560	8.2×10^{-2}	1.1×10^{-2}	8.2×10^{-4}	2.9×10^{-3}
Ashta Chemical, Ashta, Ohio	8	1,656	13,249	8.6×10^{-3}	1.1×10^{-3}	8.6×10^{-5}	3.0×10^{-4}
PPG, New Martinsville, West Virginia	18	1,671	30,073	2.0×10^{-2}	2.5×10^{-3}	2.0×10^{-4}	6.8×10^{-4}
Olin, Charleston, Tennessee	35	1,569	54,915	3.6×10^{-2}	4.6×10^{-3}	3.6×10^{-4}	1.2×10^{-3}
Olin, Augusta, Georgia	20	1,811	36,218	2.4×10^{-2}	3.1×10^{-3}	2.4×10^{-4}	8.2×10^{-4}
Philadelphia region (Bethlehem Apparatus)	137	1,957	268,150	1.7×10^{-1}	2.3×10^{-2}	1.7×10^{-3}	6.1×10^{-3}
Chicago region (D.F. Goldsmith)	60	1,256	75,372	4.9×10^{-2}	6.4×10^{-3}	4.9×10^{-4}	1.7×10^{-3}
Peru (via Port of New York)	82	2,034	166,788	1.1×10^{-1}	1.4×10^{-2}	1.1×10^{-3}	3.8×10^{-3}
Mining (Carlin, Nevada)	259	538	139,342	9.1×10^{-2}	1.2×10^{-2}	9.1×10^{-4}	3.2×10^{-3}
Total			909,667	5.9×10^{-1}	7.7×10^{-2}	5.9×10^{-3}	2.1×10^{-2}
Frequency (=Total/40)				1.1×10^{-2}[b]	1.9×10^{-3}	1.5×10^{-4}[b]	5.1×10^{-4}

[a] This heading applies to all entries below except the very last, which is the corresponding annual frequency.

[b] The use of the Poisson distribution, as described below, means that the multiplicative factor of 0.01 between all crashes and crashes with fires, does not apply to the estimated frequencies.

Note: To convert miles to kilometers, multiply by 1.60934.

Key: Bethlehem Apparatus=Bethlehem Apparatus Company, Inc.; D.F. Goldsmith=D.F. Goldsmith Chemical and Metal Corporation.

Table D–11 shows that the total number of truck miles that would have to be traveled to complete the transfer of all the mercury listed in Table D–9 is approximately 910,000 miles (approximately 1.5 million kilometers). The probability of an accident with fire and mercury release per truck mile from Table D–10 is 6.5×10^{-9} per mile. The product of this probability and the number of miles is 0.0059. This is the predicted mean number (Λ) of truck fires expected to occur during transportation of mercury to GJDS. The mean must be associated with a probability distribution; the most appropriate is the Poisson distribution, which is a discrete probability distribution that takes on the values n = 0, 1, 2, 3. It is often used as a model for the number of events (such as the number of telephone calls at a business or the number of accidents at an intersection) that would occur in a specific time period.[5] It has the following form:

- $P(n) = (\Lambda^n/n!)\exp(-\Lambda)$ (n = 0,1,2,3… being the number of accidents)
- $P(0) = \exp(-\Lambda)$ (the probability that there would be no accidents)
- For Λ = 0.0059, $P(0)$ = exp(-0.0059), approximately 0.994
- $P(n \geq 1)$ the probability of one or more accidents is 1 exp(-Λ), approximately 0.0059 in this case. This is the probability of occurrence of one or more truck accidents with fires over a period of 40 years. (When Λ is small, $P(n \geq 1)$ approximately equals Λ; this relationship breaks down as Λ approaches unity or greater.)

$P(n \geq 1)$ is the probability that one or more accidents would occur during the 40 years in which the assumed 10,000 metric tons (11,000 tons) of mercury would be transported to the receiving site. To convert the probability into a frequency, it is averaged over the period of operation of the storage facilities (40 years) to be consistent with the frequency definitions for the onsite accidents.

In this case, dividing 0.0059 by 40 gives a frequency (f) of approximately 1.5×10^{-4} per year, which is in the moderate (FL-III) category—i.e., transportation of mercury to GJDS per 40 years would lead to truck accidents with fires (and associated releases of mercury) with a moderate frequency of 1.5×10^{-4} per year.

Tables D–12 through D–14 summarize the results for each of the two truck scenarios and for the Railcar Scenario for all sites.

[5] The Poisson distribution expresses the probability of a number of events occurring in a fixed period of time if these events occur with a known average rate and independently of the time since the last event (Engineering Statistics Handbook 2009).

Table D–12. Frequency Analysis of Truck Accidents, Scenario 1, All Sites

Mercury Storage Site	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires (per year)	Frequency of Accidents with Death (per year)
Grand Junction Disposal Site, Colorado	909,667	1.1×10^{-2}	1.9×10^{-3}	1.5×10^{-4}	5.1×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Hanford Site, Washington	1,251,164	1.4×10^{-2}	2.5×10^{-3}	2.0×10^{-4}	7.0×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Hawthorne Army Depot, Nevada	1,161,577	1.3×10^{-2}	2.3×10^{-3}	1.9×10^{-4}	6.5×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Idaho National Laboratory, Idaho	984,288	1.2×10^{-2}	2.0×10^{-3}	1.6×10^{-4}	5.5×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Kansas City Plant, Missouri	754,705	9.7×10^{-3}	1.5×10^{-3}	1.2×10^{-4}	4.3×10^{-4}
	–	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Savannah River Site, South Carolina	869,314	1.1×10^{-2}	1.8×10^{-3}	1.4×10^{-4}	4.9×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Waste Control Specialists, LLC, Texas	1,000,305	1.2×10^{-2}	2.0×10^{-3}	1.6×10^{-4}	5.6×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)

Note: To convert miles to kilometers, multiply by 1.60934.
Key: FL=frequency level.

Table D–13. Frequency Analysis of Truck Accidents, Scenario 2, All Sites

Mercury Storage Site	Truck Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires (per year)	Frequency of Accidents with Death (per year)
Grand Junction Disposal Site, Colorado	1,559,319	1.6×10^{-2}	3.1×10^{-3}	2.5×10^{-4}	8.7×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Hanford Site, Washington	2,112,527	1.9×10^{-2}	4.1×10^{-3}	3.4×10^{-4}	1.2×10^{-3}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Hawthorne Army Depot, Nevada	1,943,587	1.8×10^{-2}	3.8×10^{-3}	3.1×10^{-4}	1.1×10^{-3}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Idaho National Laboratory, Idaho	1,654,225	1.6×10^{-2}	3.3×10^{-3}	2.7×10^{-4}	9.2×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Kansas City Plant, Missouri	1,385,734	1.5×10^{-2}	2.8×10^{-3}	2.2×10^{-4}	7.8×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Savannah River Site, South Carolina	1,682,503	1.7×10^{-2}	3.3×10^{-3}	2.7×10^{-4}	9.4×10^{-4}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)
Waste Control Specialists, LLC, Texas	1,806,502	1.7×10^{-2}	3.5×10^{-3}	2.9×10^{-4}	1.0×10^{-3}
	–	High (FL-IV)	Moderate (FL-III)	Moderate (FL-III)	Moderate (FL-III)

Note: To convert miles to kilometers, multiply by 1.60934.
Key: FL=frequency level.

Table D–14. Frequency Analysis of Rail Accidents, All Sites

Mercury Storage Site	Railcar Miles	Frequency of Accidents (per year)	Frequency of Accidents with Spills (per year)	Frequency of Accidents with Fires (per year)	Frequency of Accidents with Death (per year)
Grand Junction Disposal Site, Colorado	317,260	2.0×10^{-3}	9.2×10^{-6}	2.1×10^{-5}	1.3×10^{-4}
	–	Moderate (FL-III)	Low (FL-II)	Low (FL-II)	Moderate (FL-III)
Hanford Site, Washington	453,317	2.8×10^{-3}	1.3×10^{-5}	3.0×10^{-5}	1.9×10^{-4}
	–	Moderate (FL-III)	Low (FL-II)	Low (FL-II)	Moderate (FL-III)
Hawthorne Army Depot, Nevada	394,922	2.5×10^{-3}	1.1×10^{-5}	2.6×10^{-5}	1.6×10^{-4}
	–	Moderate (FL-III)	Low (FL-II)	Low (FL-II)	Moderate (FL-III)
Idaho National Laboratory, Idaho	372,924	2.3×10^{-3}	1.1×10^{-5}	2.4×10^{-5}	1.5×10^{-4}
	–	Moderate (FL-III)	Low (FL-II)	Low (FL-II)	Moderate (FL-III)
Kansas City Plant, Missouri	250,966	1.6×10^{-3}	7.2×10^{-6}	1.6×10^{-5}	1.0×10^{-4}
	–	Moderate (FL-III)	Low (FL-II)	Low (FL-II)	Moderate (FL-III)
Savannah River Site, South Carolina	304,329	1.9×10^{-3}	8.8×10^{-6}	2.0×10^{-5}	1.2×10^{-4}
	–	Moderate (FL-III)	Low (FL-II)	Low (FL-II)	Moderate (FL-III)
Waste Control Specialists, LLC, Texas	394,112	2.5×10^{-3}	1.1×10^{-5}	2.6×10^{-5}	1.6×10^{-4}
	–	Moderate (FL-III)	Low (FL-II)	Low (FL-II)	Moderate (FL-III)

Note: To convert miles to kilometers, multiply by 1.60934.
Key: FL=frequency level.

The following summarizes the above tables:

- For both truck transportation scenarios:
  - The predicted frequency of an accident, regardless of the consequences, is high (FL-IV) for all receiving sites, with the exception of KCP under Scenario 1, for which the frequency is moderate (FL-III).
  - The frequency of an accident with specific consequences (spill, fire, or death due to mechanical impact) is moderate (FL-III) for all receiving sites.
  - The variation in predicted frequencies of truck accidents across the receiving sites, regardless of the consequences, is less than a factor of two, consistent with the difference between total truck miles, which is also less than a factor of two.
- For rail transportation:
  - The predicted frequency of an accident, regardless of the consequences, is moderate (FL-III) for all receiving sites.
  - The predicted frequency of an accident with a consequence of a spill or fire is low (FL-II) for all receiving sites.
  - The predicted frequency of a fatality due to an accident is moderate (FL-III) for all receiving sites.
  - The variation in predicted frequencies of rail accidents across the receiving sites, regardless of the consequences, is less than a factor of two.

D.2.7.4 Frequencies of Crashes with Fires During Rainfall

As previously discussed, the only scenario that has the potential for mercury to be deposited on the ground or in water bodies is one involving a fire, which would cause the mercury to be converted from the elemental form, which has essentially zero potential for deposition or scavenging, to a form that can deposit. A fire would cause the released mercury to rise, so that the only possibility for high levels of mercury to be deposited on the ground near the source is if it is raining while the release is taking place.[6] Five years' worth of hourly meteorological data were obtained from the seven potential receiving sites or the nearest meteorological station (such as a nearby airport); from these data, the fraction of time during which it is expected to be raining at each site (or equivalently, the probability that it would be raining when a crash occurs[7]) was estimated, as shown in Table D–15.

Table D–15. Probability of Rainfall at Time of Crash

Mercury Storage Site	Probability of Rainfall	Source of Data	Averaged over (time period)
Grand Junction Disposal Site, Colorado	0.027	Grand Junction Airport	2004–2008
Hanford Site, Washington	0.025	Hanford Site	2002–2006
Hawthorne Army Depot, Nevada	0.016	Reno Airport	2004–2008
Idaho National Laboratory, Idaho	0.027	Idaho National Laboratory	2000–2004
Kansas City Plant, Missouri	0.054	Kansas City Airport	2004–2008
Savannah River Site, South Carolina	0.056	Savannah River Site	1997–2001
Waste Control Specialists, LLC, Texas	0.022	Odessa-Midland Airport	2004–2008

As can be seen, the difference between the driest site (Hawthorne Army Depot) and the wettest (SRS) is more than a factor of three. The various transportation routes would pass through regions of different rainfall characteristics. As a rough approximation, it is assumed that, on average, all of the transportation routes would run through areas with rainfall probabilities equal to the average of those in the above table, 0.032. The results of the frequencies of crashes involving fires predicted to occur during rainfall are given in Table D–16.

6 See Section D.7.3.3 for a discussion about why scavenging by precipitation is represented by rainfall only, and snow is not explicitly included.

7 In principal, the probability of a crash per mile might be a little higher in wet weather than in dry weather. However, it is assumed that this is a counter balanced by caution on the part of drivers of trucks containing hazardous materials (e.g., not driving in adverse weather conditions).

Table D–16. Predicted Frequencies of Crashes with Fires During Rainfall

Mercury Storage Site	Frequency of Accidents with Fires During Rainfall (per year)		
	Truck Scenario 1	**Truck Scenario 2**	**Railcar Scenario**
Grand Junction Disposal Site, Colorado	4.7×10^{-6}	8.1×10^{-6}	6.6×10^{-7}
	Low (FL-II)	Low (FL-II)	Negligible (FL-I)
Hanford Site, Washington	6.5×10^{-6}	1.1×10^{-5}	9.5×10^{-7}
	Low (FL-II)	Low (FL-II)	Negligible (FL-I)
Hawthorne Army Depot, Nevada	6.0×10^{-6}	1.0×10^{-5}	8.3×10^{-7}
	Low (FL-II)	Low (FL-II)	Negligible (FL-I)
Idaho National Laboratory, Idaho	5.1×10^{-6}	8.6×10^{-6}	7.8×10^{-7}
	Low (FL-II)	Low (FL-II)	Negligible (FL-I)
Kansas City Plant, Missouri	3.9×10^{-6}	7.2×10^{-6}	5.3×10^{-7}
	Low (FL-II)	Low (FL-II)	Negligible (FL-I)
Savannah River Site, South Carolina	4.5×10^{-6}	8.7×10^{-6}	6.4×10^{-7}
	Low (FL-II)	Low (FL-II)	Negligible (FL-I)
Waste Control Specialists, LLC, Texas	5.2×10^{-6}	9.4×10^{-6}	8.3×10^{-7}
	Low (FL-II)	Low (FL-II)	Negligible (FL-I)

Key: FL=frequency level.

As can be seen, all truck frequencies are now in the low (FL-II) category. All rail frequencies are in the negligible (FL-I) category. This means that any risk to any receptor from railcar fires with mercury spills during rain would be negligible (FL-I).

D.2.8 Spills into Water Bodies

Spills occurring during a transportation accident could result in leakage of the mercury cargo into the surrounding environment. This is the most problematic scenario in this EIS from the perspective of making solid, defensible estimates of risk because of large, inherent uncertainties. The most significant and challenging scenario (from a cleanup standpoint) would be a spill directly into a surface-water body such as a lake or river. This could occur if a truck or railcar crashes on a bridge, or if there is a crash where the truck or rail route is immediately adjacent to a river or a lake.

With respect to crashes on a bridge, only a small proportion of any route is actually directly over water, so that one might expect that the frequency of a crash with subsequent spillage into water is in the low-to-negligible (FL-II to -I) range. However, at the time of writing, no good information was available on the actual probability of a crash per truck mile or railcar mile on a bridge.

With respect to travel alongside rivers, there is a possibility that a truck or railcar might crash directly into a river, or release its contents near a river after which mercury might make its way into the river. See Section D.4.3.2 for discussion of the issues that might arise should such a spill occur.

The various potential truck and rail routes form the dispatching sites to the storage sites were reviewed and numerous places found where routes were alongside or over rivers. However, in terms of length, two examples stand out. Truck shipments from the PPG facility in West Virginia would go north to Wheeling, following the Ohio river, for about 30 miles (50 kilometers). Rail shipments would go south, following the river, for about 40 miles (65 kilometers). However, since the total amount of mercury to be shipped from this site is only about 2 to 3 percent of the total, the frequency of spillage into the river would be negligible (FL-I).

Interstate 70 in Colorado follows rivers and streams much of the distance in the state to get to GJDS. These include the Colorado River, Clear Creek, Eagle River, Straight Creek, and Gore Creek. The route to GJDS contains the greatest distance of any route where there might be a potential for spillage into a river. This issue is further discussed in Chapter 4, Section 4.3.9.

It is difficult to calculate the frequency of crashes that would lead to spillage directly into water. Therefore, for the purposes of this analysis, it is very conservatively assumed that the frequency of such crashes is in the same range as the overall frequency of crashes with spills—moderate (FL-III) for both truck scenarios and low (FL-II) for the Railcar Scenario.

D.2.9 Populations and Accident Scenarios

The consequences of a mercury release are in principle related to the affected population within 1.6 kilometers (1 mile) of the release. Urban and suburban areas may have populations exceeding 3,226 people per square mile, whereas rural areas typically have a population density of 139 people or fewer per square mile. In general, an average of 30 percent of the miles traveled in the eastern United States would be within urban or suburban areas, with the remaining 70 percent in less-populated rural areas. For travel in the western United States, the rural road mileage would increase to 92 percent, with only 8 percent of the mileage in urban or suburban areas.

Note, however, that this EIS does not account for population densities. The estimated risks to members of the public from inhalation of mercury are essentially individual risks, expressed as the predicted frequency at which an individual would be exposed to concentrations above AEGL-3, or, in some cases AEGL-2 or 0.1×AEGL-2. For all pathways via dry or wet deposition, the calculated risk is essentially the predicted frequency at which, somewhere along the transportation route, deposited levels of mercury exceed screening values tied to human or ecological receptor ingestion. Again, this measure of risk does not rely on knowledge of the population of human or ecological receptors within or near the contaminated areas.

Note that although the traffic accident rate is higher in urban and suburban areas, the posted speed limits are lower, generally limiting the severity of vehicle accidents. In rural areas, the speed limits tend to be higher. Because the traffic density is lower in rural areas, the probability of collision decreases; however, it is reasonable to expect that the consequence of a collision that occurs could be more severe. In urban and suburban areas, the emergency response capability (i.e., mitigating reactions) is generally only minutes away whereas, in rural areas, initial emergency response could take up to an hour.

D.2.10 Summary of Event Frequencies

Table D–17 summarizes the analysis of event frequencies, which is an important precursor to the remaining portions of the risk assessment.

Table D–17. Summary of Onsite and Offsite Frequency of Hazardous Events

Hazard	Activity	Postulated Scenario	Frequency of Release	Evaluated Further	Comments
Toxic	Onsite storage	Slow leak/release of liquid mercury.	High (FL-IV)	Yes	Requires failure of container.
Fire	Onsite storage	Building fire involving multiple flasks or 1-metric-ton containers.	Negligible (FL-I)	No	Limited ignition sources, reliable fire protection system, controls on combustible load, buildings constructed of nonflammable materials.
Fire/explosion nearby	All activities	Fire/explosion at nearby building impacts mercury containers.	Negligible (FL-I)	No	No facilities containing flammable or explosive materials located within 61 meters (200 feet).
Wildfire	All activities	Wildfire consumes storage facility.	Negligible (FL-I)	No	Although wildfires are common, fire monitoring, prevention and suppression systems greatly reduce likelihood of mercury release.
Kinetic	Onsite material handling	Single flask is dropped during handling, resulting in breach.	Moderate (FL-III)	Yes	Consolidation of partially filled pallets could lead to a large number of handling events per year.
Kinetic	Onsite material handling	Single pallet is dropped during transfer to storage racks, resulting in breach.	Moderate (FL-III)	Yes	Assumes pallet dropped from 3.7 meters (12 feet) and all 49 flasks breached.
Kinetic	Onsite material handling	Triple-pallet collapse.	Moderate (FL-III)	Yes	Requires failure of storage rack.
Kinetic	Onsite material handling	Single 1-metric-ton container drop.	Moderate (FL-III)	Yes	Assumes container dropped from a height of less than 1.5 meters (5 feet).
Earthquake	All activities	Earthquake results in building damage and causes pallets and/or flasks to fall and spill.	Moderate (FL-III)	Yes	Requires an earthquake and failure of flasks or 1-metric-ton containers.
Flood	All activities	Storage building floods, causing failure of 3-liter flasks or 1-metric-ton containers.	Moderate (FL-III)	Yes	Requires failure of flasks or 1-metric-ton containers. Represented by earthquake scenario.
Weather	All activities	High winds or tornadoes result in roof failure and cause pallets and/or flasks to fall.	Low (FL-II) or negligible (FL-I) (tornadoes); negligible (FL-I) (high winds)	Yes	Requires failure of flasks or 1-metric-ton containers. Bounded by earthquake scenario.
Weather	All activities	Lightning strike causes small building fire involving limited number of mercury containers.	Negligible (FL-I)	No	Lightning strike as initiator of building fire not considered credible.
Weather	All activities	Snow load causes roof collapse, resulting in mercury containers' falling.	Negligible (FL-I)	No	Assumes building designed to requirements of building codes.

Table D–17. Summary of Onsite and Offsite Frequency of Hazardous Events *(continued)*

Hazard	Activity	Postulated Scenario	Frequency of Release	Evaluated Further	Comments
Surface transportation	Onsite storage	Vehicle or train crashes into building, resulting in mercury container breach.	Negligible (FL-I)	No	Assumed slow vehicle speeds on site.
Surface transportation	Offsite transport	Truck or train crashes during transportation of mercury; fire breaks out.	Moderate (FL-III) (truck) Low (FL-II) (rail)	Yes	Impact breaches flasks or 1-metric-ton containers; spill and fire occur after crash.
Surface transportation	Offsite transport	Truck or train crashes during transportation of mercury and fire breaks out in wet weather.	Low (FL-II) (truck) Negligible (FL-I) (rail)	Yes	Impact breaches flasks or 1-metric-ton containers; spill and fire occur after crash.
Surface transportation	Offsite transport	Truck or train crashes and mercury spills (no fire).	Moderate (FL-III)	Yes	Impact breaches flasks or 1-metric-ton containers; subsequently evaporates.
Surface transportation	Offsite transport	Truck or train crashes with mechanically induced fatality.	Moderate (FL-III)	Yes	Impact causes fatality.
Aircraft crash	All activities	Aircraft crashes into building, resulting in fire, mercury container breach.	Negligible (FL-I)	No	Limited target area given type of aircraft, flight vectors, and size of storage area within building.
Intentional destructive act	Transport	Full gasoline tanker driven into truck or railcar; fire breaks out.	Not assessed	Yes	Gasoline fire causes release of mercury.

D.3 HUMAN TOXICITY ASSESSMENT FOR MERCURY

In 1997, EPA conducted a comprehensive assessment of mercury toxicity as part of its *Mercury Study Report to Congress* (EPA 1997a). The report assessed the toxicity of elemental mercury, inorganic mercury (or mercury salts), and methylmercury. Much of the information is also summarized on EPA's IRIS (www.epa.gov/iris). In addition, the National Research Council completed a comprehensive assessment of the toxicity of methylmercury in 2000 (NRC 2000). EPA revised its assessment of methylmercury toxicity in July 2001, publishing revised oral reference doses (RfDs) (EPA 2002a). The following sections provide a brief overview of mercury toxicity in these three general forms.

OSHA provides a convenient summary of exposure limits for various forms of mercury, reproduced in Table D–18 (OSHA 2009). These exposure limits were furnished by OSHA itself, NIOSH, and ACGIH.

In addition, EPA has published proposed AEGLs for mercury vapor, as shown in Table D–19.

AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. It is believed that the recommended exposure levels are applicable to the general population, including infants and children and other individuals who may be susceptible. However, although the AEGL values represent threshold levels for the general public, it is recognized that individuals, subject to unique or idiosyncratic responses, could experience the effects described below at concentrations below the corresponding AEGL.

Table D–18. Exposure Limits for Mercury

	Mercury, Alkyl Compounds[a]	Mercury, Aryl Compounds[b]	Mercury, Inorganic Compounds[c]
Occupational Safety and Health Administration			
8-hour TWA	0.01 mg/m^3	0.1 mg/m^3	0.1 mg/m^3
Ceiling	0.04 mg/m^3		
National Institute for Occupational Safety and Health			
8-hour TWA	0.01 mg/m^3, skin	0.05 mg/m^3, skin	0.05 mg/m^3, skin
STEL/Ceiling	0.03 mg/m^3 (STEL), skin	0.1 mg/m^3 (ceiling), skin	0.1 mg/m^3 (ceiling), skin
IDLH	2 mg/m^3	10 mg/m^3	10 mg/m^3
American Conference of Governmental Industrial Hygienists			
8-hour TWA	0.01 mg/m^3, skin	0.1 mg/m^3, skin	0.025 mg/m^3, skin
Short term	0.03 mg/m^3, skin		

a Alkyl compounds are organic compounds generally resembling hydrocarbons with one hydrogen atom replaced by another atom. Thus, CH_3Hg, methylmercury is an alkyl compound resembling methane.

b Aryl compounds are organic compounds generally resembling an aromatic ring. Thus, phenylmercury is a cation $C_6H_5Hg^+$ resembling a benzene ring that forms compounds such as phenylmercury acetate. As can be inferred from the exposure limits, aryl compounds are less toxic than alkyl compounds.

c elemental mercury is included in the category of inorganic compounds.

Key: IDLH=immediately dangerous to life or health; mg/m^3=milligrams per cubic meter; STEL=short-term exposure limit (15 minutes); TWA=time-weighted average.

Source: OSHA 2007.

Table D–19. Proposed EPA Values for Elemental Mercury Vapor AEGLs

Exposure	10 minutes	30 minutes	60 minutes	4 hours	8 hours
Guideline					
AEGL-1	NR	NR	NR	NR	NR
AEGL-2	3.1 mg/m^3	2.1 mg/m^3	1.7 mg/m^3	0.67 mg/m^3	0.33 mg/m^3
AEGL-3	16 mg/m^3	11 mg/m^3	8.9 mg/m^3	2.2 mg/m^3	2.2 mg/m^3

Note: Reported values are in milligrams per cubic meter, NOT parts per million. See Section D.1.1.2.1 for definitions of AEGLs. AEGL-2 values for durations of exposure other than those explicitly listed in this table are obtained by linear interpolation.

Key: AEGL=Acute Exposure Guideline Level; EPA=U.S. Environmental Protection Agency; mg/m^3=milligrams per cubic meter; NR=not recommended (due to insufficient data).

Source: EPA 2009a.

D.3.1 Toxicity of Elemental Mercury

The route of exposure (e.g., ingestion, dermal absorption, inhalation) is an important consideration in assessing elemental mercury toxicity. Elemental mercury is poorly absorbed in the human gastrointestinal tract and does not, consequently, exhibit significant oral toxicity. In contrast, elemental mercury is readily absorbed through the lungs (estimated absorption is 75 to 85 percent) and is expected to account for 97 percent of the total dose of elemental mercury vapor absorbed by an individual. The remaining 3 percent is expected to be absorbed through the skin.

Once absorbed, elemental mercury is readily distributed throughout the body, crossing both the placental and blood–brain barriers. Subsequent oxidation by the hydrogen peroxidase catalase pathway may cause the mercury to become irreversibly retained in body compartments such as brain tissue. Unconverted elemental mercury is eliminated via urine, feces, and expired air.

EPA (1997a) concluded that inhaled elemental mercury can cause a range of adverse neurological effects, including the following:

- Tremors
- Emotional liability (changeable mood, irritability, excessive shyness, loss of confidence, and nervousness)
- Insomnia
- Muscle weakness, twitching, and atrophy
- Headaches
- Polyneuropathy (a disease process involving a number of peripheral nerves)
- Impairment of cognitive function

Other severe sublethal consequences of inhaling elemental mercury include adverse renal effects and pulmonary dysfunction. Mercury exposure at concentrations consistent with those known to cause neurological effects were observed in one study to affect renal function. EPA also concluded that sufficient animal data are available to establish potential adverse reproductive and developmental effects. However, the data are insufficient to quantify the degree of the hazard.

Regarding the potential carcinogenicity of elemental mercury, EPA concluded that the available data do not support a classification as to human carcinogenicity. The available human epidemiological studies have significant limitations, and the data from the only available animal study are considered inadequate. The limited available data from genotoxicity studies do not support the existence of a carcinogenic effect.

D.3.2 Toxicity of Inorganic Mercury

In keeping with EPA practice, the toxicity of inorganic mercury is assessed based on the toxicity of mercuric chloride. The absorption of inorganic mercury from the gastrointestinal tract has been estimated at 7 to 15 percent in human volunteers following oral administration of radio-labeled inorganic mercury (EPA 2002b). About 85 percent of inorganic mercury is eliminated in feces within a few days of ingestion. Dermal absorption of mercuric chloride was measured at 2 to 3 percent in guinea pigs. Mercury absorption from inhaled aerosols was measured at 40 percent in dogs.

Inorganic mercury does not distribute as readily throughout the body as elemental mercury. Inorganic mercury has a limited capacity to cross the blood–brain and placental barriers. The principal adverse effect of low-level exposures to inorganic mercury is kidney disease consequent to autoimmune glomerulonephritis (EPA 2002b). At higher levels, inorganic mercury exposures are associated with peripheral and motor neurotoxicity in addition to renal impairment. There is limited evidence indicating that inorganic mercury exposures may have adverse developmental effects as well.

EPA classifies mercuric chloride as a "possible human carcinogen" based on the absence of human data and limited evidence of carcinogenicity in rats and mice.

D.3.3 Toxicity of Methylmercury

Methylmercury is a highly toxic substance that is readily absorbed through the gastrointestinal tract (ATSDR 1999; EPA 2002a, 2002b). Once in the body, it readily passes into the adult and fetal brain, where it accumulates and is subsequently converted to inorganic mercury. Consequently, the nervous system is considered to be the critical target organ system for methylmercury toxicity. The nervous systems of developing organisms are considered of special concern.

Chronic, low-dose exposures to methylmercury in fish have been associated with subtle, neurotoxic endpoints in children, including poor performance on neurobehavioral tests of attention, fine motor function, visual spatial abilities, and verbal memory. The effects of concern at high doses include mental retardation, cerebral palsy, deafness, blindness, speech impairments, and sensory and motor impairments. There is also evidence indicating that methylmercury exposure can have adverse cardiovascular effects, possibly at exposure levels below those associated with neurological effects. There is additional evidence indicating that methylmercury exposure may have adverse effects on the immune and reproductive systems. Based on "inadequate" data in humans and limited data in animals, EPA classifies methylmercury as a "possible human carcinogen," although there is no cancer slope factor available from EPA to assess cancer risks.

D.3.4 Human Receptors and Benchmarks

This section describes the receptors that were chosen for the human health analysis and the benchmarks applied to the exposure point concentrations.

D.3.4.1 Receptors

At each site, three human receptors are considered—involved workers, noninvolved workers, and members of the public. The involved worker is someone inside the storage facility or working on the truck or railcar unloading operation. The noninvolved worker is someone who does not specifically work on the mercury itself, but is nearby. The member of the public is the closest offsite individual. The locations of the nearest site boundary for each alternative site are shown in Table D–20.

Table D–20. Distance to Closest Site Boundary at Mercury Storage Locations

Site	Distance	Direction	Notes
Grand Junction Disposal Site			
	30 meters	North and west	Fence line
Hanford Site (200 Areas)			
	3.5 kilometers	West	Washington State Route 240
Hawthorne Army Depot			
	3.7 kilometers	Southwest	Site boundary
Idaho National Laboratory (Idaho Nuclear Technology and Engineering Center)			
	13.4 kilometers	South	Site boundary U.S. Routes 20 and 26
Idaho National Laboratory (Radioactive Waste Management Complex)			
	5.8 kilometers	South	Site boundary U.S. Routes 20 and 26
Kansas City Plant			
	100 meters	South	Site boundary
Savannah River Site (E Area)			
	8 kilometers	West	South Carolina Highway 125
Waste Control Specialists, LLC			
	67 meters	East	Fence line

Note: To convert meters to feet, multiply by 3.281; kilometers to miles, by 0.6214.

D.3.4.2 Benchmarks

The following four benchmark quantities were used in the human health analysis:

- Acute health effects among workers and members of the public exposed to concentrations of elemental mercury or inorganic mercury in air
- Chronic health effects among workers exposed to concentrations of mercury in air
- Chronic health effects among members of the public exposed to concentrations of mercury in air
- Chronic health effects among members of the public exposed to mercury deposited on soil

For a detailed discussion, see Section D.1.1.2. The benchmarks are summarized in Table D–3.

D.4 EXPOSURE ASSESSMENT AND HUMAN RISK ANALYSIS

This section describes the methods used to calculate the exposures to human receptors under each alternative and provides estimates of the magnitude of the consequences associated with each exposure scenario. Exposures are evaluated using modeled estimates of airborne concentration and deposited amounts per unit area at various receptor locations. These exposures are then compared with benchmarks to assess whether consequences are SL-I, -II, -III, or -IV. Finally, the frequency (FL-I, -II, -III, or -IV) of the exposure event is considered in conjunction with the consequences to reach a determination of risk (high, moderate, low, or negligible) to the receptor using Figure D–1.

An important assumption in the following analysis is that elemental mercury would not be deposited on the ground either as a result of dry deposition or scavenging by rainfall (see Section D.7.3.3).

However, in the event of a fire, it is conservatively assumed that all of the elemental mercury would be converted into divalent mercury. This material can deposit, (see Section D.7.3.3) thus dry and wet deposition calculations are included in the fire scenarios outlined below.

D.4.1 Exposure During Normal Operating Conditions

This pathway applies to any alternative or location in which the mercury is stored for an extended period of time. Exposures to involved workers could arise during normal operating conditions from small amounts of elemental mercury vapor escaping from storage containers or from residual contamination. Mercury vapor transported downwind could then be inhaled by noninvolved workers or members of the public. Because the mercury would escape as elemental mercury vapor, virtually no deposition of mercury would occur; therefore mercury inhalation is the only exposure route of concern.

D.4.1.1 Involved Worker – Normal Operations

It is assumed that, during normal operations, involved workers would never be exposed to airborne concentrations of mercury vapor above the ACGIH's 8-hour TWA/TLV of 0.025 mg/m^3 of mercury vapor. This would be achieved by a combination of ventilation, inspection, monitoring, and use of personal protective equipment (PPE). The *Interim Guidance* explicitly states that the main requirement driving ventilation is to meet the ACGIH limit; in this context, for example, it recommends (but does not prescribe) a Storage Area ventilation system capable of 10 building air changes per hour, which would be run to ensure at least one building air change before workers enter the Storage Area. Similarly, the *Interim Guidance* describes the desirable features of ventilation systems in the Handling Area.

In addition, the *Interim Guidance* provides advice about monitoring the air while workers are present in the mercury storage facility; it envisages the use of portable monitors, with due attention to calibration.

Finally, if the airborne mercury concentration exceeds 0.025 mg/m^3, workers are to wear appropriate PPE with respiratory protection.

Given the above assumptions about the operation of the facility, the concentrations to which the involved worker would be exposed would always be negligible during normal operations, and hence the associated human health risk would be negligible.

It is pertinent to consider whether the historical record for DNSC sites has any information about airborne concentrations in the mercury storage buildings. One study of interest is that of mercury vapor monitoring at the Somerville, New Jersey, depot (Shim, Hsieh, and Watts 2002), where there has been mercury storage since 1957. These studies took place from September 17, 2001, through September 4, 2002, before, during, and after overpacking approximately 76,000 3-L flasks into drums.

Most flasks were stored in two cubicles in Warehouse 3E, while approximately 6,000 were stored in Warehouse 4E. The drums were subsequently stored partly in Warehouse 4E and partly in Warehouse 4D, which had not previously been used for mercury storage.

The conditions in Warehouse 4D most closely approximate those that would likely be encountered in a new storage facility at one of the candidate sites. Prior to moving mercury into Warehouse 4D, measured concentrations were less than 2×10^{-6} mg/m^3 (less than 2 nanograms per cubic meter [ng/m^3]). Once the drums had been moved into Warehouse 4D, monitoring over various periods from 2 days to a week produced an average concentration over all monitoring periods of 1.2×10^{-4} mg/m^3 and a peak of 3.15×10^{-4} mg/m^3. The measurements were made with Lumex and Tekran mercury monitors. The Lumex records virtually instantaneous measurements of mercury concentration. The Tekran takes samples over periods that are typically a few minutes.

By contrast, conditions in Warehouse 3E, Cubicle 1, were those pertaining to many decades of mercury storage. Before the overpacking operations, average measured concentrations over two periods of a few days each in August and September 2001 were 3.05×10^{-3} mg/m^3 and 1.90×10^{-3} mg/m^3, respectively. During overpacking, concentrations reached approximately 0.01 mg/m^3 on January 10, 2002, and 0.04 mg/m^3 on November 16, 2001. The latter figure exceeds the ACGIH’s 8-hour TWA/TLV of 0.025 mg/m^3. However, this is not pertinent to the period of analysis at the proposed new storage facility because no large-scale overpacking is envisaged. Finally, after overpacking, the mercury was removed from Warehouse 3E, after which average mercury concentrations varied from approximately 2.50×10^{-3} mg/m^3 to approximately 5.30×10^{-3} mg/m^3 during four monitoring periods from February through May 2002. After this, average concentrations declined over a 2-month period to about 2.00×10^{-3} mg/m^3, which appears to reflect a gradual venting of residual mercury. Sampling measurements as a function of height indicated that the residual contamination was on the floor. Similar results were obtained from monitoring in the other cubicle in Warehouse 3E, except that the peak post-overpacking concentrations were 2 to 3 times as high, up to approximately 0.013 mg/m^3, with a similar decline to about 2.00×10^{-3} mg/m^3 by the end of July 2002. Similar but considerably lower results were obtained in Warehouse 4E.

In the proposed new storage facility, inspections on receipt for storage, and routine inspections during storage, would decrease the risk of residual contamination. Nevertheless, none of the measured concentrations from residual contamination (in contrast to those during overpacking) exceeded the ACGIH’s 8-hour TWA/TLV.

Graney (2007) summarizes the measurements taken at the Somerville Depot and reports on other measurements taken at the Binghampton Depot (no longer used for mercury storage) and the Warren Depot. At the Warren Depot, for example, measurements taken with a Lumex monitor prior to overpacking in drums showed airborne concentrations inside the warehouse up to approximately 9.00×10^{-5} mg/m^3. During overpacking, they rose to as much as 0.016 mg/m^3. After overpacking, they remained as high as approximately $3.00–6.00 \times 10^{-3}$ mg/m^3. However, floor cleaning reduced these concentrations by about a factor of 10.

As noted above, the overall conclusion, based on measurements that are likely conservative for a new storage facility, is that there should be no difficulty in keeping both peak and average concentrations below the ACGIH’s TWA/TLV of 0.025 mg/m^3. In the context of the risk matrix, Figure D–1, this is considered a negligible concentration. Therefore the associated risk would be negligible.

D.4.1.2 Noninvolved Worker and Public Receptor – Normal Operations

Section D.2.3 explains that a leak of the full contents of a flask into a spill tray, which then remains undetected indefinitely, is taken as a surrogate scenario for the purposes of estimating impacts on noninvolved workers and the public during normal operations. Clearly, with the envisaged level of monitoring, it is virtually inconceivable that such a leak would go undetected, so this is a very conservative scenario.

It is assumed that there is a steady state in which the evaporating mercury from the spill tray would leak from the storage building and mix into the turbulent building wake. The evaporation model for indoor spills of mercury is described in Section D.7.1.1, and the calculated evaporation rate is given in Table D–23. The building wake model is described in Section D.7.2.1. The building wake is a volume on the downwind side of a building in which turbulence generated by the building causes thorough mixing. Table D–23 shows that the predicted concentration in the wake of a newly constructed large building would be no more than approximately 2.0×10^{-5} mg/m^3, while Table D–24 shows that the building wake concentration would be no more than four times larger (i.e., 8.0×10^{-5} mg/m^3) in the wake of existing buildings at INL, Hawthorne Army Depot, KCP, or WCS.

The appropriate concentration for comparison is EPA's RfC of 3.0×10^{-4} mg/m^3, below which long-term concentrations are considered to be negligible. The noninvolved worker might actually be in the turbulent building wake. The public receptor would be further downwind, at which point even more dilution of the plume would have occurred. Therefore, for all sites, the predicted airborne concentrations encountered by the noninvolved worker and the public receptor would be negligible (SL-I), and the associated risks would be negligible.

The above-referenced study by the New Jersey Institute of Technology (Shim, Hsieh, and Watts 2002) reports measurements of concentrations near the DNSC mercury storage warehouses. The average concentration observed prior to overpacking in drums was approximately 4.50×10^{-6} mg/m^3. The averages over successive periods of a few days during overpacking were 1.87×10^{-4} mg/m^3, 2.65×10^{-5} mg/m^3, and 6.87×10^{-5} mg/m^3, respectively. After overpacking, similar averages over three periods after the completion of overpacking were 9.67×10^{-6} mg/m^3, 5.10×10^{-6} mg/m^3, and 9.33×10^{-6} mg/m^3. These results are expected to be conservative for a new storage building and are generally consistent with the conservative predictions in the calculations reported above.

Shim, Hsieh, and Watts also measured airborne concentrations of mercury at locations that are about a mile and a half (about 2.5 kilometers) from the DNSC mercury storage warehouses. These measurements were taken during nine separate periods of a few days to 3 weeks over a total period of about a year (September 2001 to September 2002). The average concentrations measured during these periods ranged from 1.48 to 3.74×10^{-6} mg/m^3, with an overall average of 2.59×10^{-6} mg/m^3. Shim, Hsieh, and Watts remarked that these readings are close to the global background level of 2.4×10^{-6} mg/m^3, measured at a different site (the Perch River site) in upstate New York over a period of 2 years from July 1992 through July 1994. There were fluctuations, of course, depending on windspeed and wind direction, with a short-team peak of 9.00×10^{-5} mg/m^3 measured during one episode of extremely low windspeed. However, this does not affect the conclusion that the average measured levels are well below EPA's RfC of 3.0×10^{-6} mg/m^3.

Data on mercury concentrations are also available for Y–12 (Fortune 2007). The ambient air concentration downwind of the storage building has been continuously monitored since 1986 and averages 3.60×10^{-4} mg/m^3, again well below EPA's RFC of 3.00×10^{-4} mg/m^3.

D.4.2 Onsite Accidents

This section discusses the methods used to evaluate onsite accidents involving releases of mercury; it includes a simple spill and a spill occurring in conjunction with a fire. Concentrations are projected for a range of distances from the source of contamination and are thus applicable to any given storage location. Site-specific factors are provided when appropriate.

D.4.2.1 General Discussion of Types of Onsite Accidents

For spills of elemental mercury with no fire, two physical phenomena act to mitigate the consequences.

The vapor pressure of mercury at typical ambient temperatures is very low. According to NIST (Huber, Laesecke, and Friend 2006), the vapor pressure of mercury, converted to its saturated vapor density, is as shown in Table D–21.

Table D–21. Saturated Vapor Density of Mercury as a Function of Temperature

Temperature			Saturated Vapor Density (mg/m^3)
K	°C	°F	
273	0	32	2.38
283	10	50	6.00
293	20	68	14.09
303	30	86	31.29
313	40	104	65.88

Key: K=Kelvin; °C=degrees Celsius; °F=degrees Fahrenheit; mg/m^3=milligrams per cubic meter.

For comparison, the benchmark for worker safety, the 1-hour AEGL-3 of 8.9 mg/m^3 (see Table D–3), cannot be exceeded if the evaporating pool has a temperature of 289 Kelvin (K)/16 °C/61 °F or less. Even at a conservatively high temperature of 313 K/40 °C/104 °F, the mercury is already approximately five orders of magnitude more diluted than a pure elemental mercury vapor release. Hence, the further dilution required to bring the concentration down to the benchmarks such as the IDLH of 10 mg/m^3 or the 60-minute AEGL-2 of 1.7 mg/m^3 considerably reduces predictions of distance beyond which the benchmarks are not exceeded (vis-à-vis point sources).

With regard to conditions inside the storage building, the assumptions made for temperature of the evaporating pool are the same as those made in the *MM EIS* (DLA 2004a). Measurements taken at the Warren Depot from December 1999 through June 2000 showed that the highest temperature recorded inside the warehouse was 23 °C (74 °F). A more-limited set of readings from the New Haven Depot showed the highest recorded temperature of 24.5 °C (76 °F) during the period from September 1999 through March 2000. The temperature assumed for the mercury evaporation model is 20 °C (68 °F), which is slightly lower than these readings for air temperature. Because mercury possesses a very large heat capacity, its temperature would lag behind that of the air in the warehouse.

For releases of elemental mercury vapor, the dry deposition velocity and the rate of removal by rainfall are essentially zero (EPA 1997b). It is only during fire scenarios that elemental mercury is converted into forms that have non-zero dry deposition velocities or scavenging rates (see Section D.7.8.3). Therefore, for spills of elemental mercury, there is no need to be concerned about any pathways that result from deposition on the ground. Only predicted airborne concentrations are important.

In Table D–22, there are five scenarios of more-than-negligible event frequency that involve the spill of mercury at ambient temperature inside the building—single-flask spill, single-pallet spill, triple-pallet spill, single 1-MT container spill, and earthquake spill (which also bounds other scenarios, such as high winds or tornadoes).

Table D–22. Summary of Types of Accidents Considered in Onsite Spill Analysis

Accident Scenario	Could Occur Indoors?	Could Occur Outdoors?
Single-flask spill	Yes	No
Single-pallet spill	Yes	Yes
Triple-pallet spill	Yes	No
1-metric-ton container spill	Yes	Yes
Earthquake spill	Yes	Yes

Evaporation inside the building is described in Section D.7.1.1 and is based on parameters such as vapor pressure and molecular weight, air velocity inside the building, pool temperature, and spill area. Spill area is estimated based on the amount of mercury spilled and physical constraints on how far the mercury can spread. As noted above, the representative scenarios inside the building are a single-flask spill, single-pallet spill, triple-pallet spill, 1-MT container spill, and earthquake spill.

Some of these spills could potentially occur outside, but close to, the storage building. For example, a forklift could potentially drop a single pallet or 1-MT container on the loading dock. However, a triple-pallet spill could only occur as a result of the collapse of a storage rack inside the building. Likewise, it is expected that single flasks would only be moved inside the building.

Finally, if an earthquake occurs, the damage to the building could be such that the resulting spill of mercury remains essentially indoors, or the damage could be so severe that the spill could effectively be outside. The above discussion is summarized in Table D–23.

D.4.2.2 Worker Inside Building (Involved Worker) – All Onsite Spill Scenarios, All Sites

As described above, the saturated vapor density of mercury at the assumed release temperature of 20 °C (68 °F) is about 14 mg/m^3. This is only slightly above the assumed threshold for the worker, the SL-IV of 8.9 mg/m^3 for an exposure of 1 hour.[8] In practice, if there is a spill while a worker is present, that worker would leave the building rapidly. Therefore, in practice, the worker would be exposed to a toxic load much less than that accumulated in a half-hour's exposure to SL-IV. If the worker moves rapidly, the equivalent toxic load could conceivably be in the SL-II (low) or even -I (very-low-to-negligible) frequencies range.

Per Table D–17, the frequencies of all of the scenarios in Table D–22 are low (FL-II) or moderate (FL-III). Combining these frequencies with consequences in the SL-I to SL-II range gives a risk in the negligible-to-low range for the worker in the building at all sites.

D.4.2.3 Predicted Concentrations in Building Wake – All Spill Scenarios

New Construction

Data for new facility construction at GJDS, Hanford's 200-West Area, INL's INTEC, SRS's E Area, or WCS would be similar regardless of location. The generic storage building is expected to be 3 to 6 meters (10 to 20 feet) high by 102 meters (336 feet) wide by 144 meters (471 feet) long. All non-buoyant releases that occur inside the building or immediately adjacent to it would be mixed into the turbulent building wake. Table D–23 shows the predicted evaporation rates and concentrations in the building wake (where applicable) for the five scenarios listed in Table D–22.

[8] See Section D.1.1.2.2 for the definitions of SLs for workers.

Table D–23. New Construction, Predicted Evaporation Rates, and Concentrations in Building Wakes

Scenario	Mass Spilled (kg)	Area (m^2)	Outdoors (O)/Stability Class or Indoors (I)	Air Speed over Pool (m/s)	Evaporation Rate (kg/s)	Concentration in Building Wake (kg/m^3)
Single-flask spill	3.45×10^{1}	7.11×10^{-1}	I	0.1	6.66×10^{-9}	9.96×10^{-12}
			O/D	4.5	N/A[a]	N/A
			O/F	1.5	N/A[a]	N/A
Full spill tray (slow release scenario)	N/A[b]	2.00	I	0.1	1.45×10^{-8}	2.16×10^{-11}
			O/D	4.5	N/A[a]	N/A
			O/F	1.5	N/A[a]	N/A
Single-pallet spill	1.69×10^{3}	3.48×10^{1}	I	0.1	1.23×10^{-7}	1.85×10^{-10}
			O/D	4.5	8.35×10^{-6}	4.17×10^{-9}
			O/F	1.5	2.93×10^{-6}	4.39×10^{-9}
Triple-pallet spill	5.08×10^{3}	1.04×10^{2}	I	0.1	2.81×10^{-7}	4.21×10^{-10}
			O/D	4.5	N/A[a]	N/A
			O/F	1.5	N/A[a]	N/A
1-metric-ton container spill	1,000	2.06×10^{1}	I	0.1	8.31×10^{-8}	1.24×10^{-10}
			O/D	4.5	1.74×10^{-6}	8.68×10^{-10}
			O/F	1.5	4.86×10^{-7}	7.28×10^{-10}
Earthquake – pool confined to building area	N/A[b]	1.50×10^{4}	I	0.1[c]	2.76×10^{-5}	4.13×10^{-8}
			O/D	4.5	7.98×10^{-4}	N/A[d]
			O/F	1.5	3.25×10^{-4}	N/A[d]
			N/A	4.5	N/A[a]	N/A
			N/A	1.5	N/A[a]	N/A

[a] These scenarios cannot occur outside the building.

[b] Area limited, not mass limited.

[c] Calculated with formula for evaporation in a turbulent flow because Reynolds number exceeds 320,000 (see Section D.8.1.1).

[d] These scenarios assume that the building has collapsed, hence there is no building wake.

Note: To convert kilograms to pounds, multiply by 2.2046; kg/m^3 to mg/m^3, by 10^6; square meters to square feet, by 10.7639; meters to feet, by 3.281.

Key: kg=kilograms; m^2=square meters; m/s=meters per second; kg/s=kilograms per second; kg/m^3=kilograms per cubic meter; mg/m^3=milligrams per cubic meter; N/A=not available.

Pertinent observations about Table D–23 are as follows:

- A typical air speed over a spilled pool in a large building is about 0.1 meters per second (m/s) (see Section D.7.1.1), driven by natural convection. Generally, the flow is laminar, and the evaporation model (see Equation 7–1) is designed for laminar flow conditions. The exception is the earthquake scenario, where the evaporating pool is so large that the flow is turbulent and Equation 7–2, is used.

- For all spills except the earthquake and the full spill tray, the pool is assumed to spread to the limit allowed by surface tension (the pool reaches the so-called "capillary depth," which for mercury is 0.36 centimeters (0.14 inches); see Equation 7–4).

- For the spill tray scenario, the surface area is limited by the dimensions of the spill tray itself, 1.44 by 1.44 meters (56 by 56 inches); the area is approximately 2 square meters (22 square feet).

- For the earthquake scenario in which the walls are still intact enough to confine the spill, the mercury would spread to occupy the floor area, in this case 15,000 square meters (approximately 161,500 square feet). If the walls are not intact, then there is no building wake. See below for further discussion.

- For indoor spills, the released mercury is assumed to leak from the storage building and be mixed into the building wake with a low windspeed of 1.5 m/s. This is low for almost all weather conditions and gives a conservative estimate of the concentration for most weather conditions (see Equation 7–9).

- For outdoor spills, there are two calculations of building wake concentrations: in Atmospheric Stability Class D with a windspeed of 4.5 m/s and in Class F with a windspeed of 1.5 m/s. There are two countervailing tendencies here. The evaporation rate increases with increasing windspeed, whereas the building wake concentration is inversely proportional to windspeed. As can be seen in Table D–23, these effects tend to cancel out.

For a noninvolved worker or a member of the public, the concentrations in Table D–23 should be compared with 0.1 × AEGL-2 (SL-II), which, for a duration of exposure of 1 hour, is 0.17 mg/m^3. All of the predicted concentrations in Table D–28 are below this benchmark, so the consequences to both onsite workers and members of the public would be in the SL-I (negligible-to-very-low) range. Hence, the corresponding risks would be negligible, per the risk matrix in Figure D–1.

Implicit in the foregoing analysis is the assumption that the duration of release is no greater than 1 hour. It is assumed that emergency response to contain the release would be available in that time. It is also assumed that spills could and would be cleaned up sufficiently quickly to ensure that there are no chronic health effects from residual contamination or propagation into groundwater.

Existing Buildings

At some sites there are existing buildings with dimensions that differ from the proposed new construction. Data on these buildings are given in Table D–51. The different dimensions of these buildings primarily affect the floor area available for a spill to spread over (the area increases with increasing length and width) and the concentration in the building wake (inversely proportional to both width and height; see Equation 7–7). The dimensions of the existing buildings are repeated in Table D–24. As can be seen, the Hawthorne Army Depot and RWMC at INL would likely spread the storage among multiple buildings. The building at WCS is intended only to be an interim measure pending the construction of a new building. Y–12 is included because it is part of the No Action Alternative.

Table D–24. Dimensions of Relevant Buildings

Site	Length (meters)	Width (meters)	Height (meters)	Number of Buildings	Floor Area (square meters)	Building Wake Factor
RWMC at Idaho National Laboratory	61	43	7	7	2,650×7	2.00
Hawthorne Army Depot	61	15	11	29	947×29	3.84
Kansas City Plant[a]	154	154	32	1	24,000	0.42
Container Storage Building at WCS[b]	58	51	8	1	3,000	1.41
Y–12 National Security Complex	46	27	6	1	1,240	3.73
New construction	145	103	6	1	15,000	1.00

[a] The dimensions assumed for the existing building at Kansas City Plant are arbitrary and are much less than the actual dimensions of the building. The building wake factor is highly conservative.

[b] This is for interim storage only. It is assumed that there would eventually be new construction at WCS.

Note: To convert meters to feet, multiply by 3.281; square meters to square feet, by 10.7639.

Key: RWMC=Radioactive Waste Management Complex; WCS=Waste Control Specialists, LLC.

The last column shows by what factor the concentration in the building wake would change for existing buildings relative to the new construction. As can be seen, the greatest factor is just under 4 at Hawthorne Army Depot. Table D–25 explicitly displays the predicted concentrations in the building wake for the scenarios listed in Table D–23 (with the exception of the slow release from the spill tray).

Table D–25. Building Wake Concentrations for New and Existing Buildings

Scenario	Outdoors (O)/ Stability Class or Indoors (I)	Air Speed over Pool (m/s)	Concentration in Building Wake (kg/m^3)					
			New Construction	Hawthorne Army Depot	INL–RWMC	Kansas City Plant	WCS–CSB	Y–12 National Security Complex
Single-flask spill	I only	0.1	9.96×10^{-12}	3.83×10^{-11}	1.99×10^{-11}	4.19×10^{-12}	1.41×10^{-11}	3.72×10^{-11}
Single-pallet spill	I	0.1	1.85×10^{-10}	6.90×10^{-10}	3.59×10^{-10}	7.54×10^{-11}	2.54×10^{-10}	6.71×10^{-10}
	O/D	4.5	4.17×10^{-9}	1.60×10^{-8}	8.33×10^{-9}	1.75×10^{-9}	5.89×10^{-9}	N/A[a]
	O/F	1.5	4.39×10^{-9}	1.68×10^{-8}	8.77×10^{-9}	1.84×10^{-9}	6.21×10^{-9}	N/A[a]
Triple-pallet spill	I only	0.1	4.21×10^{-10}	1.61×10^{-9}	8.38×10^{-10}	1.76×10^{-10}	5.93×10^{-10}	1.56×10^{-9}
1-metric-ton container spill	I	0.1	1.24×10^{-10}	4.77×10^{-10}	2.48×10^{-10}	5.22×10^{-11}	1.76×10^{-10}	N/A[b]
	O/D	4.5	8.68×10^{-10}	3.33×10^{-9}	1.74×10^{-9}	3.65×10^{-10}	1.23×10^{-9}	N/A[b]
	O/F	1.5	7.28×10^{-10}	2.79×10^{-9}	1.46×10^{-9}	3.06×10^{-10}	1.03×10^{-9}	N/A[b]
Earthquake – pool confined to building area[c]	I only	0.1	4.13×10^{-8}	1.02×10^{-8}[d]	1.48×10^{-8}[d]	2.82×10^{-8}	8.75×10^{-9}	5.57×10^{-9}

[a] Under the No Action Alternative, no pallets would be moved outside the building at Y–12 National Security Complex.

[b] There are no 1-metric-ton containers at Y–12 National Security Complex.

[c] Earthquake spills "outside" occur when building collapses, hence there is no building wake.

[d] For these multi-building sites, even though the earthquake is assumed to affect all of the buildings on the site, the concentration in the building wake cannot exceed that outside an individual building, where the rate of release of mercury is limited by the floor area of that building.

Note: To convert meters to feet, multiply by 3.281; kg/m^3 to mg/m^3, by 10^6.

Key: CSB=Container Storage Building; INL=Idaho National Laboratory; kg/m^3=kilograms per cubic meter; m/s=meters per second; mg/m^3=milligrams per cubic meter; N/A=not applicable; RWMC=Radioactive Waste Management Complex; WCS=Waste Control Specialists, LLC.

None of the predicted concentrations for existing buildings exceeds that for new construction by more than a factor of 4. All are lower than SL-II for noninvolved workers and the public. Therefore, the predicted concentrations would be negligible to very low and the risks from all onsite spills (with the exception of spills occurring during an earthquake with building collapse) would be negligible at all sites for both the noninvolved worker and the public.

For outside spills, there is no difference between the involved worker and the noninvolved worker.

D.4.2.4 Spill During an Earthquake with Building Collapse

If the building collapses during an earthquake, the spilled mercury would evaporate as if in the open air. Section D.8.1.2 describes how the release rate is calculated in these circumstances. For a new building, that release rate in Atmospheric Stability Class D with a windspeed of 4.5 m/s is 7.98×10^{-4} kilograms per second (kg/s). This release rate (which is conservative for many of the weather conditions evaluated below) was input into a ground-level Gaussian dispersion model, which calculated downwind concentrations in a spectrum of weather conditions ranging from Classes A through F and in four discrete ranges of windspeed. The maximum predicted distances to consequence SLs II through IV (SL-II, -III, and -IV) are shown in Table D–26, which also displays the distances to the closest site boundary for each site, and, for those sites where the boundary is very close, the distance to the nearest public receptor.

This calculation predicts that the maximum downwind distance from new construction to which a concentration could exceed SL-IV would be less than 100 meters (330 feet); SL-III could be exceeded to a distance of about 300 meters (980 feet); and SL-II could be exceeded to a distance of about 1.1 kilometers (0.68 miles). There are similar results for existing buildings. These distances are shown in Table D–26.

Consequences to the public would always be in the SL-I range for spills that occur during earthquakes at Hanford, Hawthorne Army Depot, INL, KCP, SRS, and Y–12 because concentrations above SL-I would not extend beyond the site boundary; the corresponding risks would be negligible. The same conclusion is valid for GJDS and WCS on the basis of the distance to the nearest residence.

With respect to the involved and noninvolved worker, the reasoning here is much the same as it was for the involved worker inside the storage building (see Section D.4.2.2). The saturated vapor density of mercury at the assumed release temperature of 20 °C (68 °F) is approximately 14 mg/m^3. This is only slightly above the SL-IV of 8.9 mg/m^3. In practice, if there is a spill while a worker is present, that worker would be able to walk out of the cloud rapidly, in much less than the half-an-hour for which he or she could potentially be exposed to the SL-IV levels and still be able to escape. Therefore, in practice, the worker would be exposed to a toxic load much less than that accumulated in a half-hour's exposure to concentrations above 8.9 mg/m^3 (AEGL-3) or 10 mg/m^3 (IDLH). If the worker moves rapidly, the equivalent toxic load could conceivably be in the SL-II or even -I range. Therefore, combining these consequences with the moderate (FL-III) frequency of an earthquake gives a negligible-to-low risk to both involved workers and noninvolved workers.

One also needs to consider the consequences to involved workers who are hit and injured by collapsing parts of the building. The worst case would be fatality. However, that is not a mercury-specific consequence and would be a widespread risk applying to all buildings on a site. From the perspective of mercury exposure, the worst case would be that of a worker who is injured or trapped and cannot walk away, as described in the previous paragraph. In the aftermath of an earthquake, such a worker may inhale mercury vapors for perhaps many hours before being rescued and thus may accumulate exposures in the SL-IV range.

The frequency of a severe earthquake that could cause significant structural collapse of the storage building would be 4.0×10^{-4} per year. Based on projected personnel functions and time required to perform these activities, it is estimated that, on average, the equivalent of one worker would be in the

Storage Area 8 hours per week for the purposes of inspections, monitoring, or movement of mercury that has been received. This correlates to 416 hours per year in which a worker could potentially be entrapped if a large earthquake were to occur. This is equivalent to a probability of 0.047 (416/8,760) that a worker would be in the building at a specific moment (e.g., when there is an earthquake). Data from an earthquake in Armenia show that the injury rate (as opposed to the death rate) for occupants in a one-story building is 4.2 percent (0.042) (Armenian et al. 1997). Conservatively assuming that all of these injuries coincide with being entrapped in debris within the building, the resulting probability would be 7.9×10^{-7} per year ($4.0 \times 10^{-4} \times 0.047 \times 0.042$), a frequency in the FL-I range. Thus, per Figure D–1, the risk of a worker being trapped in a collapsed building after an earthquake and being exposed to mercury in the SL-IV range would be negligible.

Table D–26. Distances to the Closest Site Boundary or Public Receptor Compared with Calculated Distances – Outdoor Earthquake Scenario

Site	Distance	Direction	Notes	Predicted Distance (meters)		
				SL-II	SL-III	SL-IV
GJDS[a]	30 meters	North and west	Fence line	1,140	290	<100
Nearest resident to GJDS 4 kilometers away.						
Hanford Site (200 Areas)[a]	3.5 km	West	Site boundary	1,140	290	<100
Hawthorne Army Depot[b]	3.7 km	Southwest	Site boundary	1,560	380	<100
INL (INTEC)[a]	13.4 km	South	Site boundary U.S. Routes 20 and 26	1,140	290	<100
INL (RWMC)[b]	5.8 km	South	Site boundary U.S. Routes 20 and 26	1,270	380	<100
KCP[c]	350 meters	South	Site boundary	340	100	<100
Nearest resident to KCP 350 meters away.						
SRS (E Area)[a]	8 km	West	South Carolina Highway 125	1,140	290	<100
WCS[a]	67 meters	East	Fence line	1,140	290	<100
Nearest resident to WCS 5.4 kilometers away.						
Y–12[b]	360 meters	North	Fence line	360	100	<100
Nearest resident to Y–12 890 meters away.						

[a] New construction in predicted distances calculation. Rural site.
[b] Existing building in predicted distances calculation. Rural site.
[c] Existing building in predicted distances calculation. Urban site.
Note: To convert meters to feet, multiply by 3.281; kilometers to miles, by 0.6214.
Key: GJDS=Grand Junction Disposal Site; INL=Idaho National Laboratory; INTEC=Idaho Nuclear Technology and Engineering Center; KCP=Kansas City Plant; km=kilometers; RWMC=Radioactive Waste Management Complex; SL=severity level; SRS=Savannah River Site; WCS=Waste Control Specialists, LLC; Y–12=Y–12 National Security Complex.

D.4.3 Offsite Accidental Transportation Spill of Mercury Without Fire

There are two potential cases to be considered here: accidental spillage of mercury onto the ground and accidental spillage of mercury into a river or other water body.

D.4.3.1 Spillage of Elemental Mercury Onto the Ground

For exposures occurring via evaporation from a spill of elemental mercury with no fire during a transportation accident, the fraction of the mercury being carried by the truck or railcar that would be spilled is highly uncertain. It is extremely unlikely that all flasks or all 1-MT containers would be breached. However, to be conservative, it is assumed that such a catastrophic release could take place. The largest amount of mercury that can be carried in a truck or railcar is that contained in 54 1-MT containers. Assuming that all of this mercury is spilled and spreads until the pool is at its capillary depth (so conservative as to be essentially inconceivable in an outdoor spill), the predicted rate of evaporation given a windspeed of 4.5 m/s would be 7.35×10^{-5} kg/s. Running this through the Gaussian model and ranging over all possible combinations of atmospheric stability class and windspeed, the predicted maximum distances to the airborne toxic benchmarks for GJDS (for example) are as follows: SL-IV, less than 100 meters (330 feet); SL-III, about 100 meters (330 feet); and SL-II, about 340 meters (1,115 feet). As a result, a specific individual could not be exposed to concentrations that are greater than negligible if he or she lives more than about 340 meters (1,115 feet) from a crash. Conservatively, that specific individual could only be exposed above SL-I if the crash occurs along a 680-meter (2,230-foot) stretch of road, and then only if he or she lives by the roadside.[9] This is a small fraction of any of the routes. For GJDS, the average length of a truck trip is 2,000 kilometers (1,260 miles); 680 meters (2,230 feet) is approximately 0.00034 of this. The frequency of occurrence of a truck crash with spill on the routes to GJDS is 0.0031 per year; see Table D–13 (Scenario 2). The product of the function of the route and the frequency of the occurrence is approximately 1.1×10^{-6} per year, a low frequency. Under Truck Scenario 1 and the Railcar Scenario, the corresponding frequencies would be negligible. Therefore, the risk to an individual member of the public from transportation spills onto the ground en route to GJDS without a fire would be negligible under Truck Scenario 1 and the Railcar Scenario and low under Truck Scenario 2. The same results apply to all of the other sites.

D.4.3.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. The likelihood of this occurring is discussed in Section D.2.8. See Section D.5.4.2 for a discussion of how this might affect ecological receptors. Section D.5.4.2 makes the following conclusions regarding the consequences of the spillage of elemental mercury into a water body. In summary:

- The available understanding of the behavior of elemental mercury spilled into a river or other water body is subject to great uncertainty so that an estimate of the consequences to humans (and ecological receptors) is not possible.
- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to humans (inorganic compounds of mercury and methylmercury) are slow and would allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, a study by Harris et al. (2007) appears to show that transportation to the water body would be slow, again allowing ample time for cleanup.

The conclusion in the second bullet is questionable if the spill is into a fast-flowing river.

The overall conclusion is that a direct spillage of mercury into a body of water could be of concern if it is not cleaned up, but that there is generally adequate time for such cleanup. Hence, the consequences to humans could be managed so that they would be negligible or low. Given this assumption and the fact

[9] The length of roadway on which a crash could occur and affect a specific individual is estimated by drawing a circle with a 340-meter (1,115-foot) radius centered on the individual. The relevant length of roadway is that which lies inside the circle. The maximum possible relevant length is two radii (i.e., 680 meters or 2,230 feet) if the individual lives immediately next to the roadway.

that the frequency of crashes with spills on any of the transportation routes is no more than moderate (and this is an upper bound on the frequency of spills directly into water), the risk would be negligible or low for all transportation routes. However, this assessment should be tempered by nothing that there is a large range of uncertainty.

D.4.4 Summary of Risks – All Mercury Spill Scenarios Without Fire

Table D–27 summarizes the results of the foregoing analyses of spill scenarios.

Table D–27. Summary of Risks of all Spill Scenarios Without Fire (Fixed Site and Transportation)

Scenario	Risk							
	GJDS	**Hanford Site**	**Hawthorne Army Depot**	**INL**	**KCP**	**SRS**	**WCS**	**No Action Alternative**
Spills Inside Building[a]								
Involved worker	N–L for all inside spills at all sites							Y–12: N-L Other: U[b]
Noninvolved worker	N for all inside spills at all sites							Y–12: N Other: U[b]
Member of the public	N for all inside spills at all sites							Y–12: N Other: U[b]
Spills Outside Building								
Involved worker	N–L for all outside spills at all sites							Y–12: N Other: U[b]
Noninvolved worker	N–L for all outside spills at all sites							Y–12: N Other: U[b]
Member of the public								
1-metric-ton container spill	N	N	N	N	N	N	N	Y–12: N Other: U[b]
Single-pallet spill	N	N	N	N	N	N	N	Y–12: N Other: U[b]
Earthquake with building collapse[c]	N	N	N	N	N	N	N	Y–12: N Other: U[b]
Spills During Transportation – Spills onto Ground								
Truck Scenario 1	N for members of the public for transportation to all sites by road or rail, both options (exposure of workers N/A for these scenarios).							Y–12: N/A Other: U[b]
Truck Scenario 2	L for members of the public for transportation to all sites by road or rail, both options (exposure of workers N/A for these scenarios).							Y–12: N/A Other: U[b]
Railcar Scenario	N for members of the public for transportation to all sites by road or rail, both options (exposure of workers N/A for these scenarios).							Y–12: N/A Other: U[b]
Spills During Transportation – Spills into Water								
Spills into water	N–L for members of the public for transportation to all sites by road or rail, both options (exposure of workers N/A for this scenario). Dependent on the assumption that there is time for cleanup before significant conversion into forms (inorganic, methyl) to which receptors are more sensitive. Could be higher in circumstances in which cleanup may not be easy (e.g., a rapidly flowing river).							Y–12: N/A Other: U[b]

[a] The scenarios considered for inside spills are single flask, single pallet, triple pallet, 1-metric tons container (not applicable at Y–12 because there are no 1–MT containers at Y–12 under the No Action Alternative), full spill tray under a pallet, and earthquake with intact building walls.

[b] "Other" means commercial sites that might be involved in the movement and storage of mercury under the No Action Alternative. For a qualitative discussion of the risks associated with these sites, see Section D.4.8.1. The risks depend on many unknown factors such as the standards of construction of storage buildings, the elemental mercury inventory, flammable materials in or near the storage building, distance to the nearest resident, and means of transportation to and from the site. Therefore, the risks are unknown and could be higher than those estimated for the proposed storage locations and Y–12.

[c] This scenario bounds the risk from high winds and tornadoes.

Key: GJDS=Grand Junction Disposal Site; INL=Idaho National Laboratory; KCP=Kansas City Plant; L=low; N=negligible; N/A=not applicable; SRS=Savannah River Site; U=unknown; WCS=Waste Control Specialists, LLC; Y–12=Y–12 National Security Complex.

D.4.5 Accidental Offsite Transportation Fire

Under the railcar or truck fire scenario, mercury is postulated to be released into the atmosphere and subsequently advection downwind. Table D–28 displays the parameters used as input to the atmospheric dispersion model for truck and railcar fires. Section D.7.4.1 explains how these parameters were chosen or calculated.

The discussion of accidental offsite transportation fires only applies to the potential new storage locations and not to Y–12.

Table D–28. Parameters for Estimating Emissions of Mercury During an Offsite Fire[a]

Parameter	Truck Fire	Railcar Fire
Windspeed (meters per second) (for conservatively calculating evaporation rate)	4.5	4.5
Spill area (square meters)	35.7	41.6
Fire area (square meters)	35.7	54.8
Heat input (calories per second)	1.25×10^{6}	1.46×10^{6}
Duration of pallet fire/ mercury release (seconds)	762	1,308
Release rate (milligrams per second), windspeed 4.5 meters per second	1.3×10^{6}	1.6×10^{6}
Release rate (milligrams per second), windspeed 1.5 meters per second	5.5×10^{5}	6.8×10^{5}
Plume rise (meters)	100	100
0.1×AEGL-2 (kilograms per meter cubed)	2.44×10^{-7}	2.51×10^{-7}
AEGL-2 (kilograms per meter cubed)	2.94×10^{-6}	2.51×10^{-6}
AEGL-3 (kilograms per meter cubed)	1.52×10^{-5}	1.3×10^{-5}

[a] For further information on parameters, see Tables D–60, D–61 and D–62.

Note: To convert meters to feet, multiply by 3.281, square meters to square feet, by 10.7639; cubic meters to cubic feet, by 35.3178; calories to joules, by 4.184; kilograms to pounds, by 2.2; and milligrams to ounces, by 0.00003527.

The parameters presented in Table D–28 were used to calculate plume rise in a number of weather conditions, as shown in Table D–29.

Table D–29. Predicted Plume Heights and Average Windspeeds for Truck and Railcar Crashes with Fires

Atmospheric Stability Class/ Windspeed (meters per second)	Truck		Railcar	
	Plume Height (meters)	Average Windspeed (meters per second)	Plume Height (meters)	Average Windspeed (meters per second)
A/1.5	150	1.7	156	1.7
B/3	322	3.6	345	3.6
C/4.5	101	5.2	105	5.2
D/4.5	99	5.5	103	5.5
E/3	102	5.0	106	5.1
F/1.5	271	5.9	287	6.1

Note: See Section D.7.4 for a discussion of how these heights were calculated. To convert meters to feet, multiply by 3.281.

Table D–29 shows that a plume rise of 100 meters (330 feet) is conservative for all weather conditions. To simplify the calculations, the plume rise is taken to be 100 meters for all weather conditions and for both truck and railcar fires. The foregoing assumptions also apply to the ecological risk analysis; see Section D.5.

For the fire scenarios, for purposes of simplification, the Gaussian model calculations with dry and wet deposition were carried out in three weather conditions that are representative of the full range of weather conditions:

- Atmospheric Stability Class A with a windspeed of 1.5 m/s, representative of conditions of low windspeed and high ambient thermally generated turbulence
- Atmospheric Stability Class D with a windspeed of 4.5 m/s, representative of "average" weather conditions dominated by mechanically generated turbulence
- Atmospheric Stability Class F with a windspeed of 1.5 m/s, representative of conditions with low ambient turbulence

Human Exposure – Inhalation Pathway

Calculations were performed in the three weather conditions to estimate how far downwind of the crash site concentrations in the severity bands SL-II, -III, and -IV might extend. The results are presented in Table D–30.

Table D–30 shows that, to the extent that the three weather conditions are representative of all possible weather conditions, no individual along the transportation route could be exposed to a high airborne concentration of mercury.

Table D–30. Predicted Range of Distances (meters) Downwind Within Which Acute Airborne Severity Levels Are Exceeded – Crashes with Fires

Type of Accident	Atmospheric Stability Class/Windspeed	0.1×AEGL-2 (SL-II)	AEGL-2 (SL-III)	AEGL-3 (SL-IV)
Truck crash	A/1.5 m/s	<100–2,600	160–700	Nowhere
	D/4.5 m/s	<100–16,000	Nowhere	Nowhere
	F/1.5 m/s	<100–40,000	600–1,300	Nowhere
Railcar crash	A/1.5 m/s	<100–2,800	140–840	Nowhere
	D/4.5 m/s	<100–20,000	700–2,300	Nowhere
	F/1.5 m/s	<100–40,000	440–2,100	Nowhere

Note: To convert meters to feet, multiply by 3.281.
Key: <=less than; AEGL=Acute Exposure Guideline Level; m/s=meters per second; SL=severity level.

For truck or railcar scenarios (with pallet fires), a specific individual could not be exposed to concentrations that are above SL-III if he or she lives less than 2,300 meters (7,500 feet) from a crash (2,300 meters is taken as conservative for truck crashes). That specific individual could only be exposed above SL-II if the crash occurs along a 4,600-meter (15,000-foot) (4.6-kilometer [2.9-mile]) stretch of road, and then only if he or she lives by the roadside.[10] This is a small fraction of any of the routes. The average length of a truck trip to GJDS, for example, is about 2,000 kilometers (1,260 miles), so 4.6 kilometers (2.9 miles) is a very small fraction, 0.0023, of this. Under Truck Scenario 2, the frequency of occurrence of a truck crash with spill and fire in dry weather on the routes to GJDS would be

[10] The length of roadway on which a crash could occur and affect a specific individual is estimated by drawing a circle with a 2,300-meter (7,500-foot) radius centered on the individual. The relevant length of roadway is that which lies inside the circle. The maximum possible relevant length is two radii (i.e., 4,600 meters [15,000 feet]) if the individual lives immediately adjacent to the roadway.

0.00025 per year (see Table D–13). The product of the fraction of the route and the frequency of occurrence is about 5.8×10^{-7} per year, a negligible (FL-I) frequency. Thus, the risk of exposure above SL-III would also be negligible. This applies to Truck Scenarios 1 and 2, the Railcar Scenario, and transportation risks to all sites.

For truck or railcar scenarios, a specific individual could be exposed to an SL-II airborne concentration of mercury over considerable distances. However, since no truck or rail route has more than a moderate frequency, the overall risk would be low for all transportation scenarios and all routes to all sites. Thus, by looking at the distances to which SL-III could be exceeded, the risks appear to be negligible. However, by looking at the distances to which SL-II could be exceeded, one sees that in fact the risks of all three transportation scenarios with wooden pallet fires would be low.

The above discussion is summarized in Table D–31.

Human Exposure—Inorganic Mercury Deposited on the Ground

Humans can ingest mercury deposited on the ground (e.g., via plants). The chosen screening value is 180 mg/kg (see Section D.1.1.2.6). The potential for exposure would be negligible if the level of deposited mercury is less than 180 mg/kg. The results of the analysis of all scenarios in all weather conditions show that these concentrations would never be exceeded, either by dry deposition or as a result of scavenging by rainfall. Therefore, the risks of exposure above the SL-II threshold would be negligible.

Table D–31. Summary of Inhalation Risks to Human Receptors, Accidents with Fires in Dry Weather, All Sites

	Both Truck Scenarios	Railcar Scenario
Frequency[a]	Moderate	Low
Consequence[b]	Low	Low
Risk	*Low*	*Low*

[a] Frequencies of railcar or truck crashes with spills and fires from Tables D–12, D–13, and D–14.

[b] The highest consequence in any weather condition.

D.4.6 Multiple Exposures

The AEGLs are meant to be once-in-a-lifetime exposures since the health effects of mercury can be cumulative. The first question to be addressed is, how likely is it that there will be more than one accident of a specific type in the 40-year period of analysis that is assumed for this EIS. This is calculated by taking the mean number of accidents per year for a single accident (which essentially is the same as the frequency of the accident) and multiplying by 40 to get a mean number of accidents over 40 years and inserting that product into a Poisson distribution.[11] Using the Poisson distribution to calculate the probability of two accidents in 40 years gives the following: (a) annual frequency $f = 10^{-2}$ per year – probability of two accidents in 40 years ($P(2{:}40) = 5.36 \times 10^{-2}$; (b) $f = 10^{-3}$ per year – $P(2{:}40) = 7.69 \times 10^{-4}$; (c) $f = 10^{-4}$ per year – $P(2{:}40) = 7.97 \times 10^{-6}$; and (d) $f = 10^{-5}$ per year – $P(2{:}40) = 8.0 \times 10^{-8}$. In addition, the frequency f for which the value of $P(2{:}40)$ lies just below the FL-I/FL-II boundary of 10^{-6} per year is $f = 3.5 \times 10^{-5}$ per year. The following conclusions can be drawn from this analysis:

- In the transportation analysis, no railcar accident with spill or with fire and spill has a predicted frequency greater than 3.0×10^{-5} per year; see Table D–14. Therefore, the probability of two spills in the 40-year period of analysis would be negligible and the associated risks arising from two spills would be negligible.

[11] For a more detailed discussion of the Poisson distribution, see Section D.2.7.2.

- The frequency of truck accidents with spills is in the range 1.50×10^{-3} to 4.10×10^{-3}; see Tables D–12 and D–13. Using the Poisson distribution, the corresponding values of *P*(2:40) are 1.70×10^{-3} and 1.14×10^{-2} , respectively. Therefore, the question to be asked is, given that these two accidents occur, what is the probability that the same person will be affected by both? Referring to Table D–30:

  - No transportation accidents with fires can cause exposures to SL-IV concentrations
  - It is conceivable that two exposures in the SL-III range could add up to an exposure in the SL-IV range. Calculations similar to those reported in Table D–30 show that the concentrations greater than 0.5 × AEGL-3 do not extend more than 1,000 meters (3,300 feet) downwind. Using this information and factoring in the probability that the wind during the second crash would have to be blowing towards the specific human receptor brings the predicted frequencies into the FL-I (negligible range).
  - It is conceivable that two exposures in the SL-I range could add up to an exposure in the SL-II range. However, taking account of the fact that, even with the large ranges of up to 40 kilometers (about 25 miles) shown in SL-II, the probability that the second crash will be close enough to a specific receptor to potentially expose that receptor, the frequency of two SL-I exposures would be no more than FL-II, which gives a low risk.

- For onsite accident releases, all except those resulting from the earthquake with building collapse would mix into the building wake and produce concentrations that are less than half 0.1 × AEGL-2; see Tables D–23 and D–25. Therefore, a double exposure would remain in the SL-I range and the corresponding risk would be negligible.

- For the earthquake scenario with building collapse ($f = 4 \times 10^{-4}$ per year) the corresponding value of *P*(2:40) is 1.26×10^{-4} per year. A single earthquake exposure would never cause predicted concentrations to exceed the SL-II threshold. Conservatively assuming that two SL-I exposures would always exceed the SL-II threshold, in combination with the foregoing value of *P*(2:40), would lead to a low predicted risk.

In conclusion, a conservative analysis shows that no risk to public receptors from two acute-inhalation exposures in 40 years would be greater than low.

D.4.7 Fire – Intentional Destructive Act

Section D.2.6 describes a fire caused by an IDA. The parameters needed for input into the atmospheric dispersion model are discussed in Section D.7.4.2, where it is explained that the railcar fire is a somewhat conservative bounding case for the truck fire. The results of the analyses have been calculated only for Atmospheric Stability Class D with a windspeed of 4.5 m/s and for Class F with a windspeed of 1.5 m/s, in accordance with DOE practice when meteorological data are not available for a site (actual meteorological data are available for some but not all sites).

Human Exposure – Atmospheric Pathway

Per Table D–63, the duration of release would be 10,660 seconds (approximately 3 hours). Interpolation in Table D–19 gives a corresponding AEGL-2 of 1 mg/m^3 (1.0×10^{-6} kg/m^3) and an AEGL-3 of 4.4 mg/m^3 (4.4×10^{-6} kg/m^3).

In Atmospheric Stability Class D conditions with a windspeed of 4.5 m/s, the thresholds for SL-IV (AEGL-3) and -III (AEGL-2) are not predicted to be exceeded anywhere. Concentrations in the SL-III range could occur out to about 34 kilometers (21 miles).

In Atmospheric Stability Class F conditions with a windspeed of 1.5 m/s, SL-II concentrations exceeding 0.1 × AEGL-2 could extend from less than 100 meters (330 feet) out to about 40 kilometers (25 miles). Concentrations exceeding AEGL-2 (SL-III) are predicted to extend from about 100 meters to about 5.6 kilometers (3.5 miles) downwind of the point of release. Concentrations greater than the SL-IV threshold (AEGL-3) could occur in a "hot spot" extending from about 560 to 760 meters (1,800 to 2,500 feet) downwind.

Because frequencies are not assigned to IDA scenarios, it is not possible to match the above concentrations with corresponding estimates of risk.

Human Exposure – Deposition Pathway

The calculations predict that the threshold for SL-II (180 mg/kg) would not be exceeded anywhere.

D.4.8 Risks Associated with the No Action Alternative

The No Action Alternative would not provide a DOE-designated long-term storage facility for any excess elemental mercury. Excess mercury that could not be sold would be stored as a commodity to the extent allowed by law. Some mercury would likely be considered a waste and would be stored in accordance with law. Such storage would not necessarily occur at the sites identified as potential sources of excess mercury. This storage service might be provided by a commercial waste management company(ies). In addition, approximately 1,200 metric tons (1,330 tons) of DOE mercury would continue to be stored at Y–12. This DOE mercury is currently stored in approximately 35,000 3-L flasks.

The analysis of risks associated with the No Action Alternative can be divided into two parts:

- Risks associated with storage at commercial facilities, as outlined above. These risks are very hard to describe quantitatively because to do so would require a great deal of information that is not available at the time of writing.

- Risks associated with the storage of DOE mercury at Y–12. These risks can be analyzed and characterized to the same level of detail as those for the candidate storage facilities.

D.4.8.1 Risks Associated with Commercial Sites

Many of the potential accident scenarios associated with the storage and movement of elemental mercury by commercial entities if DOE does not designate a long-term storage facility under the No Action Alternative would be the same as for transportation to and storage at one of the candidate sites. Thus, it is likely that mercury would be placed in 3-L flasks or 1-MT containers. Therefore, accidents involving the dropping of these or the dropping of pallets would be possible, both indoors and outdoors. Buildings would be vulnerable to external events, such as earthquakes, high winds, and aircraft crashes, among others. It is not known whether all buildings in which mercury would be stored or handled are designed to the same standards as the candidate storage facilities would be (for example, in their ability to resist earthquakes or high winds). The consequences of accidents involving severe damage to a building would depend on how much mercury is actually present in the building and where it is located relative to nearby populations; for example, it is conceivable that the distance to the fence line could be short and that there could be houses backing up to that fence line, in which case the risks could be higher than those predicted for the candidate storage buildings.

Mercury would continue to be transported between various facilities. It seems likely that the total amount transported would be about the same as that used for analysis purposes in this EIS. However, what is not known is how much would be transported as full truck or railcar loads and how much as partial loads (e.g., one pallet or one 1-MT container on a truck). However, it would appear that the various transportation spills with fires that were analyzed for the candidate storage facilities would also be possible under the No Action Alternative, with concomitant, but currently unquantifiable, risks to human health and ecological receptors.

The proposed action analyzed in this EIS is to implement the Mercury Export Ban Act by designating a Federal storage facility for elemental mercury. Based on Chapter 1, Table 1–1, the vast majority of mercury covered by this EIS would be generated by chlor-alkali facilities, R&R facilities and the gold-mining industry. Under the No Action Alternative, this mercury would have to be stored indefinitely at multiple privately owned facilities. It could be argued that the biggest impact of No Action is widely dispersed storage. The potential benefit of the proposed action would be long-term DOE storage and management of this material as opposed to continued, dispersed storage by multiple private entities.

D.4.8.2 Risks Associated with the Continuing Operation of Y–12 as an Elemental Mercury Storage Facility

Some risks that pertain to candidate storage facilities do not apply to Y–12 under the No Action Alternative:

- There would be no transportation to or from Y–12 under the No Action Alternative. Therefore, there would be no human health or ecological risks arising from transportation accidents.
- There are no 1-MT containers at Y–12 and hence there would be no accidents involving such containers and no associated risks.
- Flasks and pallets would not be handled outside the storage building. Hence, there could be no outside accidents involving these items, and no associated risk.

Some risks at Y–12 are the same as or similar to those for the candidate storage facilities:

- The analysis of the risk to the involved worker is the same as that in Section D.4.1.1 and shows that, given assumptions about ventilation, inspections, monitoring, and use of PPE, the concentrations to which the involved worker would be exposed would be less than the 8-hour ACGIH's TWA/TLV of 0.025 mg/m^3. Hence, the associated risk would be negligible.
- The analysis of a conservative scenario for leaks during normal operations (see Section D.4.1.2) shows that the predicted average long-term concentration in the building wake is approximately 7.5×10^{-5} mg/m^3, less than EPA's RfC of 3.0×10^{-4} mg/m^3. Hence, predicted risks to noninvolved workers and public receptors at Y–12 would be negligible during normal operations.
- The results of various indoor spillages at Y–12 are summarized in Table D–25, and show that predicted concentrations all lie in the SL-I range, which has negligible associated risk to noninvolved workers and members of the public, per Figure D–1. The analysis for involved workers shows that their risks would be in the low-to-negligible range.
- The earthquake scenario at Y–12 with building collapse is analyzed in the same way as for the candidate storage facilities. Table D–26 shows that concentrations beyond the Y–12 fence line would lie in the SL-1 range with negligible associated risk. The risks to both involved and noninvolved workers would be low to negligible.

In conclusion, continued operations of the mercury storage facility at Y–12 would pose negligible risk to members of the public and to ecological receptors, and at most low risk to involved and noninvolved workers.

D.5 ECOLOGICAL RISK ASSESSMENT

This ecological risk analysis focuses on a short list of receptors that are considered representative of those found along the transportation routes, including plants and soil invertebrates, terrestrial animals, and aquatic and sediment-dwelling biota. These representative receptors are listed below.

- Plants
- Soil invertebrates
- The short-tailed shrew
- The American robin
- The red-tailed hawk
- The great blue heron
- The river otter
- Aquatic biota
- Sediment-dwelling (i.e., benthic) biota

These ecological receptors are representative of species or communities that occur across a diversity of ecosystems present at alternative mercury storage sites and along routes to those sites. The representative ecological receptors exhibit sensitivity to mercury and other hazardous chemicals present in soil, sediment, surface water, or the food they eat (see Section D.5.1). Toxicological effects data (see Section D.5.2) and exposure information (see Section D.5.3) are available for the receptors, and individual receptor species or closely related and ecologically similar species are broadly distributed across the continent. Plants, earthworms, and sediment-dwelling invertebrates are an important component of the diets of many mammals, birds, and fish. Robins and shrews are mid-level predators exposed to contaminants in soil both directly by ingestion of soil and indirectly by ingestion of their mostly invertebrate soil-dwelling prey. Strictly herbivorous animals are not included as ecological receptors because bioaccumulation of mercury in plants is generally less than that in invertebrates; bioaccumulation of mercury and other hazardous chemicals in the food items of predators is a concern. Hawks and other birds of prey in terrestrial ecosystems are top predators that eat small mammals and birds. Herons and mustelids (e.g., mink, otter) are predators, feeding primarily on fish and other aquatic animals. These receptors represent the major exposure pathways for mercury in terrestrial and aquatic ecosystems and provide a common basis for comparing the potential adverse impacts of the alternatives being evaluated in this EIS.

Ecological consequences are evaluated using the same modeled concentrations as those presented in Section D.4. This section first provides a general description of potentially toxic effects on ecological receptors from exposure to mercury. Then, the TRVs for plants, earthworms, shrews, robins, hawks, aquatic biota, sediment-dwelling biota, river otters, and herons are derived for mercury. The derivation of the environmental-medium- and receptor-specific benchmarks based on the TRVs is discussed next. Finally, the results of the comparison of estimated concentrations of mercury in environmental media against the ecological benchmarks are presented.

D.5.1 Mercury Ecotoxicity

Soil and surface water may become contaminated by airborne releases of mercury. Because mercury deposited onto soil or into water bodies is persistent, chronic exposure to contaminated soil and water is assumed. This assumption is conservative for accidental releases because spills are likely to be mitigated by cleanup operations. Exposure to mercury by inhalation in air or suspended particles is assumed to be negligible, as explained in Section D.5.4.1.

Elemental mercury released to the environment can be oxidized to divalent mercury through reactions with soil constituents. Elemental and divalent mercury under anaerobic conditions, such as in surface water and sediment, can be converted to methylmercury. Mercury that may be released to terrestrial systems is assumed to become divalent to some extent in the long term. Two percent of the mercury released to dry soil and 15 percent of the mercury released to wetland soil and sediment are assumed to convert to methylmercury (EPA 1999a). A partitioning equation was used to estimate the concentration of mercury leaching from sediment into the surface water. Any form of mercury released to aquatic systems is assumed to be a source of methylmercury, which is a conservative assumption because this is the most toxic form of mercury. Mercury investigations generally focus on aquatic rather than terrestrial ecosystems due to methylation and bioaccumulation of methylmercury in aquatic systems. Animals primarily associated with aquatic food chains accumulate more mercury than those associated with terrestrial food chains. Methylmercury biomagnifies in aquatic biota and, as a result, tends to occur at higher concentrations in higher trophic levels. Methylmercury is the most toxic form of mercury to birds, mammals, and aquatic organisms.

Inorganic mercury accumulates to only a limited extent in plants and soil organisms and does not biomagnify in the organisms that feed on them. The effects of inorganic mercury on terrestrial receptors, according to EPA's *Mercury Study Report to Congress* (EPA 1997a), are listed below.

- In terrestrial plants, inorganic mercury can cause death as well as sublethal effects, such as decreased growth, root damage, hampered nutrient uptake, chlorophyll decline, and reduced photosynthesis.

- Earthworms exhibit effects that range from toxicity to complete mortality when exposed to inorganic mercury.

- In mammals, inorganic mercury is corrosive and may cause burning, irritation, salivation, vomiting, bloody diarrhea, upper gastrointestinal tract edema, abdominal pain, and hemorrhaging. Smaller animals are generally more susceptible to mercury poisoning than larger animals.

- In birds, sublethal effects of inorganic mercury include liver damage, kidney damage, neurobehavioral effects, reduced food consumption, weight loss, spinal cord damage, effects on enzyme systems, reduced cardiovascular function, impaired immune response, reduced muscular coordination, impaired growth and development, altered blood and serum chemistry, and reproductive effects.

The effects of methylmercury on aquatic receptors, according to EPA's *Mercury Study Report to Congress* (EPA 1997a), are listed below.

- In aquatic plants, methylmercury can cause death, as well as sublethal effects such as premature aging, growth inhibition, decreased chlorophyll content, decreased protein and ribonucleic acid content, inhibited catalase and protease activities, inhibited and abnormal mitotic activity, increased free amino acid content, discoloration of floating leaves, and leaf and root necrosis.

- The effects of methylmercury on fish include death, reduced reproduction, impaired growth and development, behavioral abnormalities, altered blood chemistry, impaired osmoregulation, reduced feeding rates and predatory success, and effects on oxygen exchange. The toxicity of methylmercury varies depending on the fish's physiological and behavioral characteristics, and the methylmercury concentration tends to increase in aquatic organisms as the trophic level in aquatic food webs increases.

D.5.2 Toxicity Reference Values

The TRVs used to derive the environmental-medium- and receptor-specific benchmarks are discussed below.

D.5.2.1 TRVs for Plants and Soil Invertebrates

Published TRVs for plants and earthworms are predominantly lowest observed adverse effect level (LOAEL) values determined for soil amended with chemical solutions at different concentrations (Efroymson, Would, and Suter 1997; Efroymson et al. 1997). In most toxicity studies, no determination is made for the biological availability of the added constituents or of the total recoverable constituents (the type of information provided by the laboratory analysis of constituents in soil) in the test soil. Therefore, it is assumed that total recoverable constituents in soil found at the sites are 100 percent bioavailable and have the same toxicity as constituents added in laboratory toxicity tests. Mercury TRVs for plants and earthworms are presented in Table D–32.

D.5.2.2 TRVs for Terrestrial Animals

The methods for assessing the potentially toxic effects of mercury on terrestrial animals are based on the derivation of a TRV. The TRVs are derived to represent conservative estimates of the mercury doses (in milligrams per kilogram of body weight per day [mg/kg BW/day]) that, if exceeded when exposed to an environmental medium, may produce toxic effects in ecological receptors exposed to that medium. Literature toxicity data are used by establishing data selection criteria so that TRVs are as relevant to the unit assessment endpoints as possible. Furthermore, the conservatism of the TRVs is reinforced by using the lowest available, appropriate toxicity values and modifying them by uncertainty factors when necessary. Toxicity values used as the basis for the TRVs were selected as described below. The source for most toxicity values used as TRVs is *Toxicological Benchmarks for Wildlife, 1996 Revision* (Sample, Opresko, and Suter 1996).

In an effort to address uncertainties up front in the ERA process, the preferred toxicity test endpoint is the lowest appropriate chronic observed adverse effect level (LOAEL) for nonlethal or reproductive effects. LOAELs are appropriate for evaluating the risk to nonthreatened and nonendangered receptor populations (Suter, Hall, and Sample 1994). When published LOAEL values are not available, LOAELs are estimated by multiplying published no observed adverse effects levels (NOAELs) by a factor of 10. If no NOAEL values are available, the next preferred form of toxicity data for use in deriving a TRV is an LD_{50} (median lethal dose) or an LC_{50} (median lethal concentration). Values based on chronic studies are preferred. Studies are considered to provide chronic toxicity data if conducted for a minimum duration of 1 year in mammals, 10 weeks in birds (Sample, Opresko, and Suter 1996), or 7 days in fish or invertebrates. Studies shorter than 90 days in mammals, 18 days in birds, and 2 days in fish or invertebrates are considered acute. Studies longer than acute tests, but shorter than chronic tests, are considered subchronic. The derivation of mercury TRVs is shown for shrews, robins, hawks, river otters, and herons in Table D–32.

Table D–32. Mercury Toxicity Reference Values for Ecological Receptors

Receptor	Form of Mercury	Toxicity Reference Value	Test Organism	Toxic Endpoint	Reference
Plants	Inorganic	0.3 mg/kg soil	Plants in soil	Unspecified toxicity	Efroymson, Would, and Suter 1997
	Methyl	None	N/A	N/A	N/A
Earthworms	Inorganic	0.1 mg/kg soil	*Octochaetus pattoni*	Survival and cocoon production	Efroymson et al. 1997
	Methyl	2.5 mg/kg soil	*Eisenia fetida*	Survival and regeneration of segments	Efroymson et al. 1997
Short-tailed shrew	Inorganic	27.7 mg/kg BW/day	Mink	Reproduction, estimated as NOAEL×10	Sample, Opresko, and Suter 1996
	Methyl	0.34 mg/kg BW/day	Rat	LOAEL for reproduction	Sample, Opresko, and Suter 1996
American robin	Inorganic	0.9 mg/kg BW/day	Japanese quail	LOAEL for reproduction	Sample, Opresko, and Suter 1996
	Methyl	0.064 mg/kg BW/day	Mallard duck	LOAEL for reproduction	Sample, Opresko, and Suter 1996
Red-tailed hawk	Inorganic	0.9 mg/kg BW/day	Japanese quail	LOAEL for reproduction	Sample, Opresko, and Suter 1996
	Methyl	0.064 mg/kg BW/day	Mallard duck	LOAEL for reproduction	Sample, Opresko, and Suter 1996
Great blue heron	Inorganic	0.9 mg/kg BW/day	Japanese quail	LOAEL for reproduction	Sample, Opresko, and Suter 1996
	Methyl	0.064 mg/kg BW/day	Mallard duck	LOAEL for reproduction	Sample, Opresko, and Suter 1996
River otter	Inorganic	5.8 mg/kg BW/day	Mink	Reproduction, estimated as NOAEL×10	Sample, Opresko, and Suter 1996
	Methyl	0.015 mg/kg BW/day	Mink	LOAEL for mortality, weight loss, ataxia	Sample, Opresko, and Suter 1996
Aquatic biota	Inorganic	1.3 μg/L	Aquatic biota	Tier II chronic value for inorganic mercury	Suter and Tsao 1996
	Methyl	0.0028 μg/L	Aquatic biota	Tier II chronic value for methylmercury	Suter and Tsao 1996
Sediment-dwelling biota	Inorganic	0.15 mg/kg sediment	Sediment-dwelling biota	NOAA ER-L	Jones, Suter, and Hull 1997
	Methyl	No toxicity reference value	N/A	N/A	N/A

Key: μg/L=micrograms per liter; BW=body weight; LOAEL=lowest observed adverse effect level; mg/kg=milligrams per kilogram; N/A=not applicable; NOAA ER-L=National Oceanic and Atmospheric Administration Effects Range – Low; NOAEL=no observed adverse effects level.

D.5.2.3 TRVs for Aquatic Biota

For aquatic receptors, the preferred source of aquatic TRVs is *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision* (Suter and Tsao 1996). This document provides a compilation of aquatic toxicity values, including Federal ambient water quality criteria, derived Tier II values (secondary chronic and acute values), and chronic values from a variety of other governmental sources. Uncertainty factors (other than for use of a surrogate chemical) are not applied to TRVs from the above sources because the methods of their derivation already account for uncertainties. The preferred toxicity value for aquatic biota is the water quality criterion for mercury in freshwater. TRVs for inorganic and methylmercury are also presented in Table D–32.

Sediment is also evaluated for potential toxicity to aquatic receptors. The preferred source of sediment TRVs is *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision* (Jones, Suter, and Hull 1997). This document provides a compilation of sediment toxicity values, including EPA Sediment Quality Criteria for the Protection of Benthic Organisms, derived sediment quality benchmarks for nonionic organic chemicals based on equilibrium partitioning, Washington State sediment quality standards for some ionic organic compounds, National Oceanic and Atmospheric Administration values from Long and Morgan (1991) and Long et al. (1995), and values from other governmental sources. National Oceanic and Atmospheric Administration Effects Range – Low (NOAA ER-L) values were used as the preferred sediment TRV for mercury (Long and Morgan 1991).

D.5.3 Ecologically Based Benchmarks for Mercury

To expedite the evaluation of potential exposures, screening benchmarks for mercury in soil, surface water, and sediment were derived. For soil, the exposure dose was set equal to the TRV for each terrestrial receptor. Then the exposure equation was solved for the soil concentration, which became the soil screening value for each receptor. This procedure also was completed for exposure of river otters and great blue herons to mercury in surface water and sediment.

As previously discussed, concentrations in environmental media were calculated to determine screening benchmarks resulting in a Hazard Quotient of 1 for each type of terrestrial receptor (lower trophic level and higher trophic level). The equations presented in the following sections were used to establish the screening benchmarks for the receptors exposed to soil, surface water, and sediment; these are presented in Tables D–33 (inorganic mercury) and D–34 (methylmercury).

Table D–33. Ecological Screening Values for Inorganic Mercury

Ecological Receptor, Pathway	TRV[a] (mg/kg BW/day)	SP[b]	Ip[c] (kg/day)	BAF_{inv}[d]	BCF[e]	Ia[f] (kg/day)	BAF_{mamm}[g]	Is[h] (kg/day)	Iw[i] (L/day)	BW[j] (kg)	UFF	Screening Value[k] (mg/kg or μg/L)
Plants	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3
Soil invertebrates	0.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.1
Short-tailed shrew	27.7	0.18	0.0012	0.34	N/A	0.008	13	0.0012	N/A	0.017	1	110
American robin	0.9	0.04	0.061	0.34	N/A	0.061	13	0.013	N/A	0.080	1	2.0
Red-tailed hawk	0.9	N/A	0	N/A	N/A	0.124	13	0	N/A	1.13	0.001	1,619
Great blue heron, sediment	0.9	0.18	0	0.34	N/A	0.009	N/A	0	N/A	2.39	1	736
Great blue heron, water	0.9	N/A	N/A	N/A	3,530	0.422	N/A	N/A	0.045	2.39	1	1.4
River otter, sediment	5.8	0.18	0	0.34	N/A	0.0278	N/A	0	N/A	8.55	1	5,255
River otter, water	5.8	N/A	N/A	N/A	3,530	1.360	N/A	N/A	0.69	8.55	1	10.33
Aquatic biota	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.3
Sediment-dwelling biota	0.15	N/A	N/A	N/A	N/A	N/A	NA	N/A	N/A	N/A	N/A	0.15

[a] Toxicity reference value in milligrams per kilogram of body weight per day.

[b] Soil-to-plant transfer factor: to vegetative parts for shrews and herons; to reproductive parts for robins (Baes et al. 1984).

[c] Ingestion rate of plant tissue in kilograms per day (EPA 1993).

[d] Soil-to-soil invertebrate transfer factor (HAZWRAP 1994).

[e] Water-to-tissue bioconcentration factor (EPA 1999a).

[f] Ingestion rate of animal tissue in kilograms per day (EPA 1993). River otter sediment value is rounded for display.

[g] Food-to-tissue uptake factor for mammals and birds (HAZWRAP 1994).

[h] Ingestion rate of soil in kilograms per day (EPA 1993).

[i] Ingestion rate of water in liters per day (EPA 1993).

[j] Body weight in kilograms (EPA 1993).

[k] Calculated by solving exposure equations for predicted concentration in soil, sediment, or surface water when the exposure dose equals the toxicity reference value; expressed in milligrams per kilogram or micrograms per liter.

Key: N/A=not applicable; UFF=unit foraging factor.

Table D–34. Ecological Screening Values for Methylmercury

Ecological Receptor, Pathway	TRV[a] (mg/kg BW/day)	SP[b]	Ip[c] (kg/day)	BAF_{inv}[d]	BCF[e]	Ia[f] (kg/day)	BAF_{mamm}[g]	Is[h] (kg/day)	Iw[i] (L/day)	BW[j] (kg)	UFF	Screening Value[k] (mg/kg or µg/L)
Plants	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	None
Soil invertebrates	2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.5
Short-tailed shrew	0.34	0.137	0.0012	8.50	N/A	0.008	13	0.0012	N/A	0.017	1	0.08
American robin	0.064	0.137	0.061	8.50	N/A	0.061	13	0.013	N/A	0.08	1	0.010
Red-tailed hawk	0.064	N/A	0	N/A	N/A	0.124	13	0	N/A	1.13	0.001	6.86
Great blue heron, sediment	0.064	0.18	0	8.50	N/A	0.0086	N/A	0	N/A	2.39	1	2.09
Great blue heron, water	0.064	N/A	N/A	N/A	11,168	0.422	N/A	N/A	0.045	2.39	1	0.032
River otter, sediment	0.015	0.137	0	8.5	N/A	0.0278	N/A	0	N/A	8.55	1	0.54
River otter, water	0.015	N/A	N/A	N/A	11,168	1.360	N/A	N/A	0.69	8.55	1	0.008
Aquatic biota	0.0028	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0028
Sediment-dwelling biota	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	None

[a] Toxicity reference value in milligrams per kilogram of body weight per day.

[b] Soil-to-plant transfer factor: to vegetative parts for shrews and herons; to reproductive parts for robins (EPA 1999a).

[c] Ingestion rate of plant tissue in kilograms per day (EPA 1993).

[d] Soil-to-soil invertebrate transfer factor (EPA 1999a).

[e] Water-to-tissue bioconcentration factor (EPA 1999a).

[f] Ingestion rate of animal tissue in kilograms per day (EPA 1993). River otter sediment value is rounded for display.

[g] Food-to-tissue uptake factor for mammals and birds (EPA 1999a).

[h] Ingestion rate of soil in kilograms per day (EPA 1993).

[i] Ingestion rate of water in liters per day (EPA 1993).

[j] Body weight in kilograms (EPA 1993).

[k] Calculated by solving exposure equations for predicted concentration in soil, sediment, or surface water when the exposure dose equals the toxicity reference value; expressed in milligrams per kilogram or micrograms per liter.

Key: NA=not applicable; UFF=unit foraging factor.

D.5.3.1 Lower-Trophic-Level Receptors (Short-Tailed Shrews and American Robins)

The concentration of mercury in soil corresponding to the mercury soil screening benchmark for lower-trophic-level receptors (shrews, robins) is back-calculated from each receptor's soil exposure dose (ED_{soil}), where ED_{soil} equals the TRV, i.e., Hazard Quotient = 1. The soil benchmark concentration (C_{soil}) is calculated by dividing the benchmark daily dose (in milligrams of constituent per day) by the daily rate of ingestion of the constituent (mercury) for all types of material ingested, where the rate is given on the basis of per unit of the constituent in soil (in kilograms of soil per day). That is,

$$C_{soil} = \frac{(BW*ED_{soil})}{[(SP*I_p) + (BAF_{inv}*I_a) + (I_{soil}*ST)]} \qquad (5\text{–}1)$$

where:

C_{soil}	=	Predicted concentration in soil (mg/kg)
BW	=	Body weight (kg)
ED_{soil}	=	Soil exposure dose for terrestrial receptor (mg/kg/day)
SP	=	Soil-to-plant uptake factor (kg soil/kg plant); SP_v for shrews and SP_r for robins
I_p	=	Receptor-specific ingestion rate of plant material (kg/day)
BAF_{inv}	=	Constituent-specific bioaccumulation factor for transfer from soil to invertebrate tissue (kg soil/kg tissue)
I_a	=	Receptor-specific ingestion rate of animal material (kg/day)
I_{soil}	=	Receptor-specific ingestion rate of soil (kg/day)
ST	=	Bioavailability factor for constituents ingested in soil (assumed to be 1.0 for all constituents and receptors)

Each component of the sum in the denominator of this ratio, when multiplied by the soil concentration, gives the daily dose of the constituent to the receptor (in milligrams per day) from ingesting that material type. This assumes that all of the constituent in the ingested material comes directly or indirectly from soil. The material types ingested by each receptor and the relevant bioaccumulation factors are defined by the parameters with non-zero values in Tables D–33 and D–34.

D.5.3.2 Terrestrial Higher-Trophic-Level Receptors (Hawks)

The concentration of mercury in soil corresponding to the mercury soil screening benchmark for terrestrial higher-trophic-level receptors (hawks) is back-calculated from the receptor's soil exposure dose (ED_{soil}), where ED_{soil} equals the TRV, i.e., Hazard Quotient = 1. In the case of the higher-trophic-level receptor, all soil exposure is through the prey (shrew). The dose to the hawk is calculated by multiplying the hawk's ingestion rate by the concentration of the constituent (mercury) in its prey, the shrew, and the unit foraging factor (UFF). The UFF is required for the hawk because its home range is larger than the areas assumed to be impacted by accidental releases of mercury. The concentration of the constituent in shrews is calculated from the animal-to-animal bioaccumulation factor (BAF_{mammal}) and the concentrations in the diet of shrews weighted by the relevant fraction of the daily rate of ingestion of shrews, where the rates are given on the basis of per unit of the constituent in soil (in kilograms of soil per day). The concentration in each type of food ingested by shrews is the product of the appropriate transfer or bioaccumulation factor and the soil benchmark concentration. The dose equation for the hawk ingesting shrews is rearranged to calculate soil benchmark concentration (C_{soil}).

That is,

$$C_{soil} = \frac{\left(\dfrac{(ED_{soil}*IR_{shrew}*BW)}{(BAF_{mammal}*I_{a(hawk)}*UFF)}\right)}{[(SP_v*I_{p(shrew)})+(BAF_{inv}*I_{a(shrew)})+(I_{soil}*ST)]} \qquad (5\text{–}2)$$

where:

C_{soil} = Predicted concentration in soil (mg/kg)
ED_{soil} = Soil exposure dose for terrestrial receptor (mg/kg/day)
IR_{shrew} = Total food and soil ingestion rate by the shrew (kg/day)
BW = Body weight (kg)
BAF_{mammal} = Bioaccumulation factor of constituent ingested by the shrew (kg food/kg tissue), 13 for mercury
$I_{a(hawk)}$ = Ingestion rate of animal material by the hawk (kg/day)
UFF = Unit foraging factor (unitless)
SP_v = Soil-to-plant uptake factor (kg soil/kg plant)
$I_{p(shrew)}$ = Ingestion rate of plant material by the shrew (kg/day)
BAF_{inv} = Constituent-specific bioaccumulation factor for transfer from soil to invertebrate tissue (kg soil/kg/tissue)
$I_{a(shrew)}$ = Ingestion rate of animal material by the shrew (kg/day)
I_{soil} = Ingestion rate of soil (kg/day) by the shrew
ST = Bioavailability factor for constituents ingested in soil (assumed to be 1.0 for all constituents and receptors)

Each component of the sum in the denominator of this ratio, when multiplied by the soil concentration, gives the daily dose of the constituent to the prey and thus the receptor (in milligrams per day) from ingesting that material type. This assumes that all of the constituent in the ingested material comes directly or indirectly from soil. The material types ingested by each receptor and the relevant bioaccumulation factors are defined by the parameters with non-zero values in Tables D–33 and D–34.

D.5.3.3 Terrestrial Semi-Aquatic Receptors (Great Blue Heron and River Otter) Exposed to Sediment

The concentration of mercury in sediment corresponding to the mercury sediment screening benchmark for terrestrial semi-aquatic receptors (great blue heron and river otter) is back-calculated from each receptor's sediment exposure dose (ED_{sed}), where ED_{sed} equals the TRV, i.e., Hazard Quotient = 1. The sediment benchmark concentration (C_{sed}) is calculated by dividing the benchmark daily dose (in milligrams of constituent per day) by the daily rate of ingestion of the constituent (mercury) for all types of material ingested, where the rate is given on the basis of per unit of the constituent in sediment (in kilograms of sediment per day). That is,

$$C_{sed} = \frac{(BW*ED_{sed})}{[(SP*I_p) + (BAF_{inv}*I_a)+(I_{sed}*ST)]} \qquad (5\text{–}3)$$

where:

C_{sed} = Predicted concentration in sediment (mg/kg)
BW = Body weight (kg)
ED_{sed} = Sediment exposure dose for terrestrial receptor (mg/kg/day)
SP = Soil-to-plant uptake factor (kg soil/kg plant)
I_p = Receptor-specific ingestion rate of plant material (kg/day)

BAF_{inv} = Constituent-specific bioaccumulation factor (unitless)
I_a = Receptor-specific ingestion rate of sediment-dwelling animal material (kg/day)
I_{sed} = Receptor-specific ingestion rate of sediment (kg/day)
ST = Bioavailability factor for constituents ingested in sediment (assumed to be 1.0 for all forms of mercury)

Each component of the sum in the denominator of this ratio, when multiplied by the sediment concentration, gives the daily dose of the constituent to the receptor (in milligrams per day) from ingesting that material type. This assumes that all of the constituent in the ingested material comes directly or indirectly from sediment. The material types ingested by each receptor and the relevant bioaccumulation factors are defined by the parameters with non-zero values in Tables D–33 and D–34.

D.5.3.4 Terrestrial Semi-Aquatic Receptors (Great Blue Heron and River Otter) Exposed to Surface Water

The concentration of mercury in surface water corresponding to the mercury surface-water screening benchmark for terrestrial semi-aquatic receptors (great blue heron and river otter) is back-calculated from each receptor's surface-water exposure dose (ED_{sw}), where ED_{sw} equals the TRV, i.e., Hazard Quotient = 1. The surface-water benchmark concentration (C_{sw}) is calculated by dividing the benchmark daily dose (in milligrams of constituent per day) by the daily rate of ingestion of the constituent (mercury) for all types of material ingested, where the rate is given on the basis of per unit of the constituent in surface water (in liters of surface water per day). That is,

$$C_{sw} = \frac{(BW*ED_{sw})}{[I_{sw}+(BCF*I_a)]} \quad (5–4)$$

where:

C_{sw} = Predicted concentration in surface water (milligrams/liter)
BW = Body weight (kg)
ED_{sw} = Surface-water exposure dose for terrestrial receptor (mg/kg/day)
I_{sw} = Receptor-specific ingestion rate of surface water (liters/day)
BCF = Constituent-specific water-to-tissue bioconcentration factor for prey (liters/kilogram)
I_a = Receptor-specific ingestion rate of animal material (kg/day)

Each component of the sum in the denominator of this ratio, when multiplied by the surface-water concentration, gives the daily dose of the constituent to the receptor (in milligrams per day) from ingesting that material type. This assumes that all of the constituent in the ingested material comes directly or indirectly from surface water. The material types ingested by each receptor and the relevant bioaccumulation factors are defined by the parameters with non-zero values in Tables D–33 and D–34.

D.5.3.5 Conversion of Ecological Screening Values to Equivalent Deposited Screening Values

The output of the atmospheric dispersion model provides airborne concentrations in kg/m^3 and amounts of deposited mercury in kg/m^2. For ease of comparison with these outputs, the ecological screening values can be converted into equivalent levels of deposited mercury (independent of the mercury release scenario). Table D–35 provides equivalent deposited screening values for the ecological screening values in Tables D–33 and D–34.

Table D–35. Equivalent Deposited Screening Value

Ecological Receptor, Pathway	Form of Mercury	Screening Value (mg/kg or µg/L)	Equivalent Deposited Screening Value (kg/m^2)
Plants	Inorganic mercury	3.00×10^{-1}	2.76×10^{-5}
Soil invertebrates	Inorganic mercury	1.00×10^{-1}	9.18×10^{-6}
Short-tailed shrew	Inorganic mercury	1.10×10^{2}	1.01×10^{-2}
River otter, sediment	Inorganic mercury	2.00	2.23×10^{-1}
River otter, water	Inorganic mercury	1.62×10^{3}	2.67×10^{-1}
American robin	Inorganic mercury	7.36×10^{2}	1.84×10^{-4}
Red-tailed hawk	Inorganic mercury	1.40	1.49×10^{-1}
Great blue heron, sediment	Inorganic mercury	5.26×10^{3}	3.12×10^{-2}
Great blue heron, water	Inorganic mercury	1.03×10^{1}	3.61×10^{-2}
Aquatic biota	Inorganic mercury	1.30	3.36×10^{-2}
Sediment-dwelling biota	Inorganic mercury	1.50×10^{-1}	6.35×10^{-6}
Plants	Methylmercury	None	None
Soil invertebrates	Methylmercury	2.50	1.13×10^{-2}
Short-tailed shrew	Methylmercury	8.00×10^{-2}	3.60×10^{-4}
River otter, sediment	Methylmercury	1.00×10^{-2}	1.31×10^{-4}
River otter, water	Methylmercury	6.86	7.78×10^{-4}
American robin	Methylmercury	2.09	4.50×10^{-5}
Red-tailed hawk	Methylmercury	3.20×10^{-2}	3.09×10^{-2}
Great blue heron, sediment	Methylmercury	5.40×10^{-1}	5.02×10^{-4}
Great blue heron, water	Methylmercury	8.00×10^{-3}	3.11×10^{-3}
Aquatic biota	Methylmercury	2.80×10^{-3}	2.72×10^{-4}
Sediment-dwelling biota	Methylmercury	None	None

Key: mg/kg=milligrams per kilogram; µg/L=micrograms per liter; kg/m^2=kilograms per square meter.

D.5.4 Ecological Risk Analysis

This section presents the estimated ecological health consequences associated with each of the release scenarios for the alternative sites. These consequences are characterized by comparing the screening values (or equivalent deposited screening values) with the output of the atmospheric dispersion calculations.

Ecological consequences were also evaluated by considering the ratio of the exposure concentration to benchmarks for ecological receptors. A qualitative indication of the overall significance of the effect on an ecological receptor was taken from the *MM EIS* (DLA 2004a) to describe this ratio. If the calculated ratio is 20 or higher, a consequence level of SL-IV is assigned; between 10 and 20, SL-III; between 1 and 10, SL-II; and below 1, SL-I (negligible); see Table D–3. These assignments are subsequently applied to the risk matrix presented in Figure D–1.

D.5.4.1 Slow Leaks, Accidental Spills at Storage Sites, and Spills Without Fires During Transportation

This section applies to all spills of elemental mercury except those directly into water (see Section D.5.4.2). The analysis applies to all sites because there are no site-specific differences in the way spilled mercury would behave. Ecological risks associated with slow leaks during normal operations and accidental spills arise from the escape of mercury vapors from the containers during storage and handling. Generally, the release of liquid mercury results in its subsequent volatilization into the atmosphere in the form of elemental mercury vapor. The ingestion of soil contaminated with mercury represents the greatest inorganic plausible long-term threat from mercury releases. As discussed in Section D.7.3.3, deposition of airborne inorganic mercury is the primary mechanism of soil contamination. However, elemental mercury is not subject to significant atmospheric deposition, unlike compounds containing divalent mercury. Although mercury vapor transported downwind could then be inhaled by ecological receptors at the site or nearby, the inhalation exposure route is generally insignificant relative to the major exposure pathway (i.e., ingestion) for ecological receptors.

Given the dispersion of mercury upon leaving the storage facility, exposures to ecological receptors would be minimal at most. As a result, risks to ecological receptors from slow leaks, accidental spills at storage sites, and spills without fires during transportation (other than spills directly into a water body) are considered to be negligible at all storage sites and along all transportation routes.

D.5.4.2 Spills of Elemental Mercury into Water Bodies

It is conceivable that, during transportation, there could be a crash and a resulting spill of elemental mercury into a river or other body of water. The likelihood of this occurring is discussed in Section D.2.7. For ecological receptors in the water bodies or underlying sediment, the severity of the consequences depends on how much of the elemental mercury is converted into inorganic or methylmercury. The following discussion of this topic relies heavily on a study by Pfister (1977).

Oxidation of elemental mercury to divalent mercury ions can and has been shown experimentally to occur under conditions present at the bottoms of lakes and rivers. Despite the fact that most inorganic mercury is found in association with suspended solids or immobilized in the sediment and does not often exist in hazardous concentrations in solution, it serves as a ready reservoir for alteration by microorganisms (see also Holm and Cox 1975). Investigations have shown that inorganic mercury, whether discharged initially in this state or chemically oxidized from elemental mercury, is methylated in waters and natural sediments by bacteria under anaerobic conditions, be it enzymatically, as with the methanogenic bacteria, or non-enzymatically via the transfer of methyl groups from cobalt to mercury in biological systems. Methylation also occurs in the top layer of sediments if they are continuously oxygenated. From experimental data, it appears that all forms of mercury may be converted directly or indirectly to either mono- or dimethylmercury. Not surprisingly, the transformation rate varies as a function of pH, type of bacteria, initial concentration, amount of sunlight, organic sediment index, etc. Much inorganic mercury is sequestered in sediments but can then be transformed into methylmercury by bacteria.

Holm and Cox (1975) found that no methylmercury (less than 0.6 μg/L) was formed over 48 hours in pure cultures of bacteria with elemental mercury added, although mercury was oxidized (but not recovered as mercuric ion) and did accumulate in bacterial cells.

A study on fish (Harris et al. 2007) concluded that mercury spilled away from a lake had less than 1 percent exported to the lake and that a steady state was not reached in 3 years.

The following conclusions were made regarding spills into water bodies:

- There is insufficient knowledge to perform a calculation of the risks arising from the direct spillage of elemental mercury into a water body.
- Should such a spillage occur, it appears that the processes that convert elemental mercury into forms that are potentially hazardous to ecological receptors are slow and would allow ample time for cleanup.
- If the spillage occurs onto the banks of a river or water body, but not directly into it, the study by Harris et al. (2007) appears to show that transportation to the water body would be slow, again allowing ample time for cleanup.

However, the conclusion in the second bullet is questionable if the spill is into a fast-flowing river.

D.5.4.3 Transportation Spills with Fire

Ecological risks associated with transportation spills with fires arise from inhalation of airborne mercury or deposition of inorganic mercury on soil, on wetland sediments, or into water bodies. Some of this mercury subsequently is converted to methylmercury. As discussed previously, the inhalation exposure route is generally insignificant relative to the major exposure pathway (i.e., ingestion).

As described in Sections D.2 and D.4, this analysis assumes that the pallets transporting the 3-L flasks or the 1-MT containers are made of wood. The analysis has been performed for truck and rail transportation.

D.5.4.3.1 Pallet Fires – Truck Transportation

This section considers truck crashes with pallet fires in both dry conditions and wet conditions.

Dry Deposition

Table D–36 presents the calculated amount of mercury deposited per unit area by dry deposition after a truck crash with fire as a function of distance downwind for Atmospheric Stability Class A with a windspeed of 1.5 m/s. These ground-level values are characteristic of those for elevated releases, showing an initial rise, a peak, and a subsequent decline. Interspersed between the results are the equivalent deposited screening values from Table D–38 (including the screening value itself and 10× and 20× that value) to show the expected downwind extent of SL-IV, -III, and -II for the various ecological receptors. The extent of SL-I is not provided because exposures to ecological receptors at that SL are predicted to be negligible.

The first column provides the distances downwind at which calculations were performed. The second column contains predicted quantities of mercury deposited per square meter, interspersed with the screening values for specific ecological receptors. The maximum predicted deposited amount is approximately 1.85×10^{-4} kg/m^2 at approximately 300 meters (980 feet) downwind. The fourth column provides the name of the ecological receptor, while the third column specifies the exposure pathway (i.e., whether by ingestion of inorganic mercury or methylmercury) and the SL that corresponds to the value in the second column.

The table should be read as follows: the first row contains SL-II for sediment-dwelling biota exposed via the ingestion of inorganic mercury. This SL (6.35×10^{-6} kg/m^2) is below any calculated quantity of deposited mercury, so sediment-dwelling biota could potentially be exposed to SL-II concentrations at the source of the fire. The deposited quantities of mercury are expected to remain above this level out to a distance of between 2,000 and 3,000 meters (6,600 to 9,800 feet), so the downwind extent of the area within which sediment-dwelling biota could be exposed above SL-II as a consequence of ingestion via the inorganic pathway is from 0 to approximately 3,000 meters (9,800 feet). Similarly, sediment-dwelling biota could be exposed to concentrations above SL-III from between 100 and 200 meters (330 and 6,600 feet) to just over 500 meters (1,640 feet) downwind, and above SL-IV from just under 200 meters (660 feet) to just under 500 meters (1,640 feet) downwind.

Table D–36. Comparison of Predicted Ground-Level Centerline Airborne Concentrations with Equivalent Deposited Screening Values – Atmospheric Stability Class A, Windspeed 1.5 m/s, Truck Spill with Pallet Fire, No Rain

Distance Downwind (meters)	Deposited Material (kg/m^2)	Form of Mercury and Screening Value	Ecological Receptor, Pathway
	6.35×10^{-6}	Inorganic Hg SV – SL-II	Sediment-dwelling biota

Distance Downwind (meters)	Deposited Material (kg/m^2)	Form of Mercury and Screening Value	Ecological Receptor, Pathway
25	6.57×10^{-6}		
50	8.20×10^{-6}		
	9.18×10^{-6}	Inorganic Hg SV – SL-II	Soil invertebrates
100	1.32×10^{-6}		
	2.76×10^{-5}	Inorganic Hg SV – SL-II	Plants
	4.50×10^{-5}	Methyl Hg SV – SL II	American robin
	6.35×10^{-5}	Inorganic Hg SV×10 – SL-III	Sediment-dwelling biota
	9.18×10^{-5}	Inorganic Hg SV×10 – SL-III	Soil invertebrates
	1.27×10^{-4}	Inorganic Hg SV×20 – SL-IV	Sediment-dwelling biota
	1.31×10^{-4}	Methyl Hg SV – SL-II	Otter, sediment
200	1.42×10^{-4}		
	1.84×10^{-4}	Inorganic Hg SV – SL-II	American robin
	1.84×10^{-4}	Inorganic Hg SV×20 – SL-IV	Soil invertebrates
300	1.85×10^{-4}		
	1.84×10^{-4}	Inorganic Hg SV×20 – SL-IV	Soil invertebrates
	1.83×10^{-4}	Inorganic Hg SV – SL-II	American robin
500	1.34×10^{-4}		
	1.31×10^{-4}	Methyl Hg SV – SL-II	Otter, sediment
	1.27×10^{-4}	Inorganic Hg SV×20 – SL-IV	Sediment-dwelling biota
	9.18×10^{-5}	Inorganic Hg SV×10 – SL-III	Soil invertebrates
700	8.55×10^{-5}		
	6.35×10^{-5}	Inorganic Hg SV×10 – SL-III	Sediment-dwelling biota
1,000	4.70×10^{-5}		
	4.50×10^{-5}	Methyl Hg SV – SL-II	American robin
	2.756×10^{-5}	Inorganic Hg SV – SL-II	Plants
2,000	1.26×10^{-5}		
	9.18×10^{-6}	Inorganic Hg SV – SL-II	Soil invertebrates
	6.35×10^{-6}	Inorganic Hg SV – SL-II	Sediment-dwelling biota
3,000	5.79×10^{-6}		
4,000	2.12×10^{-6}		
5,000	1.10×10^{-6}		
10,000	5.57×10^{-7}		
20,000	1.57×10^{-7}		
30,000	8.25×10^{-6}		
40,000	5.60×10^{-6}		

Note: To convert meters to feet, multiply by 3.281.
Key: Hg=mercury; kg/m^2=kilograms per square meter; SL=severity level; SV=screening value**.**

The affected ranges for other ecological receptors can be read off Table D–36 in the same way. Note that soil invertebrates are the only receptor in addition to sediment-dwelling biota that could potentially be exposed above SL-IV.

Some receptors in Table D–36 show exposures through both the inorganic mercury pathway and the methylmercury pathway. An example is the American robin. In this case, the potential for exposure via the methylmercury pathway is greater than that via the inorganic mercury pathway. Both are included in Table D–36 for illustrative purposes, but from here on only the most sensitive pathway is included when presenting potential ranges over which exposures may occur.

Finally, some receptors do not appear on Table D–36 because their associated SLs are greater than the maximum calculated level of deposited mercury, 1.85×10^{-4} kg/m^2. They are listed in Table D–37.

Table D–37. Equivalent Deposited Screening Values Exceeding the Maximum Calculated Value in Table D–39

Ecological Receptor, Pathway	**Form of Mercury**	**Equivalent Deposited Screening Value (kg/m^2)**
Short-tailed shrew	Inorganic mercury	$1.01{\times}10^{-2}$
River otter, sediment	Inorganic mercury	$2.23{\times}10^{-1}$
River otter, water	Inorganic mercury	$2.67{\times}10^{-1}$
Red-tailed hawk	Inorganic mercury	$1.49{\times}10^{-1}$
Great blue heron, sediment	Inorganic mercury	$3.12{\times}10^{-2}$
Great blue heron, water	Inorganic mercury	$3.61{\times}10^{-2}$
Aquatic biota	Inorganic mercury	$3.36{\times}10^{-2}$
Plants	Methylmercury	None
Soil invertebrates	Methylmercury	$1.13{\times}10^{-2}$
Short-tailed shrew	Methylmercury	$3.60{\times}10^{-4}$
River otter, water	Methylmercury	$7.78{\times}10^{-4}$
Red-tailed hawk	Methylmercury	$3.09{\times}10^{-2}$
Great blue heron, sediment	Methylmercury	$5.02{\times}10^{-4}$
Great blue heron, water	Methylmercury	$3.11{\times}10^{-3}$
Aquatic biota	Methylmercury	$2.72{\times}10^{-4}$
Sediment-dwelling biota	Methylmercury	None

Key: kg/m^2=kilograms per square meter.

Table D–38 summarizes Table D–36 in such a way that it is easy to see which screening values are never exceeded and which are exceeded.

Table D–38 shows that, for a truck spill with a pallet fire in Atmospheric Stability Class A conditions with no rain and a windspeed of 1.5 m/s, the following conclusions can be made:

- There are only two ecological receptors that could potentially be exposed to SL-IV concentrations: sediment-dwelling biota and soil invertebrates (both via inorganic mercury).

- There are only two ecological receptors that could potentially be exposed to SL-III concentrations: sediment-dwelling biota and soil invertebrates (both via inorganic mercury).

- There are four ecological receptors that could potentially be exposed to SL-II concentrations: the two in the preceding bullets and plants (via inorganic mercury), American robins (via methylmercury), and river otters (via methylmercury); American robins could also be exposed to low concentrations of inorganic mercury in addition to their potential low exposure to methylmercury.

- No other ecological receptors could be exposed to greater-than-negligible deposited levels of mercury.

Table D–38. Summary of Potential Exposure of Receptors to Deposited Mercury at Severity Levels II, III, and IV– Atmospheric Stability Class A, Windspeed 1.5 m/s, Truck Spill with Pallet Fire, No Rain

Ecological Receptor, Pathway (Form of Mercury)	Distance Downwind to Which the Lower Bound of Severity Levels is Exceeded (meters)		
	SL-II	SL-III	SL-IV
Sediment-dwelling biota (inorganic mercury)	2,000–3,000	700–1,000	500–700
Soil invertebrates (inorganic mercury)	2,000–3,000	500–700	300–500
Plants (inorganic mercury)	1,000–2,000		
American robin (methylmercury)	1,000–2,000		
River otter, sediment (methylmercury)	500–700		
American robin (inorganic mercury)	300–500		
Aquatic biota (methylmercury)			
Short-tailed shrew (methylmercury)			
Great blue heron, sediment (methylmercury)			
River otter, water (methylmercury)			
Great blue heron, water (methylmercury)			
Short-tailed shrew (inorganic mercury)			
Soil invertebrates (methylmercury)			
Red-tailed hawk (methylmercury)			
Great blue heron, sediment (inorganic mercury)			
Aquatic biota (inorganic mercury)			
Great blue heron, water (inorganic mercury)			
Red-tailed hawk (inorganic mercury)			
River otter, sediment (inorganic mercury)			
River otter, water (inorganic mercury)			

Note: Shaded cells denote no exceedance of the appropriate screening value. The ranges presented in this table represent the furthest point downwind at which the corresponding equivalent deposited screening values are exceeded. See the upper half of Table D–39 for the distances where the screening values are first exceeded. To convert meters to feet, multiply by 3.281.
Key: SL=severity level.

The calculations reported in Table D–38 for Atmospheric Stability Class A with a windspeed of 1.5 m/s were repeated for Class D with a windspeed of 4.5 m/s and Class F with a windspeed of 1.5 m/s. The results are summarized in Table D–39.

Table D–39 shows characteristic behavior for elevated releases. In Atmospheric Stability Class A conditions, the associated high degree of atmospheric turbulence brings mercury down to ground level quickly, but also dilutes the plume quickly. More receptors are affected than in the other two stability classes, but not for great distances. The results for Class F are strongly affected by the fact that the dry deposition velocity is an order of magnitude lower than it is in the other two weather conditions (see Table D–59). If the dry deposition velocity had been of the same order, many more receptors would have been affected. This leaves Class D as the intermediate one that does not dilute the plume as quickly as Class A, but also does not bring mercury down to ground level as quickly near the source, so that no receptors are affected in the range of 100 to 1,000 meters (330 to 3,300 feet).

Table D–39 shows that, for a truck crash with a pallet fire but no rain, ecological receptors could be exposed to deposited mercury in the SL-IV and SL-III range, but over distances of no more than 700 meters (2,300 feet), and then only in Atmospheric Stability Class A conditions. Similarly, it is only in Class A conditions that the river otter could be exposed to SL-II concentrations of deposited mercury out to about 700 meters (2,300 feet). In Classes D and F, ecological receptors are predicted to be exposed to deposited mercury in the SL-II range or lower.

Table D–39. Summary of Potential Exposure of Receptors to Deposited Mercury at Severity Levels II, III, and IV – Truck Spill with Pallet Fire, No Rain

Ecological Receptor	Distance (meters) to Which Benchmark is Exceeded (A[a], 1.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (D[a], 4.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (F[a], 1.5 m/s[b])		
	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV
Sediment-dwelling biota	2,000–3,000	700–1,000	500–700	10,000–20,000			1,000–2,000		
Soil invertebrates	2,000–3,000	500–700	300–500	10,000–20,000					
Plants	1,000–2,000			5,000–7,000					
American robin	1,000–2,000			2,000–3,000					
River otter	500–700								
Aquatic biota									
Short-tailed shrew									
Great blue heron									
Red-tailed hawk									

[a] Atmospheric Stability Class.

[b] Windspeed measured at 10 meters.

Note: Shaded cells denote no exceedance of the appropriate benchmark. The ranges in this table indicate that there is uncertainty in the predicted distances to which the various benchmarks are exceeded. The distances downwind at which the various concentrations are first encountered can conservatively be set to 0. To convert meters to feet, multiply by 3.281.

Key: m/s=meters per second; SL=severity level.

The consequences above can be combined with the predicted frequencies of crashes with fires from Tables D–12 and D–13 to provide risks. Tables D–12 and D–13 show that the predicted frequencies of spills with fires are in the FL-III range under both truck scenarios and for all of the candidate storage sites. Conservatively, these frequencies are associated with the highest SL predicted in any weather condition in Table D–39, a conservative assumption.[12] Table D–40 summarizes the FL, consequence level, and risk to ecological receptors and applies to all candidate storage sites.

Table D–40. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Pallet Fires and No Rain[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level[c]	Risk[d]
Sediment-dwelling biota	III (moderate)	IV	High
Soil invertebrates	III (moderate)	IV	High
Plants	III (moderate)	II	Low
American robin	III (moderate)	II	Low
River otter	III (moderate)	II	Low
Aquatic biota	III (moderate)	I	Negligible
Short-tailed shrew	III (moderate)	I	Negligible
Great blue heron	III (moderate)	I	Negligible
Red-tailed hawk	III (moderate)	I	Negligible

[a] Applies equally to all seven candidate sites.

[b] Frequencies of truck crashes with spills from Tables D–12 and D–13.

[c] The highest consequence in any weather condition from Table D–39.

[d] Applies to both Truck Scenarios 1 and 2.

[12] In principle, one could calculate the probability, conditional on the occurrence of the crash with fire, that an SL-IV consequence for (say) sediment-dwelling biota could occur. This probability is less than unity, because it does not occur in all weather conditions. It might be small enough that, when multiplied by the FL-III frequencies in Table D–40, it would drop those frequencies into a lower frequency range. However, this is not possible because the calculations reported in Table D–39 were only done for the three representative weather conditions, not all weather conditions. Nevertheless, omitting this step in the calculation of frequency does add considerable conservatism.

The following observations apply to the results represented in Table D–40:

- As noted above, if a particular outcome occurs even in only one of the three representative weather conditions listed above, it is conservatively assumed to occur always (e.g., sediment-dwelling biota would only be exposed to potentially high concentrations in Atmospheric Stability Class A conditions). This introduces conservatism into the frequency portion of the risk equation.

- The truck results apply to both Scenarios 1 and 2.

- For all receiving sites, there is a high risk that, in the event of a truck crash with fire and no rain, somewhere along the truck routes, areas could contain deposited mercury in the SL-IV range for sediment-dwelling biota and soil invertebrates living in that area. Per Figure D–1, these indicate situations of major concern.

- Furthermore, though not shown explicitly in Table D–40, there could be a moderate risk that, for the same event, areas along truck routes (in addition to the areas in the previous bullet) could contain deposited mercury in the SL-III range for sediment-dwelling biota and soil invertebrates. Per Figure D–1, these indicate situations of concern.

- For all receiving sites, there is a low risk that, somewhere along the truck routes, for the same event, areas could contain deposited mercury in the SL-II range for nearby plants, American robins, and river otters. Per Figure D–1, these indicate situations of minimal concern. Furthermore, though not shown explicitly in Table D–40, there could be a low risk that areas along truck routes (in addition to the areas in the previous two bullets) contain deposited mercury in the SL-II range for sediment-dwelling biota and soil invertebrates.

- For truck routes to all receiving sites, the risks to the short-tailed shrew, aquatic biota, the great blue heron, and the red-tailed hawk are negligible.

Wet Deposition

The wet deposition analysis proceeded exactly as for the dry deposition, except that the quantity against which equivalent deposited screening values were compared was the amount of mercury deposited on the ground by the action of rain instead of by dry deposition. Table D–41 is analogous to Table D–36 and presents the comparisons of calculated levels of deposited mercury with equivalent deposited screening values for Atmospheric Stability Class A with a windspeed of 1.5 m/s.

The downwind distance to which a particular receptor could be exposed to greater than various deposited SLs can be read from Table D–41 in the same way as described in the text accompanying Table D–39, with the exception that, in this case, the predicted deposited levels of mercury do not rise to a peak but instead decline monotonically as a function of distance from the source of the release. Thus, for example, sediment-dwelling biota could potentially be exposed in the SL-II range out to between 30,000 and 40,000 meters (18.6 and 24.8 miles).

Table D–41. Comparison of Predicted Ground-Level Centerline Airborne Concentrations with Equivalent Deposited Screening Values – Atmospheric Stability Class A, Windspeed 1.5 m/s, Truck Spill with Pallet Fire and Rain

Distance Downwind (meters)	Deposited Material (kg/m^2)	Form of Mercury and Screening Value	Ecological Receptor, Pathway
25	1.02×10^{-3}		
50	9.86×10^{-4}		
100	9.19×10^{-4}		
	9.00×10^{-4}	Methyl Hg SV×20 – SL-IV	American robin
	7.78×10^{-4}	Methyl Hg SV – SL-II	Otter, water
	5.51×10^{-4}	Inorganic Hg SV×20 – SL-IV	Plants
200	5.42×10^{-4}		
	5.02×10^{-4}	Methyl Hg SV – SL-II	Great blue heron, sediment
	4.50×10^{-4}	Methyl Hg SV×10 – SL-III	American robin
300	3.86×10^{-4}		
	3.60×10^{-4}	Methyl Hg SV – SL-II	Short-tailed shrew
	2.76×10^{-4}	Inorganic Hg SV×10 – SL-III	Plants
	2.72×10^{-4}	Methyl Hg SV – SL-II	Aquatic biota
500	2.70×10^{-4}		
700	2.23×10^{-4}		
	1.84×10^{-4}	Inorganic Hg SV×20 – SL-IV	Soil invertebrates
	1.84×10^{-4}	Inorganic Hg SV – SL-II	American robin
1,000	1.74×10-4		
	1.31×10-4	Methyl Hg SV – SL-II	Otter, sediment
	1.27×10-4	Inorganic Hg SV×20 – SL-IV	Sediment-dwelling biota
	9.18×10-5	Inorganic Hg SV×10 – SL-III	Soil invertebrates
2,000	9.01×10-5		
	6.35×10-5	Inorganic Hg SV×10 – SL-III	Sediment-dwelling biota
3,000	5.76×10-5		
	4.50×10-5	Methyl Hg SV – SL-II	American robin
5,000	3.08×10-5		
	2.76×10-5	Inorganic Hg SV – SL-II	Plants
7,000	1.97×10-5		
10,000	1.18×10-6		
	9.18×10^{-6}	Inorganic Hg SV – SL-II	Soil invertebrates
	6.35×10^{-6}	Inorganic Hg SV – SL-II	Sediment-dwelling biota
20,000	3.58×10^{-6}		
30,000	1.52×10^{-6}		
40,000	7.51×10^{-7}		

Note: To convert meters to feet, multiply by 3.281.
Key: Hg=mercury; kg/m^2 kilograms per square meter; SL=severity level; SV=screening value.

The calculations reported in Table D–41 for Atmospheric Stability Class A with a windspeed of 1.5 m/s were repeated for Class D with a windspeed of 4.5 m/s and Class F with a windspeed of 1.5 m/s. The results are summarized in Table D–42.

Table D–42. Summary of Potential Exposure of Receptors to Deposited Mercury at Severity Levels II, III, and IV – Truck Spill with Pallet Fire and Rain

Ecological Receptor	Distance (meters) to Which Benchmark is Exceeded (A[a], 1.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (D[a], 4.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (F[a], 1.5 m/s[b])		
	SL-II	**SL-III**	**SL-IV**	**SL-II**	**SL-III**	**SL-IV**	**SL-II**	**SL-III**	**SL-IV**
Sediment-dwelling biota	10,000–20,000	2,000–3,000	1,000–2,000	30,000–40,000	3,000–5,000		20,000–30,000	7,000–10,000	3,000–5,000
Soil invertebrates	10,000–20,000	1,000–2,000	700–1,000	20,000–30,000	3,000–5,000		20,000–30,000	5,000–7,000	2,000–3,000
Plants	5,000–7,000	300–500	300–500	7,000–10,000			10,000–20,000	1,000–2,000	700–1,000
American robin	3,000–5,000	200–300					7,000–10,000	700–1,000	<100
River otter	1,000–2,000						3,000–5,000		
Aquatic biota	300–500						1,000–2,000		
Short-tailed shrew	300–500						1,000–2,000		
Great blue heron	200–300						700–1,000		
Red-tailed hawk									

[a] Atmospheric Stability Class.

[b] Windspeed measured at 10 meters.

Note: Shaded cells denote no exceedance of the appropriate benchmark. The ranges in this table indicate that there is uncertainty in the predicted distances to which the various benchmarks are exceeded. The distances downwind at which the various concentrations are first encountered can conservatively be set to 0. To convert meters to feet, multiply by 3.281.

Key: <=less than; m/s=meters per second; SL=severity level.

Table D–42 shows that, for a truck crash with a pallet fire and rain, some ecological receptors could be exposed to deposited mercury in the SL-IV range over distances of up to 5,000 meters (approximately 3.1 miles); in the SL-III range, up to 10,000 meters (approximately 6.2 miles); and in the SL-II range, up to about 30,000 meters (approximately 18.6 miles). The consequences above can be combined with the predicted frequencies of crashes with fires and rain from Table D–16 to provide risks. Table D–16 shows that the predicted frequencies of spills with fire and rain are in the low (FL-II) range for all of the candidate storage sites and under both truck scenarios. Conservatively, these frequencies are associated with the highest SL predicted in any weather condition in Table D–42. Table D–43 summarizes the FL, consequence level, and risk to ecological receptors and applies to all candidate storage sites.

Table D–43. Frequencies, Consequences, and Risks to Ecological Receptors from Truck Crashes with Pallet Fires and Rain[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level[c]	Risk[d]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	IV	Moderate
American robin	II (low)	IV	Moderate
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	II	Low
Great blue heron	II (low)	II	Low
Red-tailed hawk	II (low)	I	Negligible

[a] Applies equally to all seven candidate sites.

[b] Frequencies of truck crashes with fires and rain from Table D–16.

[c] The highest consequence in any weather condition from Table D–45.

[d] Applies to both Truck Scenarios 1 and 2.

The following observations apply to the results represented in Table D–43:

- As noted above, if a particular outcome occurs even in only one of the three representative weather conditions listed above, it is conservatively assumed to occur always. This introduces conservatism into the frequency portion of the risk equation.

- The truck results apply to both Scenarios 1 and 2.

- For all receiving sites, there is a moderate risk that, somewhere along the truck routes, for truck crashes with pallet fires and rain, areas could contain deposited mercury in the SL-IV range for sediment-dwelling biota, soil invertebrates, plants, and American robins. Per Figure D–1, these indicate situations of concern. Furthermore, though not shown explicitly in Table D–43, there could be a low risk that areas along truck routes (in addition to the areas in the previous bullet) could contain deposited mercury in the SL-III range for sediment-dwelling biota, soil invertebrates, plants, and American robins.

- For all receiving sites, there is a low risk that, for the same event, somewhere along the truck routes, areas could contain deposited mercury in the SL-II range for nearby river otters, aquatic biota, short-tailed shrews, and great blue herons. Per Figure D–1, these indicate situations of minimal concern. Furthermore, though not shown explicitly in Table D–43, there is a low risk that areas along truck routes (in addition to the areas in the previous two bullets) could contain deposited mercury in the SL-II range for sediment-dwelling biota, soil invertebrates, plants, and American robins.

- For all receiving sites, the risk to the red-tailed hawk is negligible.

D.5.4.3.2 Pallet Fires – Rail Transportation

This section considers railcar crashes with pallet fires in both dry conditions and wet conditions.

Dry Deposition

As was the case for truck pallet fires, calculations of deposited levels of mercury were carried out for Atmospheric Stability Class A with a windspeed of 1.5 m/s, Class D with a windspeed of 4.5 m/s, and Class F with a windspeed of 1.5 m/s. The results are summarized in Table D–44.

Table D–44 shows that, for a railcar crash with fire but no rain, ecological receptors could be exposed to deposited mercury in the SL-IV range, but over distances of no more than 1,000 meters (3,300 feet), and then only in Atmospheric Stability Class A conditions. In Class A and D conditions, some receptors could be exposed to SL-III levels of deposited mercury out to about 5,000 meters (approximately 3.1 miles). In Class A, D, and F conditions, several of the ecological receptors are predicted to be exposed to deposited mercury in the SL-II range for considerable distances downwind. Table D–44 is similar to Table D–39 except that predicted distances are somewhat greater. This is because the assumed rate of evaporation of mercury from a railcar fire, 1.6 kg/s, is greater than that assumed for a truck fire, 1.3 kg/s; see Section D.8.4.1.

Table D–44. Summary of Potential Exposure of Receptors to Deposited Mercury at Severity Levels II, III, and IV – Railcar Spill with Pallet Fire, No Rain

Ecological Receptor	Distance (meters) to Which Benchmark is Exceeded (A[a], 1.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (D[a], 4.5 m/s[b])			Distance (meters) to Which Benchmark is Exceeded (F[a], 1.5 m/s[b])		
	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV	SL-II	SL-III	SL-IV
Sediment-dwelling biota	3,000–5,000	1,000–2,000	700–1,000	20,000–30,000	3,000–5,000		3,000–5,000		
Soil invertebrates	3,000–5,000	700–1,000	500–700	10,000–20,000			2,000–3,000		
Plants	1,000–2,000	300–500		7,000–10,000					
American robin	1,000–2,000			5,000–7,000					
River otter	700–1,000								
Aquatic biota	300–500								
Short-tailed shrew									
Great blue heron									
Red-tailed hawk									

[a] Atmospheric Stability Class.

[b] Windspeed measured at 10 meters.

Note: Shaded cells denote no exceedance of the appropriate benchmark. The ranges in this table indicate that there is uncertainty in the predicted distances to which the various benchmarks are exceeded. The distances downwind at which the various concentrations are first encountered can conservatively be set to 0. To convert meters to feet, multiply by 3.281.

Key: m/s=meters per second; SL=severity level.

The consequences above can be combined with the predicted frequencies of crashes with fires from Table D–14 to provide risks. Table D–14 shows that the predicted frequencies of railcar spills with fires are in the FL-II range for all of the candidate storage sites. Conservatively, these frequencies are associated with the highest SL predicted in any weather condition in Table D–44. Table D–45 summarizes the FL, consequence level, and risk to ecological receptors and applies to all candidate storage sites.

Table D–45. Frequencies, Consequences, and Risks to Ecological Receptors from Railcar Crashes with Pallet Fires and No Rain[a]

Ecological Receptor	Frequency Level of Crash with Fire[b]	Consequence Level[c]	Risk[d]
Sediment-dwelling biota	II (low)	IV	Moderate
Soil invertebrates	II (low)	IV	Moderate
Plants	II (low)	III	Low
American robin	II (low)	II	Low
River otter	II (low)	II	Low
Aquatic biota	II (low)	II	Low
Short-tailed shrew	II (low)	I	Negligible
Great blue heron	II (low)	I	Negligible
Red-tailed hawk	II (low)	I	Negligible

[a] Applies equally to all seven candidate sites.

[b] Frequencies of railcar crashes with spills from Table D–14.

[c] The highest consequence in any weather condition from Table D–44.

The following observations apply to the results represented in Table D–45:

- As noted above, if a particular outcome occurs even in only one of the three representative weather conditions listed above, it is conservatively assumed to occur always (e.g., sediment-dwelling biota are only exposed to SL-IV concentrations in Atmospheric Stability Class A conditions). This introduces conservatism into the frequency portion of the risk equation.

- For all receiving sites, there is a moderate risk that, somewhere along the rail routes, areas could contain deposited mercury in the SL-IV range for sediment-dwelling biota and soil invertebrates living in that area. Per Figure D–1, these indicate situations of concern.

- For all receiving sites, there is a low risk that, somewhere along the rail routes, areas could contain deposited mercury in the SL-III range for plants. Per Figure D–1, these indicate situations of minimal concern. Furthermore, though not shown explicitly in Table D–45, there is a low risk that areas along rail routes (in addition to the areas in the previous bullet) could contain deposited mercury in the SL-III range for sediment-dwelling biota and soil invertebrates.

- For all receiving sites, there is a low risk that, somewhere along the rail routes, areas could contain deposited mercury in the SL-II range for nearby American robins, river otters, and aquatic biota. Per Figure D–1, these indicate situations of minimal concern. Furthermore, though not shown explicitly in Table D–45, there could be a low risk that areas along rail routes (in addition to the areas in the previous two bullets) could contain deposited mercury in the SL-II range for sediment-dwelling biota, soil invertebrates, and plants.

- For all receiving sites, the risk to the short-tailed shrew, the river otter, and the red-tailed hawk is negligible.

Wet Deposition

Per Table D–16, the frequencies of railcar crashes with subsequent fire and rain would be negligible for the rail routes to every site. Therefore, all corresponding risks would be negligible.

D.5.4.4 Intentional Destructive Acts

Tables D–46 through D–49 summarize the results of calculations of the impact on ecological receptors consequent upon the intentionally initiated gasoline tanker fire described in Section D.2.6. These tables are similar to those above (see Section D.5.4.3.2) for the accidental railcar fire. As noted previously, the railcar fire is used as a conservatively bounding scenario for the truck fire (see also Section D.8.4.2).

Tables D–46 and D–47 present the consequences of the IDA to ecological receptors via dry deposition (i.e., the accident is assumed to occur during dry conditions).

Table D–46. Summary of Potential Exposure of Receptors to Low, Moderate, or High Concentrations – Atmospheric Stability Class D, Windspeed 4.5 m/s, Intentionally Initiated Railcar Spill with Fires, No Rain

Ecological Receptor (Form of Mercury)	Distance (meters) Downwind to Which Concentration Levels Are Exceeded		
	SL-II	SL-III	SL-IV
Sediment-dwelling biota	>40,000	10,000–20,000	5,000–7,000
Soil invertebrates	>40,000	10,000–20,000	2,000–3,000
Plants	>40,000		
American robin	20,000–30,000		
River otter	3,000–5,000		
Aquatic biota			
Short-tailed shrew			
Great blue heron			
Red-tailed hawk (methylmercury)			

Note: Shaded cells denote no exceedance of the appropriate screening value. The ranges presented in this table represent the furthest point downwind at which the corresponding equivalent deposited screening values are exceeded. To convert meters to feet, multiply by 3.281.
Key: >=greater than; SL=severity level.

Table D–47. Summary of Potential Exposure of Receptors to Low, Moderate, or High Concentrations – Atmospheric Stability Class F, Windspeed 1.5 m/s, Intentionally Initiated Railcar Spill with Fire, No Rain

Ecological Receptor	Distance (meters) Downwind to Which Concentration Levels Are Exceeded		
	SL-II	SL-III	SL-IV
Sediment-dwelling biota	>40,000	2,000–3,000	700–1,000
Soil invertebrates	30,000–40,000	1,000–2,000	
Plants	5,000–7,000		
American robin	3,000–5,000		
River otter	700–1,000		
Aquatic biota			
Short-tailed shrew			
Great blue heron			
Red-tailed hawk			

Note: Shaded cells denote no exceedance of the appropriate screening value. The ranges presented in this table represent the furthest point downwind at which the corresponding equivalent deposited screening values are exceeded. To convert meters to feet, multiply by 3.281.
Key: >=greater than; SL=severity level.

Tables D–48 and D–49 repeat the information in Tables D–46 and D–47, but in the following tables, the IDA is assumed to occur during rainfall (i.e., exposure via wet deposition).

Table D–48. Summary of Potential Exposure of Receptors to Low, Moderate, or High Concentrations – Atmospheric Stability Class D, Windspeed 4.5 m/s, Intentionally Initiated Railcar Spill with Fire and Rain

Ecological Receptor, Pathway	Distance (meters) Downwind to Which Concentration Levels Are Exceeded		
	SL-II	SL-III	SL-IV
Sediment-dwelling biota	>40,000	>40,000	20,000–30,000
Soil invertebrates	>40,000	30,000–40,000	20,000–30,000
Plants	>40,000	10,000–20,000	7,000–10,000
American robin	>40,000	7,000–10,000	5,000–7,000
River otter, sediment	20,000–30,000	3,000–5,000	2,000–3,000
Aquatic biota	10,000–20,000	2,000–3,000	500–700
Short-tailed shrew	10,000–20,000	1,000–2,000	
Great blue heron	7,000–10,000	700–1,000	
Red-tailed hawk			

Note: Shaded cells denote no exceedance of the appropriate screening value. The ranges presented in this table represent the furthest point downwind at which the corresponding equivalent deposited screening values are exceeded. To convert meters to feet, multiply by 3.281.
Key: >=greater than; SL=severity level.

Table D–49. Summary of Potential Exposure of Receptors to Low, Moderate, or High Concentrations – Atmospheric Stability Class F, Windspeed 1.5 m/s, Intentionally Initiated Railcar Spill with Fire and Rain

Ecological Receptor (Form of Mercury)	Distance (meters) Downwind to Which Concentration Levels Are Exceeded		
	SL-II	SL-III	SL-IV
Sediment-dwelling biota	>40,000	20,000–30,000	20,000–30,000
Soil invertebrates	>40,000	20,000–30,000	10,000–20,000
Plants	30,000–40,000	10,000–20,000	10,000–20,000
American robin	30,000–40,000	10,000–20,000	7,000–10,000
River otter	20,000–30,000	5,000–7,000	3,000–5,000
Aquatic biota	10,000–20,000	2,000–3,000	1,000–2,000
Short-tailed shrew	10,000–20,000	2,000–3,000	700–1,000
Great blue heron	10,000–20,000	1,000–2,000	300–500
Red-tailed hawk (methylmercury)			

Note: Shaded cells denote no exceedance of the appropriate screening value. The ranges presented in this table represent the furthest point downwind at which the corresponding equivalent deposited screening values are exceeded. To convert meters to feet, multiply by 3.281.
Key: >=greater than; SL=severity level.

The above tables show that the IDA fire could lead to severe consequences to ecological receptors at considerable distances downwind. It is not possible to estimate the frequencies of IDAs, so the risks are not tabulated.

D.6 UNCERTAINTY ASSESSMENT

This section describes uncertainties in the risk estimates and an indication of the magnitude and predominant direction of the uncertainties (i.e., whether the stated risk estimates tend to understate or overstate the risks).

D.6.1 Mercury Source

The following discussion considers sources of mercury that might be expected under normal operating and accidental conditions.

D.6.1.1 Normal Operating Conditions

A principal assumption is the chemical form of mercury released. Mercury exists in three forms in the environment: elemental Hg^0 (metallic), Hg_2^{2+} (mercurous), and Hg^{2+} (mercuric) (see Section D.1.1.2). During normal storage, it is highly unlikely that mercury would be released in a form other than elemental mercury vapor. Specific types of chemical reactions must occur for elemental mercury to form a mercurous or mercuric compound. One example is oxidation of metallic mercury into mercuric mercury in water in the presence of an oxidizer such as hydrogen peroxide. However, it is highly unlikely that these conditions would occur within the storage facility during normal operating conditions. Consequently, the uncertainty in the assessment of releases of elemental mercury vapor is considered minimal.

Exposure during normal operating conditions is extensively discussed in Section D.4.1. For the involved worker, the analysis of experiments, the historical record, and acknowledgment of the expected reliance on a combination of ventilation, inspection, monitoring, and use of personal protective equipment (PPE), indicate that it is so highly unlikely that the worker will be exposed to concentrations exceeding the ACGIH's 8-hour TWA/TLV of 0.025 mg/m^3 of mercury vapor.

In addition, highly conservative analysis of predicted concentrations in the turbulent building wake of storage buildings show that noninvolved workers and members of the public would be exposed to concentrations elemental mercury vapor that are far below EPA's RFC of 0.003 mg/m^3.

D.6.1.2 Accidental Spillages of Elemental Mercury

The analysis considers a variety of spills of elemental mercury: inside the storage building, outside the storage building, and during transportation. For all such scenarios, the assessed human health and ecological risks are in the negligible-to-low range. This is in spite of conservative assumptions such as assuming a larger-than-expected spreading of the pool, thus providing a faster predicted rate of evaporation. Physical properties of mercury, such as its very low saturated vapor density at expected ambient temperatures, essentially ensure that consequences cannot be high. Thus uncertainties do not affect the conclusion that the risks associated with such spills are all in the negligible-to-low range.

For direct spillage of elemental mercury into water, the biggest uncertainty is in how the elemental mercury would be transformed into those forms (inorganic and methyl) that, when ingested, are most significant in terms of their effects on humans and sensitive ecological receptors. The available information on such transformations is summarized in Section D.5.4.2. It appears that they are slow. In addition, if elemental mercury is spilled onto the banks of a river or other water body rather than directly into it, the available evidence suggests that the mercury would make its way into the water slowly. This would allow ample time for cleanup.

In Section D.4.3.2, the human health risk of spillages into water is assessed as negligible to low. This almost entirely depends on the assumption that there would be time to clean up the spilled mercury before the deposited mercury could cause human health effects. The same conclusion follows for ecological receptors. This conclusion may not be valid for spillage into a fast-flowing river. Thus, uncertainties in this area are large.

D.6.1.3 Transportation

The transportation analysis assumes that empty 3-L flasks weigh 4.1 kilograms (9.0 pounds). It is possible that the flasks could weigh 6.1 kilograms (13.4 pounds). In that case, the mass of a 7 × 7 pallet would increase by 49 × 2.2 = 108 kilograms (238 pounds). This would increase the weight of a fully loaded pallet from about 2,000 kilograms (4,400 pounds) to about 2,100 kilograms (4,630 pounds). The weight limitation on trucks would then reduce the number of pallets per truck from 9.09 to 8.65, rounded down to 8. Under Truck Scenario 1, this would increase the frequency of crashes by a factor of 9/8 or 1.125. The current analysis is therefore slightly non-conservative. Similar reasoning applies to the Railcar Scenario. Truck Scenario 2, in which the truck is only half full, is unaffected.

D.6.1.4 Fires

This EIS considers four fire scenarios: accidental truck fire, accidental railcar fire, deliberately initiated truck fire through collision with a gasoline tanker, and similarly initiated railcar fire. Although the mercury released into the atmosphere under a fire scenario would be partially in the form of elemental mercury and partially in the form of divalent mercury, this analysis implicitly assumes that all of the mercury is in the divalent form (see Section D.7.3.3). Under operating conditions that include stack emissions in the presence of environmental controls, EPA recommends phase allocations for mercury emissions of 20 percent vapor phase elemental mercury, 60 percent vapor phase divalent mercury, and 20 percent particle phase mercury (EPA 1998). No information is available concerning the speciation of mercury resulting from sources involving combustion in the absence of emission controls. Because divalent mercury is assumed to be more susceptible to deposition processes than either elemental or particle mercury (EPA 1997b) and all forms of mercury are assumed to be equally as toxic as the most toxic form, the assumption that 100 percent of the mercury is released as divalent mercury represents a worst case when considering deposition.

One potential conservatism in the analysis is the assumption that pallets would be made of wood. An alternative envisioned in the *Interim Guidance* (DOE 2009a) is the use of metal pallets. If these were used, there would be much less fuel to burn and a much shorter duration of release, and much less mercury would become airborne.

Assumptions are used to address the mercury release rate, the duration of the fire (and correspondingly, the mercury release and deposition flux durations), the chemical type of mercury released, and the effective release height. As much as 2 kg/s of mercury would be released into the atmosphere in the case of the deliberately-initiated railcar fire. This release rate estimate was derived using the methods recommended in EPA guidance on conducting the offsite consequence analyses for Risk Management Programs required under the Clean Air Act (EPA 1999b). As noted in this guidance, these methods produce worst-case estimates. As such, the release rate used in this analysis is more likely to result in an overstatement of the risks from a railcar accident than an understatement.

Consideration has been devoted to whether the method used for assessing the rate of evaporation of mercury is appropriate. For the accidental fires involving railcars and trucks, a search of many references and sources, including other EISs, turned up no method for calculating the evaporation rate from a pool of mercury (or any nonflammable substance) that is exposed to a fire. The kind of fire envisaged here is one in which the source of heat is the wood used to make the pallets containing the 7 × 7 array of 3-L flasks or the wood in which each 1-MT container is transported. Given the circumstances of the crash, it is extremely unlikely that the wood fire would be underneath the pool of mercury with the potential for directly boiling it. That is why the calculation envisages the mercury being raised to its boiling point and behaving as an evaporating pool. This process, if it occurs at all, would require radiative heat transfer from the burning wood to the pool. Given that the crash would damage the truck or railcar, the chances that any spilled mercury would necessarily remain in a pool collocated with the burning wood are small—it would be more likely to run away and spread across the ground such that radiative heat transfer would be very inefficient.

The energy necessary to raise the entire mass of mercury on a railcar to its boiling point and to allow the evaporation of the amount of mercury predicted by Equation 7–19 represents 11.4 percent of the entire heat from the fire. The above considerations suggest that the configuration of the fire and pool would likely be such that this is a conservative estimate of the heat transferred to the pool, simply based on the qualitative observation that the resulting pool/fire configuration is unlikely to arrange itself into the precise form required to maximize radiative heat transfer. On those grounds, the source term for accidental truck and railcar fires is likely to be conservative.

In the case of the two IDAs, a fully loaded gasoline tanker is postulated to crash into the truck or railcar and its contents to spill and ignite. Some mercury flasks or 1-MT containers might be ruptured by the mechanical effects of the crash. Others might rupture as they are heated by the gasoline fire. Again, the resulting geometry of the burning fuel and the spilled mercury available for evaporation is very uncertain; thus there are very large uncertainties in the calculation of the fraction of heat from the fire that would actually heat the mercury and allow it to evaporate. It is assumed that the truck fire would consume 0.2 percent of the fire's energy to boil the predicted amount of mercury, while the railcar fire would use 0.5 percent of the fire's energy. Given this, the source terms for the IDA fires may not be conservative, and the consequences of such fires could be understated.

The duration of the fire was estimated using the methods recommended by the U.S. Nuclear Regulatory Commission for conducting accident analysis of nuclear fuel cycle facilities (Ayer et al. 1988). As applied in this analysis, these equations tend to overestimate the rate of heat input into the rising contaminant plume (see above) and to underestimate the duration of the release. The overestimation of the rate of heat input into the rising contaminant plume tends to result in an overestimation of the effective release height, which tends to result in an underestimation of the dry deposition flux rate. The wet deposition flux rate is, however, largely insensitive to the effective release height. The noted underestimation of the release duration tends to result in an underestimation of the total mass of mercury deposited through both dry and wet deposition processes. Overall, the U.S. Nuclear Regulatory Commission methods, as applied in this analysis, would tend to result in an understatement rather than an overstatement of risk.

The equation for estimating the effective release height (see Section D.7.4.1) is that recommended by the U.S. Army for use in chemical hazard prediction (Army 1980). Table D–60 shows the predicted height of plume rise for both the accidental truck and railcar fires in a variety of weather conditions. One hundred meters (330 feet) is a lower bound on the predicted plume rise in all cases; this height was chosen for all the weather conditions considered in this analysis. As a result, the assumptions about plume rise tend to overstate the results.

For the IDA fires, the U.S. Army model predicts a height of plume rise of approximately 250 meters (820 feet) for both Atmospheric Stability Class D and F weather conditions. As discussed in Section D.8.4, the computer model actually used to perform the atmospheric dispersion calculations, SAPLUME, limits the height of plume rise in Class F conditions such that rise is terminated when the upper edge of the plume encounters an inversion lid at 260 meters (850 feet). In practice, the maximum plume rise allowed in Class F conditions is 120 meters (390 feet). Incorporating this assumption tends to overstate risk.

While a plume is rising, the boundary is well defined and the concentration is essentially zero outside it. However, the model assumes that the radius of the plume defines the 10 percent concentration boundary of a Gaussian plume and that concentrations can extend beyond it. Thus, airborne concentrations and amounts deposited on the ground by dry deposition near the source tend to be overstated.

Overall, the contaminant source assumptions are such that the analyses of accidental truck and railcar fires are more likely to overstate the risks than to understate them.

For the IDA fires, no frequency estimates are possible, and hence no risk estimates are possible. However, the consequence results could be overstated or understated.

D.6.2 Receptors

This analysis estimates mercury concentrations in air, soil, surface water, and sediment that could occur as a result of onsite and offsite fires. Several receptor-related assumptions were made in the analysis. Explicit assumptions were made concerning receptor locations; implicit assumptions were also made. The analysis assumes that the mercury concentration estimated for each location represents the mercury exposure associated with a receptor nominally occupying that location. Over the short term, an individually identifiable location may be appropriate. Over the long term, an individual's exposure represents an aggregate of the concentrations present in each of the numerous areas (or microenvironments) visited by the individual over time. EPA provides information on activity patterns, including information on the amount of time spent "at home" for men and women ages 18 to 64 years (EPA 1997c). According to EPA, men spend about 60 percent of their time at home, while women spend about 70 percent.

The screening level for mercury deposited on the ground is based on exposure assumptions appropriate for a child (ATSDR 2009b). Thus, using the SSL in the derivation of the health-based benchmark results in the implicit assumption that the receptor of interest is a child. Moreover, because the assumed soil ingestion rate for children is higher than that of non-smoking adults, while the assumed body weight is lower, child-based screening levels are lower than those of adults.

There is uncertainty about which organisms potentially exposed at the storage sites or in the environs of accidental releases are at most risk. If more-sensitive receptors are present, then they may not be adequately addressed by the assessment endpoints evaluated in the ERA. The receptor species listed as potentially present in the area are a limited subset of the species that may utilize the area to some extent for at least a portion of the year. However, the species evaluated in the ERA are considered to provide a conservative representation of the range of exposures that may be experienced by other species not evaluated.

D.6.3 Environmental Pathways

The modeling of atmospheric transport, transformation, and fate is a significant source of uncertainty in the risk estimates. In the case of elemental mercury, the uncertainties arise from the assumption that elemental mercury neither deposits nor transforms within the area addressed by this analysis. Also important is the assumption that the Pasquill Gifford Gaussian plume model is appropriate for this analysis (especially when applied close to the release sources).

An important condition of the risk assessment is that releases of elemental mercury are not likely to deposit locally. The available information indicates that transformation of elemental mercury into other forms of mercury that are prone to deposition is unlikely. Discernible concentrations of the other forms of mercury locally (e.g., within 10 kilometers [6.2 miles] of the storage facility) are thus unlikely. This assumption is well supported by EPA's *Mercury Study Report to Congress* (EPA 1997a). Homogeneous gas phase transformation of elemental mercury is considered to be of little consequence even on a regional scale. Regionally significant heterogeneous reactions are likely to occur very slowly as a result of the low water solubility of elemental mercury (Bloxam 1995; EPA 1997a). As concluded by EPA (1997c):

> Global atmospheric circulation systems can take Hg^0 emissions from their point of origin and carry them anywhere on the globe before transformation and deposition occur… .[Elemental] mercury vapor is not thought to be susceptible to any major process of direct deposition to the earth's surface due to its relatively high vapor pressure and low water solubility. On non-assimilating surfaces elemental mercury deposition appears negligible…[and] this elemental mercury is expected to volatilize into the atmosphere.

Thus, even though some transformation and deposition of elemental mercury would inevitably occur, the available information indicates that on a local scale the magnitude of transformation and deposition of elemental mercury released as a result of normal operations is undoubtedly very small. Consequently, even though the transformation and fate assumptions may cause an understatement of the risks, the magnitude of the understatement would also be very small. The significance of any such understatement is tempered by the significant assumptions made in the risk assessment that tend to overstate risks.

Numerous assumptions are implicitly made in employing a Gaussian plume model to estimate atmospheric pollutant concentrations and deposition rates. The implicit general assumptions are discussed in references addressing air pollution models such as Hanna, Briggs, and Hosker (1982) and Schulze (1991). Several specific assumptions of importance have been made in this analysis. These assumptions concern the selection of values or equations for windspeed, stability class, stability parameters, and deposition velocities. For ground-level releases, the computer model SACRUNCH was used to run dispersion models in a range of atmospheric stability classes and windspeeds that cover the whole range of data available from the sites. This approach essentially finesses any uncertainties that might arise if one chooses only one weather condition as a surrogate for all potential weather conditions.

For the fire calculations, the computer model SAPLUME (SAIC 1994) was used with three weather conditions that, between them, span a range of conditions that are representative of the full spectrum of possible weather conditions: Atmospheric Stability Class A with a windspeed of 1.5 m/s, representing highly turbulent ambient atmospheric conditions; Class D with a windspeed of 4.5 m/s, representing "average" or "most likely" weather conditions; and Class F with a windspeed of 1.5 m/s, representing highly stable weather conditions. The analysis of human health risks and ecological receptor risks used the worst-case consequence, e.g., even if high inhaled levels of mercury relative to any specific benchmark were only predicted in one of the three weather conditions, the potential consequences were assumed to be high in all weather conditions. This adds an element of conservatism to the estimate of risks.

The assumption that the Gaussian equations apply to distances close to the source area (distances less than 100 meters [330 feet]) is problematic because there is no information to validate the model under the assumption. This uncertainty is to some extent addressed by considering that releases from within the storage building or just outside it are first diluted in the building wake. This is a more-realistic assumption than using the point source Gaussian model, which would overestimate peak centerline concentrations near the source.

The analysis also explicitly assumes that the dry deposition velocity for divalent mercury is in the upper end of the range of available values. Thus, the dry deposition calculations in this EIS generally produce conservative results.

Regarding the assumed rainfall scavenging rate of $1.5 \times 10^{-4}\ s^{-1}$, Hanna, Briggs, and Hosker (1982) note that this is a median value from 20 field experiments conducted by McMahon and Dennison. They indicate a range of $0.4 \times 10^{-4}\ s^{-1}$ to $3 \times 10^{-3}\ s^{-1}$. They also state, "The use of scavenging coefficients for wet removal modeling is probably best regarded as an order-of-magnitude estimation procedure" (Hanna, Briggs, and Hosker 1982). Furthermore, windspeeds and stability classes are themselves uncertain due to changes in weather conditions. Taken as a group, the direction of any resulting bias is indeterminate.

Intake from inhalation exposures is difficult to quantify for ecological receptors. Intake via this route is likely to be minimal relative to intake via ingestion. However, there is an increase in the uncertainty for the total risk encountered by leaving inhalation out and a likely but insignificant underestimate of total risk.

D.6.4 Effects Due to Exposure to Mercury

D.6.4.1 Human Health Effects

The limitations in toxicological testing and extrapolation of results from toxicological study populations to the general population result in considerable uncertainty in determining the concentrations below which adverse effects are unlikely (e.g., Dourson, Felter, and Robinson 1996). However, the process of determining RfDs attempts to account for these uncertainties through the use of uncertainty and modifying factors. Consequently, it is unlikely that an RfC would understate toxicity. As noted by EPA, "the RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." The worker safety criteria are regulatory in nature and are thus considered appropriate for screening worker safety risks.

Values of elemental mercury toxicity were used as the sole basis for evaluation of exposure to mercury vapor. The standard for mercury vapor is five times higher than the value for organic mercury alkyl compounds. However, use of the lower value would not change the results of the analysis because it is highly unlikely that any mercury vapor released under normal operating conditions would be transformed in a significant manner to any other form of mercury. EPA provides oral RfDs for mercuric chloride and methylmercury (3×10^{-4} mg/kg/day and 1×10^{-4} mg/kg/day, respectively), but not for elemental mercury (since it is primarily an inhalation hazard). Converting the inhalation RfC for elemental mercury to an equivalent oral RfD yields a value of 9×10^{-5} mg/kg/day. Although this conversion may not be appropriate from a toxicological standpoint, it does serve to illustrate that reliance on elemental mercury alone as the basis for toxicological comparison does not appear to bias the risk results away from protection of human health.

Regarding the limitations in the toxicity data for mercury compounds, EPA classified its confidence in the elemental mercury RfC as "medium." Inadequate quantification of exposure levels and lack of human or multi-species reproductive or developmental studies were cited by EPA as the reasons a rating of high could not be assigned (EPA 2002d). It is thus possible that the RfC understates (or overstates) the toxicity of elemental mercury. However, EPA's use of a 30-fold uncertainty factor in the derivation of the RfC makes it unlikely that the RfC is insufficiently conservative. In contrast, EPA classified its confidence in the mercuric chloride and methylmercury RfDs as "high" in both cases. EPA identified the weight of evidence from the studies of the brown Norway rat and the overall quality of the mercuric chloride toxicity database as the reasons supporting its assessment of confidence. The quality of the three epidemiological studies used to derive the methylmercury RfD, together with consistent evidence from studies in monkeys, were cited by EPA as supporting its confidence assessment. In addition, the available information indicates that even if mercuric chloride or methylmercury is a carcinogen, they are unlikely to exhibit high carcinogenic potency.

The toxicity values used to assess short-term health effects related to exposures to mercury present uncertainties. However, as a general statement, the methods used to derive IDLH and AEGL values from available human and animal data tend to be conservative and thus are likely, if anything, to introduce conservatism into the estimates of human health risks.

D.6.4.2 Ecological Receptors

In calculating constituent intakes, conservative exposure factors are assumed in order to be protective of all potential receptors. Low-end estimates of body weights and high-end estimates of ingestion rates are assumed in order to model the highest potential dose to the receptor. Conservatism is also employed in estimating bioavailability and the percent of contaminated plant and animal materials in the diet. The conservative exposure factors and exposure concentrations used provide confidence that calculated intakes are reasonably conservative estimates for receptor populations. Intakes from dermal and inhalation exposures are not quantifiable for ecological receptors. However, this does not significantly increase the uncertainty of the estimated total intake because, for most receptors, intakes via these routes are likely to be minimal relative to intakes via ingestion.

There is uncertainty associated with TRVs used in this ERA because the toxicity data are not site specific. Limitations in toxicity values include variations in physiological or biochemical factors that may exist among species, behavioral and ecological parameters that may make a species' sensitivity to a contaminant different from that of the test organism, and limited information on long-term effects on natural populations. In addition, most laboratory studies use highly bioavailable forms of chemicals during toxicity-related derivations. Since most chemicals in nature are bounded or associated with inorganic matrices or organics, many are not as bioavailable as the forms used in the laboratory studies. The combination of maximum intakes and conservative TRVs provides confidence that the Hazard Quotients resulting from the evaluation are conservative.

The TRVs for plants and earthworms are based on studies in which the receptors were maintained in soil to which the test compounds had been added. Because the concentration of biologically available mercury species is likely to be lower than the total concentration, the TRVs for plants and earthworms probably overstate the toxicity of inorganic mercury and methylmercury to these receptors.

The TRV for mammals exposed to inorganic mercury is based on a study in which mink were fed mercuric chloride in the diet for 6 months, during which they had pups. An NOAEL of 1.0 mg/kg/day for reproductive success was reported. However, only one dose level was used in the study. Therefore, a higher dose might also have produced an NOAEL. The convention of multiplying the NOAEL by 10 to estimate an LOAEL is based on the observation that the LOAEL is 10-fold higher than the NOAEL in studies that use a series of 10-fold dilutions in the dose level. Therefore, 10 is an arbitrary conversion factor. However, since an LOAEL was not observed, the highest possible NOAEL is likely high enough that the toxicity of inorganic mercury is overstated by the assumptions used in this analysis. The TRV for mammals exposed to methylmercury is based on a study in which rats were fed methylmercury in the diet for 1 year, during which they had pups. An LOAEL of 0.16 mg/kg/day for viability of the pups was calculated by using an allometric (i.e., based on measurements of various body parts) equation for the food consumption rate. Therefore, there is some uncertainty in the actual dosage. Whether the LOAEL understates or overstates toxicity is indeterminate, but the effect on the analysis of risk is expected to be minor.

TRVs for mammals were scaled from LOAELs for the test species by the body weight of each receptor. The scaling factor is based on the principle that uptake and retention of chemicals are determined by metabolic rate, which is in turn related to body weight. Therefore, the same dose is expected to have quantitatively different toxic effects in different receptors. There is uncertainty that the scaling factors used are strictly accurate for each combination of test species and ecological receptor. Also, whether the calculated TRV overstates or understates toxicity is indeterminate. However, the effect on the analysis of risk is expected to be minor.

The TRV for birds exposed to inorganic mercury is based on a study in which Japanese quail were fed mercuric chloride in the diet for 1 year, during which they had offspring. An LOAEL of 0.9 mg/kg/day and an NOAEL of 0.45 mg/kg/day for reproductive success were calculated by using an allometric equation for the food consumption rate. Therefore, there is some uncertainty in the actual dosage. Whether the TRVs understate or overstate toxicity is indeterminate, but the effect on the analysis of risk is expected to be minor. The TRV for birds exposed to methylmercury is based on a study in which mallard ducks were fed methylmercury in the diet for three generations. An LOAEL of 0.064 mg/kg/day for reproductive success was observed. However, only one dose level was used in the study. Therefore, a lower dose might also have produced an LOAEL. As a result, the TRV for birds probably understates the toxicity of methylmercury.

TRVs for aquatic biota are intended to protect most aquatic species and are therefore likely to overstate the toxicity of inorganic mercury and methylmercury. The TRV for sediment biota is based on a correlation of observed adverse effects on sediment biota with concentrations of mercury in sediments that were contaminated by other pollutants as well. Because the concentration of biologically available mercury is likely to be lower than the total concentration and because other contaminants may have contributed to the observed toxicity, the TRV for sediment biota probably overstates the toxicity of inorganic mercury in sediment.

D.6.4.3 Summary

The risk estimates are believed to provide an adequate basis for health-protective decisionmaking. Taken together, the simplifying assumptions cause significant uncertainty in the final risk estimates. However, the predominant conservatism of most of the assumptions likely outweighs the biases caused by other assumptions. Uncertainty in the human and ecological risk characterization is a direct result of the conservative methodology employed. The conservative methodology and assumptions used in the exposure pathway selection, exposure assessment, and toxicity assessment are expected to overestimate, rather than underestimate, the potential for mercury to pose risk to assessment endpoints. By overestimating risk, the actual risk of the alternatives considered is believed to be less than indicated by the numeric results presented in the risk assessment.

D.7 TECHNICAL DETAILS AND ANALYSES – EVAPORATION, ATMOSPHERIC DISPERSION, AND DEPOSITION MODELING

D.7.1 Evaporation

This section describes the models used to calculate evaporation from spilled pools of mercury inside and outside buildings.

D.7.1.1 Evaporation Inside Buildings

The evaporation rate R (kg/s) for indoor spills is given by the following equation, derived from laminar boundary layer theory (Fauske and Associates 2007):

$$R_e = 0.664\, A.D(\rho_v(T_p)/L)(\nu/D)^{1/3}(\mathrm{u}L/\nu)^{1/2} \qquad (7\text{–}1)$$

where:

R_e = Evaporation rate (kg/s)
A = Area of pool (square meters)
D = Binary diffusion coefficient of mercury in air (approximately 1.0×10^{-5} meters squared per second [$m^2\ s^{-1}$]) (Perry and Chilton 1973)
$\rho_v(T_p)$ = Saturation vapor density of mercury at temperature T_p (kg/m^3) (see Figure D–6 and Table D–53)
T_p = Pool temperature (K)
L = Length of the liquid spill in the direction of the airflow (meters)
ν = Kinematic viscosity of air (approximately 1.5×10^{-5} $m^2\ s^{-1}$) (Engineering Toolbox 2009a)
u = Velocity of the airflow above the surface of the pool (m/s)

The Fauske article indicates that natural-convection-driven air currents are more important than mechanical-ventilation-induced air currents, and a typical value for u is 0.1 m/s. At this velocity, the airflow over the pool is well within the laminar regime for all the indoor spills of interest in this EIS except for that caused by an earthquake—the transition from laminar to turbulent flow occurs when the Reynolds number $\mathrm{u}L/\boldsymbol{\nu}$ exceeds 320,000 (CCPS 1996).

D.7.1.2 Evaporation in the Open Air

Spills could take place in the open air (e.g., in the aftermath of a transportation accident). In this case, formulas for evaporation are derived from turbulent boundary layer theory. The one used in this EIS is taken from guidance provided by the Center for Chemical Process Safety (CCPS 1996).

The rate of evaporation from an outside pool of area *A* is given by:

$$R_e = k_g . A . P_{vp}(T_p) . M)/(R . T_p) \qquad (7–2)$$

where:

R_e = Evaporation rate (kg/s)
k_g = Mass transfer coefficient
A = Area of pool (m^2)
P_{vp} = Vapor pressure of mercury (pascals) (see Table D–68)
T_p = Pool temperature (K)
R = Gas constant (8.31 joules per kilogram-mole [J/kg-mol])
M = Molecular weight (200.59 kilograms per kilogram-mole [kg/kg-mol])

$$k_g = D . N_{sh}/L$$

where:

D = Binary diffusion coefficient of mercury in air (approximately 1.0×10^{-5} m^2 s^{-1}) (Perry and Chilton 1973)
N_{sh} = Sherwood number
L = Length of the liquid spill in the direction of the airflow (meters)

$$N_{sh} = 0.037\ (\nu/D)^{1/3}((uL/\nu)^{0.8}\text{-}15{,}200) \qquad (7–3)$$

where:

ν = Kinematic viscosity of air (approximately 1.5 × 10-5 m^2 s^{-1}) (Engineering Toolbox 2009a)
u = Velocity of the airflow above the surface of the pool (m/s)

D.7.1.3 Vapor Pressure and Saturated Vapor Density of Elemental Mercury

Equations 7–1 and 7–2 require the saturated vapor pressure or saturated vapor density of mercury in pascals or kg/m^3, respectively. These data are available in a study of mercury vapor pressure from NIST (Huber, Laesecke, and Friend 2006). Figure D–6 provides a graphical representation of the vapor pressure of mercury as a function of temperature. Table D–50 provides a tabulation of the vapor pressure and the corresponding vapor density. As discussed in Section D.4.2.1, the default evaporation temperature assumed for this EIS is 20 °C (68 °F).

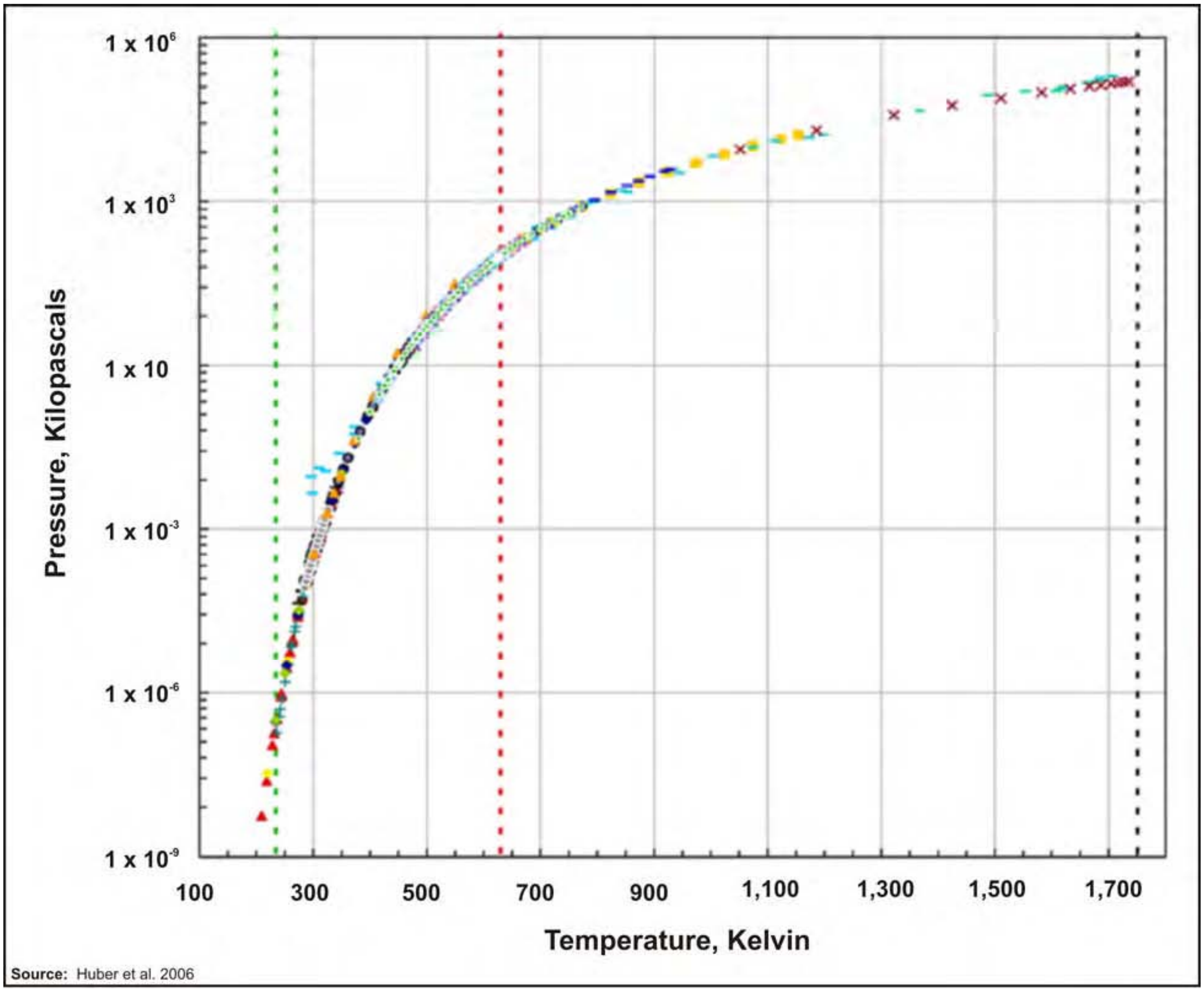

Figure D–6. Mercury Vapor Pressure as a Function of Temperature

Table D–50. Mercury Vapor Pressure and Vapor Density

T, K	*t*, °C	*p*, MPa	Ideal gas density,† mol/L	Ideal gas density,† ng/mL	*T*, K	*t*, °C	*p*, MPa	Ideal gas density,† mol/L	Ideal gas density,† ng/mL
273.15	0	$2.698829\cdot10^{-8}$	$1.188337\cdot10^{-8}$	2.383684	304.15	31	$4.259045\cdot10^{-7}$	$1.684185\cdot10^{-7}$	33.78306
274.15	1	$2.979392\cdot10^{-8}$	$1.307088\cdot10^{-8}$	2.621887	305.15	32	$4.611495\cdot10^{-7}$	$1.817581\cdot10^{-7}$	36.45885
275.15	2	$3.286720\cdot10^{-8}$	$1.436675\cdot10^{-8}$	2.881826	306.15	33	$4.990473\cdot10^{-7}$	$1.960527\cdot10^{-7}$	39.32620
276.15	3	$3.623129\cdot10^{-8}$	$1.577990\cdot10^{-8}$	3.165289	307.15	34	$5.397770\cdot10^{-7}$	$2.113631\cdot10^{-7}$	42.39732
277.15	4	$3.991118\cdot10^{-8}$	$1.731989\cdot10^{-8}$	3.474196	308.15	35	$5.835283\cdot10^{-7}$	$2.277535\cdot10^{-7}$	45.68508
278.15	5	$4.393376\cdot10^{-8}$	$1.899698\cdot10^{-8}$	3.810605	309.15	36	$6.305024\cdot10^{-7}$	$2.452917\cdot10^{-7}$	49.20305
279.15	6	$4.832795\cdot10^{-8}$	$2.082217\cdot10^{-8}$	4.176720	310.15	37	$6.809117\cdot10^{-7}$	$2.640489\cdot10^{-7}$	52.96556
280.15	7	$5.312487\cdot10^{-8}$	$2.280723\cdot10^{-8}$	4.574903	311.15	38	$7.349813\cdot10^{-7}$	$2.841004\cdot10^{-7}$	56.98770
281.15	8	$5.835798\cdot10^{-8}$	$2.496477\cdot10^{-8}$	5.007682	312.15	39	$7.929493\cdot10^{-7}$	$3.055255\cdot10^{-7}$	61.28535
282.15	9	$6.406319\cdot10^{-8}$	$2.730825\cdot10^{-8}$	5.477762	313.15	40	$8.550671\cdot10^{-7}$	$3.284075\cdot10^{-7}$	65.87527
283.15	10	$7.027907\cdot10^{-8}$	$2.985209\cdot10^{-8}$	5.988031	314.15	41	$9.216005\cdot10^{-7}$	$3.528344\cdot10^{-7}$	70.77506
284.15	11	$7.704698\cdot10^{-8}$	$3.261169\cdot10^{-8}$	6.541579	315.15	42	$9.928302\cdot10^{-7}$	$3.788986\cdot10^{-7}$	76.00327
285.15	12	$8.441128\cdot10^{-8}$	$3.560348\cdot10^{-8}$	7.141702	316.15	43	$1.069052\cdot10^{-6}$	$4.066972\cdot10^{-7}$	81.57939
286.15	13	$9.241950\cdot10^{-8}$	$3.884501\cdot10^{-8}$	7.791920	317.15	44	$1.150580\cdot10^{-6}$	$4.363324\cdot10^{-7}$	87.52391
287.15	14	$1.011225\cdot10^{-7}$	$4.235498\cdot10^{-8}$	8.495986	318.15	45	$1.237743\cdot10^{-6}$	$4.679116\cdot10^{-7}$	93.85838
288.15	15	$1.105749\cdot10^{-7}$	$4.615334\cdot10^{-8}$	9.257899	319.15	46	$1.330888\cdot10^{-6}$	$5.015475\cdot10^{-7}$	100.6054
289.15	16	$1.208348\cdot10^{-7}$	$5.026135\cdot10^{-8}$	10.08192	320.15	47	$1.430383\cdot10^{-6}$	$5.373585\cdot10^{-7}$	107.7888
290.15	17	$1.319646\cdot10^{-7}$	$5.470161\cdot10^{-8}$	10.97260	321.15	48	$1.536613\cdot10^{-6}$	$5.754690\cdot10^{-7}$	115.4333
291.15	18	$1.440308\cdot10^{-7}$	$5.949822\cdot10^{-8}$	11.93475	322.15	49	$1.649985\cdot10^{-6}$	$6.160093\cdot10^{-7}$	123.5653
292.15	19	$1.571046\cdot10^{-7}$	$6.467678\cdot10^{-8}$	12.97352	323.15	50	$1.770928\cdot10^{-6}$	$6.591162\cdot10^{-7}$	132.2121
293.15	20	$1.712619\cdot10^{-7}$	$7.026452\cdot10^{-8}$	14.09436	324.15	51	$1.899890\cdot10^{-6}$	$7.049329\cdot10^{-7}$	141.4025
294.15	21	$1.865835\cdot10^{-7}$	$7.629036\cdot10^{-8}$	15.30308	325.15	52	$2.037347\cdot10^{-6}$	$7.536097\cdot10^{-7}$	151.1666
295.15	22	$2.031558\cdot10^{-7}$	$8.278502\cdot10^{-8}$	16.60585	326.15	53	$2.183795\cdot10^{-6}$	$8.053040\cdot10^{-7}$	161.5359
296.15	23	$2.210708\cdot10^{-7}$	$8.978112\cdot10^{-8}$	18.00919	327.15	54	$2.339760\cdot10^{-6}$	$8.601806\cdot10^{-7}$	172.5436
297.15	24	$2.404265\cdot10^{-7}$	$9.731323\cdot10^{-8}$	19.52006	328.15	55	$2.505789\cdot10^{-6}$	$9.184118\cdot10^{-7}$	184.2242
298.15	25	$2.613271\cdot10^{-7}$	$1.054180\cdot10^{-7}$	21.14581	329.15	56	$2.682462\cdot10^{-6}$	$9.801783\cdot10^{-7}$	196.6140
299.15	26	$2.838837\cdot10^{-7}$	$1.141344\cdot10^{-7}$	22.89423	330.15	57	$2.870385\cdot10^{-6}$	$1.045669\cdot10^{-6}$	209.7507
300.15	27	$3.082141\cdot10^{-7}$	$1.235036\cdot10^{-7}$	24.77358	331.15	58	$3.070193\cdot10^{-6}$	$1.115081\cdot10^{-6}$	223.6740
301.15	28	$3.344440\cdot10^{-7}$	$1.335691\cdot10^{-7}$	26.79262	332.15	59	$3.282555\cdot10^{-6}$	$1.188620\cdot10^{-6}$	238.4253
302.15	29	$3.627066\cdot10^{-7}$	$1.443770\cdot10^{-7}$	28.96059	333.15	60	$3.508170\cdot10^{-6}$	$1.266503\cdot10^{-6}$	254.0478
303.15	30	$3.931433\cdot10^{-7}$	$1.559763\cdot10^{-7}$	31.28729					

† Assumes ideal gas law applies.

Key: *T*, K=temperature, Kelvin; *t*, °C=temperature, degrees Celsius; *p*, MPa=pressure, megapascals; mol/L=mole per liter; ng/mL=nanograms per milliliter.
Source: Huber et al. 2006.

D.7.1.4 Area of Pool *A* and Linear Dimension *L*

When a spill occurs on a smooth surface, the elemental mercury would spread until it reaches a thickness defined by the "capillary length," *b*, which is the minimum pool depth allowed by surface tension:

$$b = [2(\sigma\ (1\text{-}\cos\Theta)/\rho_L g)]^{1/2} \tag{7–4}$$

where:

- b = Capillary length
- σ = Surface tension of mercury
- Θ = Contact angle
- ρ_L = Density of liquid elemental mercury, approximately 13,580 kg/m^3 at 20 °C (Engineering Toolbox 2009b)
- g = Acceleration due to gravity (9.82 m/s^2)

The formula above is given by de Gennes, Brochart-Wyart, and Quéré (2002), who also give a calculated value for *b*, 0.36 centimeters (0.14 inches).

If there is a spillage of *m* kilograms of liquid mercury, it would spread to an area A, where:

$$A = m/(b\rho_L) = m/(0.0036\times 13{,}580) \sim 0.02m\ \text{m}^2 \tag{7–5}$$

Equation 7–5 is used for indoor spills. For outdoor spills, the surface is highly unlikely to be smooth. And an effective value of *b* may be greater than 0.36 centimeters, or 0.0036 meters. However, for the sake of conservatism, Equation 7–5 is used for outdoor spills also unless explicitly stated otherwise.

For the purposes of this EIS, it is assumed that the pool is circular and that the length of the spill in the direction of pool flow *L* equals the diameter:

$$L = 2(0.02m/\pi)^{1/2} \tag{7–6}$$

D.7.2 Atmospheric Dispersion

This section describes the atmospheric dispersion models used for this EIS: mixing in the building wake, Gaussian dispersion, and plume rise. It also contains a discussion of dry and wet deposition.

D.7.2.1 Mixing into the Building Wake

Releases inside the building or outside but in the vicinity of the building would first mix into the building wake. The following discussion is divided into two parts: new construction and existing facilities. Table D–51 provides details on the sizes of the buildings at the various sites, including the size of Y–12 under the No Action Alternative.

New Construction

The generic storage building is expected to be 3 to 6 meters (10 to 20 feet) high by 102 meters (336 feet) wide by 144 meters (471 feet) long. A simple model for the concentration *C* (kg/m^3) of effluent in the building wake is (Hanna, Briggs, and Hosker 1982):

$$C = R_e/(hW\alpha U(h)) \qquad (7–7)$$

where:

C = Concentration of effluent in building value (kg/m^3)
R_e = Release rate (kg/s)
h = Height of the building (meters)
W = Width of the building (meters)
α = Dimensionless constant, approximately 0.7[13]
$U(h)$ = Windspeed at height h (m/s)

For the dimensions given above, using 102 meters for the width of the building,

$$C = (1/0.7 \times 6.2 \times 103)\ R/U(h) \sim 0.0022\ R/U(h) \qquad (7–8)$$

For a windspeed of 1.5 m/s (typical of Atmospheric Stability Class F), Equation 7–8 becomes:

$$C = 0.0015R \qquad (7–9)$$

For a windspeed of 4.5 m/s (typical of Atmospheric Stability Class D), Equation 7–8 becomes:

$$C = 0.0005R \qquad (7–10)$$

Table D–52 provides a summary table of the estimated release rate *R* and the concentrations in the wake of a newly constructed building under the various onsite spill scenarios discussed in Section D.4.

Existing Buildings

Similar calculations to those described in Equations 7–7 through 7–10 have been performed for existing buildings. Results are summarized in Table D–53.

13 Hanna, Briggs, and Hosker (1982) say that α lies between 0.5 and 2, with test results supporting values towards the lower end of the range.

Table D–51. Physical Data for a Mercury Storage Facility – New Construction and Existing Buildings

Parameter	New Facility[a]	INL – RWMC	Hawthorne Army Depot	KCP	WCS[b] – CSB	Y–12 National Security Complex
Facility footprint	205,536 sf	Within existing DOE complex.	Within existing DoD complex.	Within existing DOE complex.	Within existing commercial complex.	Within existing DOE complex.
Dimensions (length × width)	471×336 sf	200×140 ft (each)	200×50 ft (each)	Part of a large building of more than 3×10^6 sf	190×166 ft; interim storage building only	150×90 ft
Building height	10–20 ft	24 ft	35 ft	32 ft	25 ft	20 ft
Number of buildings	1	7	29	1	1	1
Total storage space	146,496 sf	205,394 sf	290,000 sf	150,000 sf	28,500 sf	13,500 sf
Building construction	Structural steel frame on reinforced-concrete slab and sheet metal shell; epoxy-sealed floor.	Prefabricated modular buildings on curbed-concrete slab. Insulate and heated interior. Sealed floor.	Concrete floor, walls, and support columns with steel roof trusses and transite roofing.	–	Enclosed, commercial-grade metal building erected on a reinforced-concrete foundation with 24-inch-diameter piers.	Concrete block structure, designed and built for the storage of mercury; steel support beams; roof is gypsum (4-ply and asphalt).
Percentage of storage space used	85 percent	65 percent	50 percent	80 percent	100 percent	33 percent
Access/security	Manned security 24 hours per day, 7 days per week, with perimeter barbed-wire fence; remote interior and exterior surveillance.	Exists within RWMC, a secure area.	Exists within the Hawthorne Army Depot complex, a military secure area.	Exists within Bannister Federal Complex. Perimeter fence and security gates.	Exists within WCS; manned guardhouse at main complex entrance and perimeter fence.	Exists within Y–12 National Security Complex in N Area. Perimeter fence and security gates.

[a] Data for new facility construction would be similar regardless of location and would include the Grand Junction Disposal Site, the 200-West Area at the Hanford Site, Idaho Nuclear Technology and Engineering Center at INL, E Area at the Savannah River Site, and WCS in Andrews County, Texas.

[b] The CSB at WCS could store approximately 2,000 metric tons (2,200 tons), a fraction of the maximum of the 10,000 metric tons (11,000 tons) of surplus mercury anticipated over a 40-year period of analysis.

Note: To convert square feet to square meters, multiply by 0.092903; feet to meters, by 0.3048.

Key: CSB=Container Storage Building; DoD=U.S. Department of Defense; DOE=U.S. Department of Energy; ft=feet; INL=Idaho National Laboratory; KCP=Kansas City Plant; RWMC=Radioactive Waste Management Complex; sf=square feet; WCS=Waste Control Specialists, LLC.

Source: See Appendix C for the provenance of Table D–51.

Table D–52. Evaluation Rates and Building Wake Concentrations for Various Spill Scenarios – New Construction

Scenario	Mass Spilled (kg)	Area (m^2)	Outdoors (O)/Stability Class or Indoors (I)	Air Speed over Pool (m/s)	Evaporation Rate (kg/s)	Concentration in Building Wake (mg/m^3)
Single-flask spill	3.45×10^{1}	7.11×10^{-1}	I	0.1	6.66×10^{-9}	8.96×10^{-6}
			O/D	4.5	N/A[a]	N/A
			O/F	1.5	N/A[a]	N/A
Single-pallet spill	1.69×10^{3}	3.48×10^{1}	I	0.1	1.23×10^{-7}	1.85×10^{-4}
			O/D	4.5	8.35×10^{-6}	4.17×10^{-3}
			O/F	1.5	2.93×10^{-6}	4.39×10^{-3}
Triple-pallet spill	5.08×10^{3}	1.04×10^{2}	I	0.1	2.81×10^{-7}	4.21×10^{-4}
			O/D	4.5	N/A[a]	N/A
			O/F	1.5	N/A[a]	N/A
1-metric-ton container spill	1,000	2.06×10^{1}	I	0.1	8.31×10^{-8}	1.24×10^{-4}
			O/D	4.5	1.74×10^{-6}	8.68×10^{-4}
			O/F	1.5	4.86×10^{-7}	7.28×10^{-4}
Earthquake – pool confined to building area	N/A[b]	1.50×10^{4}	I	0.1[c]	2.76×10^{-5}	4.13×10^{-2}
			O/D	4.5	7.98×10^{-4}	N/A[d]
			O/F	1.5	3.25×10^{-4}	N/A[d]
Full spill tray (slow release scenario)	N/A[b]	2.00	I	0.1	1.45×10^{-8}	2.16×10^{-5}
			N/A	4.5	N/A[a]	N/A
			N/A	1.5	N/A[a]	N/A

[a] These scenarios cannot occur outside the building.
[b] Area limited, not mass limited.
[c] Calculated with formula for evaporation in a turbulent flow because Reynolds number exceeds 320,000 (see Section D.7.1.1).
[d] These scenarios assume that the building has collapsed, hence there is no building wake.
Note: To convert kilograms to pounds, multiply by 2.2046; square meters to square feet, by 10.7639; meters to feet, by 3.281.
Key: kg=kilograms; m^2=square meters; m/s=meters per second; kg/s=kilograms per second; mg/m^3=milligrams per cubic meter; N/A=not available.

Table D–53. Building Wake Concentrations for Existing Buildings

Scenario	Outdoors (O)/ Stability Class or Indoors (I)	Air Speed over Pool (m/s)	Concentration in Building Wake (kg/m^3)					
			New Construction	INL – RWMC	Hawthorne Army Depot	Kansas City Plant	WCS – CSB	Y–12 National Security Complex
Single-flask spill	I only	0.1	9.96×10^{-12}	1.99×10^{-11}	3.83×10^{-11}	4.19×10^{-12}	1.41×10^{-11}	3.72×10^{-11}
Single-pallet spill	I	0.1	1.85×10^{-10}	3.59×10^{-10}	6.90×10^{-10}	7.54×10^{-11}	2.54×10^{-10}	6.71×10^{-10}
	O/D	4.5	4.17×10^{-9}	8.33×10^{-9}	1.60×10^{-8}	1.75×10^{-9}	5.89×10^{-9}	N/A[a]
	O/F	1.5	4.39×10^{-9}	8.77×10^{-9}	1.68×10^{-8}	1.84×10^{-9}	6.21×10^{-9}	N/A[a]
Triple-pallet spill	I only	0.1	4.21×10^{-10}	8.38×10^{-10}	1.61×10^{-9}	1.76×10^{-10}	5.93×10^{-10}	1.56×10^{-9}
1-metric-ton container spill	I	0.1	1.24×10^{-10}	2.48×10^{-10}	4.77×10^{-10}	5.22×10^{-11}	1.76×10^{-10}	N/A[b]
	O/D	4.5	8.68×10^{-10}	1.74×10^{-9}	3.33×10^{-9}	3.65×10^{-10}	1.23×10^{-9}	N/A[b]
	O/F	1.5	7.28×10^{-10}	1.46×10^{-9}	2.79×10^{-9}	3.06×10^{-10}	1.03×10^{-9}	N/A[b]
Earthquake – pool confined to building area[c]	I only	0.1	4.13×10^{-8}	1.48×10^{-8}[d]	1.02×10^{-8}[d]	2.82×10^{-8}	8.75×10^{-9}	5.57×10^{-9}

[a] Under the No Action Alternative, no pallets would be moved outside the building at Y–12 National Security Complex.

[b] There are no 1-metric-ton containers at Y–12 National Security Complex.

[c] Earthquake spills "outside" occur when building collapses, hence there is no building wake.

[d] For these multi-building sites, even though the earthquake is assumed to affect all of the buildings on the site, the concentration in the building wake cannot exceed that outside an individual building, where the rate of release of mercury is limited by the floor area of that building.

Note: To convert meters to feet, multiply by 3.281; kg/m^3 to mg/m^3, by 10^6.

Key: CSB=Container Storage Building; INL=Idaho National Laboratory; kg/m^3=kilograms per cubic meter; mg/m^3=milligrams per cubic meter; m/s=meters per second; N/A=not applicable; RWMC=Radioactive Waste Management Complex; WCS=Waste Control Specialists, LLC.

D.7.3 The Gaussian Dispersion Model

This section describes the Gaussian model (as modified to take into account dry and wet deposition). The most commonly used methods to estimate human exposure to airborne gases, vapors, and particles from individual sources are the Gaussian plume models. These models represent a steady state average solution to the transport of pollutants arising from wind, turbulence, and other atmospheric forces (for example, see Hanna, Briggs, and Hosker 1982). These models have been modified to estimate the flux of contaminants from the atmosphere to land, water, and other surfaces arising from atmospheric deposition processes. Such processes include particle impaction and settling, as well as scavenging during rainstorms. The following equation describes the model used for the evaluation of both short- and long-term effects in this analysis:

$$C(x,y,z) = \frac{Q}{2\pi U\sigma_y\sigma_z}\exp\left[\frac{-y^2}{2(\sigma_y)^2} - g(x)\right]\left(\exp\left[\frac{-((h-z))^2}{2(\sigma_z)^2}\right] + \exp\left[\frac{-((h+z))^2}{2(\sigma_z)^2}\right]\right) \quad (7–11)$$

$$g(x) = \sqrt{\frac{2}{\pi}}\frac{v_s}{U}\int_0^x \frac{1}{\sigma_z(y)}\exp\left[\frac{-h^2}{2(\sigma_z(y))^2}\right]dy + \frac{\Lambda x}{U} \quad (7–12)$$

$$F(x,y,0) = C(x,y,0)\left[v_s + \Lambda\sqrt{2\pi}\sigma_z(x)\exp\left[\frac{+h^2}{2(\sigma_z(x))^2}\right]\right] \quad (7–13)$$

where:

$C(x,y,z)$	=	Pollutant concentration at a location x meters downwind, y meters crosswind of the source, at a height of z meters (kg/m^3)
Q	=	Pollutant release rate (kilograms per second [kg/s])
U	=	Windspeed in the x direction (m/s)
σ_y	=	Crosswind stability coefficient at location x meters downwind of the source (meters)
σ_z	=	Vertical stability coefficient at location x meters downwind of the source (meters)
h	=	Effective release height of the source (including buoyant plume rise as appropriate) (meters)
v_s	=	Dry deposition velocity (m/s)
Λ	=	Rainfall scavenging rate (liters per second)
$F(x,y,0)$	=	Pollutant deposition flux rate at a location x meters downwind, y meters crosswind of the source, at ground level (kilograms per square meter per second)

Focusing on rainfall only (i.e., neglecting dry deposition), Equations 7–11 and 7–13 become:

$$C(x,y,z) = \frac{Q}{2\pi U\sigma_y\sigma_z}\exp\left[\frac{-y^2}{2(\sigma_y)^2}-\Lambda x/U\right]\left(\exp\left[\frac{-((h-z))^2}{2(\sigma_z)^2}\right]+\exp\left[\frac{-((h+z))^2}{2(\sigma_z)^2}\right]\right) \quad (7–14)$$

and

$$F(x,y,0) = C(x,y,h)\left[2\Lambda\sqrt{2\pi}\sigma_z(x)\right] \quad (7–15)$$

Equation 7–15 is used later in this section when discussing rainfall events.

It may be objected that mercury vapor is very dense—after all, mercury has a molecular weight that is nearly an order of magnitude greater than that of air. However, as previously discussed, for spills at ambient temperature, the saturated vapor density is approximately 1.4×10^{-5} kg/m^3. This amount of mercury is mixed with approximately 1.2 kilograms of air in 1 cubic meter: the addition of mercury makes such a small difference to the density of the air that the resulting plume is essentially neutrally buoyant; thus it is appropriate to use the Gaussian model. The other kinds of releases considered here are those caused by fire, in which case the released mercury is part of a buoyant plume. The approach adopted below is to calculate a height of plume rise at which point the plume is neutrally buoyant; this height is appropriate to use as the starting point for Gaussian modeling.

D.7.3.1 Stability Coefficients

Formulas providing values for the dispersion parameters (σ_y and σ_z) as a function of distance (x) are available for each of the six Pasquill atmospheric stability classes. Briggs originally developed the most widely used equations in 1973 (Hanna, Briggs, and Hosker 1982) and provided formulas for σ_y and σ_z under open-country and urban conditions for each of the six stability classes; see Table D–54. Briggs' formulas were used in the Gaussian dispersion model.

The Briggs' formulas were developed for use between 100 meters and 10 kilometers (330 feet and 6.2 miles) downwind of the source.

Table D–54. Briggs' Dispersion Coefficients

Rural Terrain		
Atmospheric Stability Class	**σ_y (meters)**	**σ_z (meters)**
A	$0.22x\ (1+0.0001x)^{-1/2}$	$0.20x$
B	$0.16x\ (1+0.0001x)^{-1/2}$	$0.12x$
C	$0.11x\ (1+0.0001x)^{-1/2}$	$0.08x\ (1+0.0002x)^{-1/2}$
D	$0.08x\ (1+0.0001x)^{-1/2}$	$0.06x\ (1+0.0015x)^{-1/2}$
E	$0.06x\ (1+0.0001x)^{-1/2}$	$0.03x\ (1+0.0003x)^{-1}$
F	$0.04x\ (1+0.0001x)^{-1/2}$	$0.016x\ (1+0.0003x)^{-1}$
Urban Terrain		
Atmospheric Stability Class	**σ_y (meters)**	**σ_z (meters)**
A–B	$0.32x\ (1+0.0004x)^{-1/2}$	$0.24x\ (1+0.001x)^{+1/2}$
C	$0.22x\ (1+0.0004x)^{-1/2}$	$0.20x$
D	$0.16x\ (1+0.0004x)^{-1/2}$	$0.14x\ (1+0.0003x)^{-1/2}$
E–F	$0.11x\ (1+0.0004x)^{-1/2}$	$0.08x\ (1+0.0015x)^{-1/2}$

D.7.3.2 Height of Release

The height of release is dependent on the scenario being evaluated. For evaporation from pools, the release height is zero. For the fire scenarios, plume rise is discussed below.

D.7.3.3 Wet and Dry Deposition

This subsection describes the values of the dry deposition velocity and the rainfall scavenging rate that were used to determine how much mercury is deposited on the ground at any given location. The text below describes assumptions about how the mercury mixes with the soil.

Deposition Parameters

For releases of elemental mercury vapor, the dry deposition velocity and the scavenging rate are essentially zero (EPA 1997b). Under most of the scenarios identified in this risk assessment, mercury would in fact be released as elemental mercury, thus deposition pathways are not important.

In the case of fire scenarios, such as the offsite truck or railcar fire, there is a possibility that mercury could be converted into a form with a significant dry deposition velocity. In practice, the mercury released into the atmosphere during a fire would partially be in the form of elemental mercury and partially in the form of divalent mercury. Under operating conditions that include stack emissions in the presence of environmental controls, EPA (1998) recommends phase allocations for mercury emissions of 20 percent vapor phase elemental mercury, 60 percent vapor phase divalent mercury, and 20 percent particle phase mercury. No information is available concerning the speciation of mercury resulting from sources involving combustion in the absence of emission controls. Therefore, in this risk assessment, it is conservatively assumed that 100 percent of the mercury is released as divalent mercury because divalent mercury is more susceptible to deposition processes than either elemental or particle mercury (EPA 1997b). This is an important assumption in the assessment of ecological risks.

EPA (1997b) has published estimates of dry deposition velocities for divalent mercury in all six atmospheric stability classes, in all four seasons, and for 11 different types of terrain (including urban)—a total of 264 values. Table D–55 shows an example for Atmospheric Stability Class A.

Table D–55. Deposition Velocities for Divalent Mercury (cm/s) for Various Types of Land Areas in Atmospheric Stability Class A

Type of Land Area	Season				Annual Average
	Winter	Spring	Summer	Fall	
Water	1.09	0.98	0.92	1.00	1.00
Barren land	1.16	1.05	0.98	1.07	1.07
Range	1.89	1.49	1.67	1.78	1.71
Mixed agricultural/range	1.62	1.60	1.90	1.93	1.76
Agricultural	1.32	1.60	2.29	2.02	1.81
Rocky open areas	1.98	1.84	1.95	1.97	1.94
Nonforested wetland	2.02	1.85	1.91	1.88	1.92
Mixed forest/wetland	3.49	3.28	3.17	3.32	3.32
Coniferous forest	3.61	3.42	3.32	3.46	3.45
Deciduous forest	3.61	3.42	3.32	3.46	3.45
Urban	4.83	4.59	4.47	4.64	4.63

Note: To convert centimeters to inches, multiply by 0.3937.
Key: cm/s=centimeters per second.
Source: EPA 1997b.

In the analysis of fire scenarios described below, calculations are carried out in Atmospheric Stability Classes A, D, and F. Values of dry deposition velocity for each of these three classes were selected from Table 4–3 of EPA (1997b) on the following basis:

- For rural sites, the highest deposition velocity associated with each of the Atmospheric Stability Classes A, D, and F, selected from those associated with any of 10 types of terrain (excluding urban) and all four seasons

- For urban sites, the highest deposition velocity associated with each of the Atmospheric Stability Classes A, D, and F, selected from those associated with urban terrain and all four seasons

The selected values are shown in Table D–56.

Table D–56. Dry Deposition Velocities (cm/s) for Divalent Mercury

Atmospheric Stability Class	Dry Deposition Velocity (cm/s)	
	Rural	Urban
A	3.6	4.8
D	3.0	4.3
F	0.29	0.36

Note: To convert centimeters to inches, multiply by 0.3937.
Key: cm/s=centimeters per second.

Regarding the scavenging rate $\Lambda=1.5\times10^{-4}\ s^{-1}$, Hanna, Briggs, and Hosker (1982) note that this is a median value from 20 field experiments conducted. They indicate a range of $0.4 \times 10^{-4}\ s^{-1}$ to $3 \times 10^{-3}\ s^{-1}$. They also state, "The use of scavenging coefficients for wet removal modeling is probably best regarded as an order-of-magnitude estimation procedure."

There is information in EPA (1997b) regarding the scavenging rate of mercury compounds in particulate form:

$$\Lambda = \alpha 1.0 \times 10^{-4} \times R \text{ s}^{-1} \tag{7–16}$$

where R is the rainfall rate in millimeters per hour (mm/hr). Light, moderate, and heavy rainfall rates are 1 mm/hr, 3 mm/hr, and 5 mm/hr (or more), respectively (CCPS 1996). The coefficient α depends on particle diameter and varies from a minimum of approximately 0.5 for particles with diameters in the range of 0.5 to 1 micron up to approximately 6.5 for particles with diameters in excess of approximately 10 microns.

It is assumed that the divalent mercury formed during the combustion process would be in particulate form for two reasons. First, the predominant divalent compound of mercury in the plume would be mercuric oxide, which is solid at the temperature of the plume after it has ceased rising and is at the temperature of the surrounding atmosphere. Second, particulate matter would be formed in the fire (e.g., soot), and it is assumed that divalent mercury would attach to these particles.

EPA (1997b) discusses the particle size distribution and notes that it may differ from one combustion process to another, based on an analysis of flue gases. The distribution depends on the type of furnace and design of combustion chamber, composition of feed/fuel, particulate matter removal efficiency and design of air pollution control equipment, and amount of air in excess of stoichiometric amounts that is used to sustain the temperature of combustion. Data collected from measurements on flue gases indicate that there are two ranges of particle size. The first is governed by accumulation (i.e., the condensation of the mercury compound formed during combustion to form particles). The second range contains "coarse" particles, which would include soot and any particulate matter that may already be present in the air that mixes into the rising plume. The geometric mean diameter of several hundred measurements indicates that the accumulation mode dominates particle size, and a representative particle diameter for this mode is 0.3 microns. A representative diameter for coarse particles is 5.7 microns. The fraction of particle emissions assigned to each particle class is approximated based on the determination of the density of the surface area of each representative particle size relative to the total surface area of the aerosol mass. Using this method, 93 percent and 7 percent of the total surface area are estimated to comprise 0.3- and 5.7-micron-diameter particles, respectively.

To simplify the calculation, it is assumed that all particles are in the range that has a 0.3-micron mean and that the corresponding value for α is approximately 0.8.

The average rainfall rates at the seven candidate sites range from approximately 1 mm/hr (GJDS, Hawthorne Army Depot, Hanford, and INL), to approximately 2 mm/hr (KCP and WCS), to approximately 2.5 mm/hr (SRS). These rates correspond to values of Λ of 8.0×10^{-5} s^{-1}, 1.6×10^{-4} s^{-1}, and 2.0×10^{-4}s^{-1}, respectively. For the purposes of this analysis, an intermediate value of 1.5×10^{-4} s^{-1} has been chosen.

Note that this risk assessment does not explicitly consider precipitation scavenging by snowfall (it is included by implication in the rainfall scavenging rate). Slinn (1984) provides a comprehensive review of precipitation scavenging, including snow scavenging. He shows a figure (11.14) in which the snow scavenging rate for a given snowfall rate (rain equivalent) varies over four orders of magnitude depending on the shape and size of the snowflakes and on the size of the aerosol that is being scavenged. However, the scavenging rate for rain lies right in the middle of this range of uncertainty, so it was assumed that the rainfall scavenging rate in Equation 7–16 also applies to snow.

Note that EPA's study of the fate and transport of mercury in the environment (EPA 1997b, Section 4.3.2) used a precipitation scavenging rate that does not discriminate between the types of precipitation (rainfall or snowfall). This risk assessment adheres to that precedent.

Mercury Concentration in Soil

In the 2004 *MM EIS* (DLA 2004a), the Gaussian model, modified for deposition and scavenging, was used to determine the location and magnitude of the highest mercury deposition (or flux) to soil in representative weather conditions of Atmospheric Stability Class D and a windspeed of 4.5 m/s. The total mass of mercury deposited per unit area at that location was calculated as the mercury flux (in units of milligrams per square meter per second) multiplied by the duration of plume passage. The mercury was assumed to mix completely within the top 5.1 centimeters (2 inches) of soil, which, when multiplied by the soil density (1.8 grams per cubic meter) and scaled accordingly, yields soil concentration estimates (in units of mg/kg). With the exception of the use of a single representative weather condition (discussed further below), these assumptions have been retained.

In the case in which mercury is deposited on a water surface, the assumption was that the mercury would rapidly find its way into the sediment and mix into the top 2 centimeters (0.8 inches). It would then be partitioned into water using a sediment-water distribution coefficient K_d of 710,000 liters per kilogram (L/kg) for inorganic mercury and 27,000 L/kg for methylmercury.

What is also needed is the percentage of the mercury in sediment or soil that would remain as inorganic mercury and the percentage that would transform into methylmercury. These assumptions are summarized in Table D–57.

Table D–57. Percentage of Inorganic and Methylmercury in Various Types of Soil

Nature of Soil	Inorganic Mercury	Methylmercury
Dry soil	98 percent	2 percent
Wet soil	85 percent	15 percent
Sediment	85 percent	15 percent

D.7.3.4 Use of Gaussian Model in a Probabilistic Framework

The outcome of calculations using the Gaussian model varies depending on the atmospheric stability class, the windspeed, and the roughness of the surface (e.g., a smooth, barren surface; a forest; or an urban environment). For the 2004 *MM EIS* (DLA 2004a), a simple screening analysis was performed using only Atmospheric Stability Class D with a windspeed of 4.5 m/s at a rural site (low surface roughness). In this EIS, the analysis is a little more sophisticated in that it includes calculations performed over the full range of weather conditions and weights results arising from the use of annualized joint frequency distributions (jfds). These give the probability of occurrence of weather conditions with a specific atmospheric stability class and a windspeed within a specified range and a specific direction (one of the usual 16 directions of the conventional wind rose). Table D–58 shows the jfd for KCP.[14] The data for the other sites are similar. In the jfd, there are four ranges of windspeed: 0–3 m/s, 3–5 m/s, 5–8 m/s, and greater than 8 m/s. In subsequent analyses, these are each represented by a single windspeed, 1.5 m/s, 4.5 m/s, 6.5 m/s, and 8 m/s, respectively.

[14] The jfd for KCP is actually that for Kansas City International Airport. This is usual practice for running computer models for screening risk assessments such as the present one. For WCS, the data are from Midland-Odessa International Airport; for Hawthorne Army Depot, from Reno-Tahoe International Airport; for GJDS, from Grand Junction Regional Airport; and for Hanford, INL, and SRS, from measurements actually taken at the sites. In each case, 5 consecutive years of hourly weather data were analyzed and converted into the jfd format.

It was necessary to choose a computer model that has the following capabilities:

- Can model Gaussian dispersion for both ground-level and elevated releases
- Can model dry deposition and possibly wet deposition[15]
- Can run a full spectrum of weather conditions
- Can accept a jfd or equivalent
- Can easily compare the calculated outcomes (airborne concentrations and deposited quantities per unit area) with numerous screening values (such as AEGL-2 and screening levels of deposited mercury for humans and all of the ecological receptors) and can calculate the probability that screening values would be exceeded as a function of distance downwind

Initially, it was thought that MACCS2 [MELCOR Accident Consequences Code System] (NRC 1998) would fit the bill. However, in practice it becomes very cumbersome to use MACCS2 to satisfy the requirements of the fifth bullet above. Instead it was decided to use two Science Applications International Corporation computer models, SAPLUME (for elevated releases) and SACRUNCH (for ground-level releases), that have the ability to easily manipulate jfds and, in particular, to readily perform repetitive calculations for a host of screening values (SAIC 1994). These models have a considerable pedigree and have been used extensively for the modeling of accidental releases of hazardous chemicals. For example, they were used to model postulated hydrogen fluoride releases from refineries for regulatory purposes (Ultramar 1990) and were used extensively in helping EPA to prepare guidance on atmospheric dispersion modeling in support of the Risk Management Program (40 CFR 68; Kaiser 1999; Kaiser, Price, and Urdaneta 1999). Examples are EPA's guidance on ammonia refrigeration facilities and wastewater treatment plants (EPA 2009a:Appendices E and F). However, to provide further support for the use of SAPLUME and SACRUNCH, Table D–59 provides some sample comparisons with MACCS2.

Table D–59 mostly shows reasonable agreement between the predictions of MACCS2 and those of SACRUNCH or SAPLUME (within a factor of about 2) except close to the release under a rising plume, where concentrations are very small. Therefore, the use of SAPLUME and SACRUNCH instead of MACCS2 is judged to be acceptable.

[15] Wet deposition can be easily managed by postprocessing in an Excel spreadsheet.

Table D–58. Joint Frequency Distribution for Kansas City Plant

Atmospheric Stability Class	Windspeed Range (m/s)	Percentage of Time Wind Blows from the Indicated Direction															
		NNE	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**
A	0–3	0.00047	0.00025	0.00032	0.00025	0.00025	0.00010	0.00023	0.00057	0.00039	0.00043	0.00026	0.00022	0.00025	0.00016	0.00032	0.00022
	3–5	0.00021	0.00014	0.00019	0.00014	0.00014	0.00007	0.00016	0.00016	0.00023	0.00031	0.00019	0.00012	0.00014	0.00007	0.00019	0.00012
B	0–3	0.00105	0.00055	0.00052	0.00056	0.00073	0.00047	0.00060	0.00059	0.00094	0.00064	0.00073	0.00072	0.00084	0.00059	0.00063	0.00056
	3–5	0.00180	0.00108	0.00082	0.00098	0.00127	0.00098	0.00091	0.00127	0.00155	0.00134	0.00101	0.00096	0.00110	0.00061	0.00105	0.00101
	5–8	0.00155	0.00105	0.00070	0.00068	0.00068	0.00098	0.00091	0.00115	0.00248	0.00171	0.00152	0.00084	0.00073	0.00075	0.00075	0.00091
C	0–3	0.00046	0.00024	0.00029	0.00024	0.00031	0.00019	0.00046	0.00039	0.00058	0.00044	0.00030	0.00050	0.00052	0.00034	0.00037	0.00032
	3–5	0.00195	0.00120	0.00115	0.00098	0.00131	0.00077	0.00152	0.00136	0.00277	0.00225	0.00197	0.00159	0.00204	0.00134	0.00141	0.00117
	5–8	0.00574	0.00255	0.00267	0.00251	0.00380	0.00347	0.00438	0.00532	0.01050	0.00719	0.00537	0.00291	0.00335	0.00377	0.00342	0.00366
	>8	0.00094	0.00049	0.00038	0.00035	0.00080	0.00066	0.00108	0.00197	0.00516	0.00356	0.00171	0.00068	0.00077	0.00061	0.00110	0.00077
D	0–3	0.00095	0.00057	0.00046	0.00048	0.00061	0.00048	0.00053	0.00049	0.00075	0.00057	0.00055	0.00036	0.00060	0.00045	0.00071	0.00080
	3–5	0.00483	0.00241	0.00244	0.00169	0.00237	0.00192	0.00195	0.00220	0.00366	0.00284	0.00227	0.00164	0.00209	0.00230	0.00209	0.00277
	5–8	0.01811	0.01015	0.00747	0.00776	0.01396	0.01244	0.01371	0.01495	0.02249	0.01010	0.00511	0.00359	0.00590	0.00628	0.00970	0.01024
	>8	0.02418	0.01052	0.00656	0.00586	0.01518	0.01139	0.01326	0.02488	0.07615	0.03494	0.01010	0.00476	0.00972	0.01230	0.02067	0.02125
E	3–5	0.00518	0.00319	0.00352	0.00323	0.00295	0.00422	0.00471	0.00520	0.00708	0.00445	0.00295	0.00267	0.00356	0.00253	0.00321	0.00323
	5–8	0.00548	0.00185	0.00195	0.00267	0.00532	0.00565	0.00731	0.01188	0.02076	0.00996	0.00469	0.00262	0.00412	0.00410	0.00523	0.00473
F	0–3	0.00369	0.00231	0.00237	0.00191	0.00212	0.00186	0.00305	0.00260	0.00448	0.00331	0.00220	0.00237	0.00396	0.00293	0.00285	0.00226
	3–5	0.00574	0.00445	0.00525	0.00403	0.00321	0.00462	0.00661	0.00738	0.01155	0.00848	0.00576	0.00525	0.00799	0.00705	0.00576	0.00450
All stability classes	0–3	0.00661	0.00392	0.00397	0.00345	0.00403	0.00310	0.00487	0.00464	0.00713	0.00538	0.00405	0.00417	0.00618	0.00445	0.00488	0.00415
	3–5	0.01971	0.01247	0.01336	0.01106	0.01125	0.01258	0.01586	0.01757	0.02683	0.01966	0.01415	0.01223	0.01692	0.01389	0.01371	0.01279
	5–8	0.03088	0.01560	0.01279	0.01361	0.02376	0.02254	0.02631	0.03329	0.05623	0.02896	0.01668	0.00996	0.01411	0.01490	0.01910	0.01954
	>8	0.02512	0.01101	0.00694	0.00621	0.01598	0.01204	0.01434	0.02685	0.08130	0.03850	0.01181	0.00544	0.01050	0.01291	0.02177	0.02202
All windspeeds and classes	–	0.08231	0.04300	0.03705	0.03432	0.05501	0.05026	0.06139	0.08236	0.17150	0.09250	0.04669	0.03179	0.04770	0.04616	0.05945	0.05851

Note: To convert meters to feet, multiply by 3.281.

Key: >=greater than; m/s=meters per second.

Table D–59. Comparisons of Outputs of MACCS2, SACRUNCH, and SAPLUME Runs

Distance (meters)	D, 4.5 m/s, Ground Level[a]			D, 4.5 m/s, 25 meters[a]			D, 4.5 m/s, 100 meters[a]		
	Concentration kg/m^3	Concentration kg/m^3		Concentration kg/m^3	Concentration kg/m^3		Concentration kg/m^3	Concentration kg/m^3	
	MACCS2	**SACRUNCH**	**Ratio[b]**	**MACCS2**	**SAPLUME**	**Ratio[b]**	**MACCS2**	**SAPLUME**	**Ratio[b]**
100	7.63×10^{-4}	9.50×10^{-4}	0.80	3.68×10^{-6}	none	N/A	none	none	N/A
200	2.18×10^{-4}	2.20×10^{-4}	0.99	4.29×10^{-5}	very small	N/A	none	none	N/A
500	4.29×10^{-5}	3.50×10^{-5}	1.23	2.97×10^{-5}	3.50×10^{-5}	0.85	1.17×10^{-7}	none	N/A
1,000	1.33×10^{-5}	1.00×10^{-5}	1.33	1.16×10^{-5}	1.40×10^{-5}	0.83	1.58×10^{-6}	4.70×10^{-7}	3.36
2,000	4.42×10^{-6}	3.10×10^{-6}	1.42	4.17×10^{-6}	5.00×10^{-6}	0.83	1.88×10^{-6}	1.00×10^{-6}	1.88
5,000	1.15×10^{-6}	7.40×10^{-7}	1.56	1.13×10^{-6}	1.30×10^{-6}	0.87	8.63×10^{-7}	8.02×10^{-7}	1.08
10,000	4.58×10^{-7}	2.80×10^{-7}	1.64	4.54×10^{-7}	4.50×10^{-7}	1.01	3.99×10^{-7}	3.60×10^{-7}	1.11
Distance (meters)	**F, 1.5 m/s Ground Level[a]**			**F, 1.5 m/s, 25 meters[a]**			**F, 1.5 m/s, 100 meters[a]**		
	Concentration kg/m^3	Concentration kg/m^3		Concentration kg/m^3	Concentration kg/m^3		Concentration kg/m^3	Concentration kg/m^3	
	MACCS2	**SACRUNCH**	**Ratio[b]**	**MACCS2**	**SAPLUME**	**Ratio[b]**	**MACCS2**	**SAPLUME**	**Ratio[b]**
100	4.79×10^{-2}	2.27×10^{-2}	2.11	1.48×10^{-21}	none	N/A	none	none	N/A
200	7.29×10^{-3}	5.30×10^{-3}	1.38	7.79×10^{-10}	none	N/A	none	none	N/A
500	3.77×10^{-4}	8.20×10^{-4}	0.46	2.25×10^{-5}	7.00×10^{-5}	0.32	1.32×10^{-28}	none	N/A
1,000	2.44×10^{-4}	2.10×10^{-4}	1.16	7.13×10^{-5}	8.00×10^{-5}	0.89	9.04×10^{-13}	none	N/A
2,000	8.63×10^{-5}	6.20×10^{-5}	1.39	4.88×10^{-5}	5.00×10^{-5}	0.98	4.00×10^{-8}	1.00×10^{-6}	4.00×10^{-2}
5,000	2.18×10^{-5}	1.50×10^{-5}	1.46	1.84×10^{-5}	1.80×10^{-5}	1.02	1.10×10^{-6}	2.00×10^{-6}	5.48×10^{-1}
10,000	1.21×10^{-5}	6.90×10^{-6}	1.75	9.13×10^{-6}	8.40×10^{-6}	1.09	1.49×10^{-6}	1.00×10^{-6}	1.49

[a] Atmospheric stability class, windspeed, height of release.

[b] Ratio = (MACCS2 concentration)/(SACRUNCH or SAPLUME concentration).

Note: The assumed release rate is 1 kilogram per second of a passive (non-buoyant, non-heavy) chemical. Release approximates a point source. To convert meters to feet, multiply by 3.281; kg/m^3 to mg/m^3, by 10^6.

Key: kg/m^3=kilograms per cubic meter; m/s=meters per second; mg/m^3=milligrams per cubic meter; N/A=not applicable.

D.7.3.5 The Gaussian Model and Wet Deposition

The approach described in Section D.7.3.4 applies only to dry deposition. A simplified approach was adopted to wet deposition.

- From the 5-year data sets for each site, select only those hourly data that include rainfall. Calculate the fraction of time that it rains at each site (see Table D–15 for results).
- Assume that the seven data sets, on the whole, are representative of the meteorology along all of the transportation routes. Calculate representative probabilities of rain for the routes to each of the seven candidate sites (see Section D.2.7.4).
- Modify the predicted frequencies of crashes with fires by multiplying by the probability of rain during each trip (see Table D–16).
- Perform runs of SAPLUME with a 100-meter (336-foot) release height (see below for why this is expected to be conservative for truck and railcar scenarios) for three representative conditions of atmospheric stability class and windspeed: A, 1.5 m/s; D, 4.5 m/s; and F, 1.5 m/s.
- From the runs of SAPLUME, extract the plume centerline concentrations and vertical standard deviations as a function of distance in each of the three weather conditions.
- Use Equation 7–15 to calculate the amount of mercury deposited per unit area under each release scenario.
- Compare these to the equivalent deposited amounts per unit area for human and ecological receptors and make qualitative judgments about the severity of the consequences.
- Combine these consequences with the aforementioned rainfall-modified frequencies of crashes with fires during rainfall to obtain estimates of risk.

D.7.4 Modeling Fire Events

As discussed above, it is only in the case of fire scenarios that deposition of mercury onto the ground is expected. Thus, the fire scenarios are important considerations with regard to chronic human health risk and ecological risk. The fires considered in this risk assessment include those caused by truck or railcar crashes off site. This section illustrates the fire modeling employed by focusing on a railroad accident that would result in the combustion of the pallets on a single railcar transporting 3-L flasks in a 7×7 array. Pallets would not be stacked for transport. The accident is also assumed to cause a breach in a sufficient number of mercury containers to create an exposed area equal to the area of the railcar bed. This exposed mercury is assumed to reach its boiling point and to release mercury at the maximum rate consistent with the dynamics of boiling mercury. The analysis assumes that the mercury would boil as long as the pallets are on fire.

The parameters of interest for long-term human health risk assessment are listed below.

- Heat output, area, and duration of the pallet fire
- Mercury release rate
- Effective release height
- Windspeed at the release height

The heat output and area of the fire are used to estimate the effective release height. The mercury release rate, effective release height, and windspeed at the release height are used in conjunction with the Gaussian model to estimate atmospheric mercury concentrations and mercury deposition flux rates to soil.

The duration of the pallet fire determines the duration of the mercury deposition, which is then used to determine the mercury concentrations in the soil, sediment, or surface water. The duration of the pallet fire and the mercury release rate determine the mass of mercury released into the atmosphere.

D.7.4.1 Accidental Truck and Railcar Fires

In this section, parameters of interest for truck and railcar fires are determined. The calculations included here are for the railcar fire. However, the calculations for the truck fire are similar. The dimensions of the railcar considered in this analysis are 18 by 3 meters (59 by 10 feet). As shown in Section D.2.7, the maximum number of pallets that can be loaded into the railcar is 24: 2 rows of 12 pallets each. Each unloaded pallet is assumed to weigh approximately 27 kilograms (60 pounds). Under these assumptions, the total mass of fuel available for combustion in the pallets is approximately 635 kilograms (1,400 pounds). The area occupied by the pallets, and consequently, the area of the fire is 48.7 square meters (530 square feet). Similar considerations show that the area of the truck fire is 35.7 square meters (380 square feet).

Pallet Fire Heat Output

The heat output of the pallet fire (dH_e/dt) for the railcar fire was estimated as follows. The rate of solids combusted in a fire was estimated as (Ayer et al. 1988):

$$\dot{M}_{Burned} = \frac{\text{(Heat flux generated)} \bullet A}{\text{(Heat absorbed/mass fuel vapor generated)}} \qquad (7\text{–}17)$$

The term A equals the area of the fire. The heat flux generated is the sum of the convective heat flux (18 kilowatts per square meter [kW/m^2] for wood) and the radiative heat flux (40 kW/m^2 for wood) minus the surface radiation heat loss (16 kW/m^2 for wood), or 42 kW/m^2 for wood. The heat absorbed/mass fuel vapor generated for wood is 3.6 kW-s/g. The area of the fire is about 41.6 square meters (448 square feet). Accordingly:

$$\dot{M}_{Burned} = 42 \text{ kW/m}^2/3.6 \text{ kW-s/g} = 11.667 \text{ g/s-m}^2$$
$$11.667 \text{ g/s-m}^2 \times 41.6 \text{ m}^2 = 485.8 \text{ g/s}$$

At this rate of combustion, the pallet fire would last approximately 1,308 seconds, or about 21.8 minutes. The heat output is calculated as:

$$dH_e/dt = \dot{M}_{Burned} \times THR \times EFF \times (1{,}000/4.186)$$
$$dH_e/dt = 485.8 \text{ g/s} \times THR \times EFF \times (1{,}000/4.186) \qquad (7\text{–}18)$$

where:

dH_e/dt = Heat output
M_{Burned} = Rate of solids combusted in fire
THR = Theoretical heat release (18 kilojoules per gram for wood)
EFF = Fraction of heat not lost to thermal radiation (0.7)

Consequently:

$$dH_e/dt = 485.8 \times 18 \times 0.7 \times (1{,}000/4.186)$$
$$= 1.4623 \times 10^6 \text{ calories per second (cal/s)}$$

Mercury Release Rate

The equation used to estimate the mercury release rate is that specified by EPA for use in conducting the offsite consequence analyses for Risk Management Programs required under the Clean Air Act (EPA 1999b). The equation, originally published in EPA's *Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances* (EPA 1987), estimates the worst-case release from a toxic liquid at elevated temperatures as follows:

$$R_e = (0.284 \times u^{0.78} \times MW^{2/3} \times A \times VP \times 453{,}600)/(82.05 \times T \times 60) \qquad (7\text{–}19)$$

where:

R_e = Release rate (mg/s)

u = Windspeed (m/s)

MW = Molecular weight of mercury (200.59 kg/kg-mol)

A = Surface area (approximately 54.8 square meters [590 square feet])

VP = Vapor pressure (760 millimeters of mercury at its boiling point)

T = Temperature of released substance (630 K, the boiling point of mercury)

The following are the assumptions for estimating evaporation from pools of mercury at the atmospheric boiling point:

u = 1.5 m/s (Atmospheric Stability Class A or F weather conditions) or 4.5 m/s (Class D weather conditions)

VP = 760 millimeters of mercury (the vapor pressure of any liquid at its boiling point)

T = 630 K (357 °C or 673 °F) (the boiling point of mercury)

Taken together, these assumptions yield a release rate (*RR*) for a railcar fire of about 1.56×10^6 mg/s if the windspeed is 4.5 m/s. This equates to a total atmospheric mercury release of about 2,048 kilograms (4,514 pounds) for a 1,308-second (21.8-minute) duration. For different windspeeds *u*, this rate of release scales in proportion to $(u/4.5)^{0.78}$; see Equation 7–19.

Effective Release Height

The effective release height was calculated using the following equations (U.S. Army 1980):

$$h = [6F/(U(h)\gamma^2 s) + (r/\gamma)^3]^{1/3} - r/\gamma \qquad (7\text{–}20)$$

where

$$F = g(dH_e/dt)/(\pi\, \rho_a\, T_a\, C_p) \qquad (7\text{–}21)$$

For air material properties, the equation for F becomes:

$F = 0.0000347\ (dH_e /dt)$ and the equation for h becomes:

$$h = [-5.2\ (dH_e /dt)/(U(h)) + (2r)^3]^{1/3} - 2r \qquad (7\text{–}22)$$

For the truck plume radius, the equation becomes:

$$h = [-5.2\ (dH_e /dt)/(U(h)) + 313.3]^{1/3} - 6.8 \qquad (7\text{–}23)$$

For the railcar fire plume radius, the equation becomes:

$$h = [-5.2\ (dH_e /dt)/(U(h)) + 582.6]^{1/3} - 8.4 \qquad (7\text{–}24)$$

For the plume specific heat input, these equations become:

$$h = [-6.5\times10^6/(U(h)) + 313.3]^{1/3} - 6.8 \textit{ (truck fire)} \qquad (7\text{–}25)$$

$$h = [-7.28\times10^6/(U(h)) + 582.6]^{1/3} - 8.4 \textit{ (railcar fire)} \qquad (7\text{–}26)$$

where:

h	=	Effective release height (meters)
F	=	Buoyancy parameter
$U(h)$	=	Average windspeed from ground to the plume rise elevation (m/s)
γ	=	Entrainment coefficient (0.5 for uncontrolled fires)
s	=	Stability parameter (technically, the square of the Brunt-Väisälä frequency) (-1.6×10^{-4} s^{-2})
r	=	Initial plume radius • Truck fire: 3.396 meters (11.14 feet) • Railcar fire: 4.176 meters (13.70 feet)
g	=	Gravitational acceleration (8.8 m/s^2)
dH_e/dt	=	Rate of heat input to the plume • Truck fire: 1.25×10^6 cal/s • Railcar fire: 1.46×10^6 cal/s
ρ_a	=	Standard density of air (1.293 kg/m^3)
T_a	=	Ambient air temperature (289 K [16 °C or 60 °F])
C_p	=	Specific heat of air (0.24 cal/g-K)

Note that this equation does not explicitly relate the effective release height (h) to the other parameters because the average windspeed (an otherwise independent variable) is itself a function of h. Consequently, the equation was solved iteratively by successively calculating h and $U(h)$ until successive estimates differed by less than 0.1 percent.

The average windspeed (U) was estimated by integrating the assumed vertical windspeed profile ($u(z)$) over the height of the rising plume and dividing by the height, i.e., $U = (1/h) \int u(z)dz$.

The vertical windspeed profile was estimated using a power law equation for elevations up to 200 meters (660 feet). The power law equation relating the windspeed at an elevation to the windspeed at 10 meters (33 feet) is (Hanna, Briggs, and Hosker 1982):

$$u(z) = u(10) \times (z/10)p \quad (7\text{–}27)$$

where:

$u(z)$	=	Windspeed at elevation z (m/s)
$u(10)$	=	Windspeed at 10 meters (m/s)
z	=	Elevation above ground (meters)
p	=	A dimensionless exponent, dependent upon atmospheric stability class (see Hanna, Briggs, and Hosker 2002)

The predicted height of plume rise and average windspeed for the six atmospheric stability classes with representative windspeeds are given in Table D–60 for both the truck and railcar fires.

Table D–60. Predicted Plume Heights and Average Windspeeds for Truck and Railcar Crashes with Fires

Atmospheric Stability Class/Windspeed	Truck Fire		Railcar Fire	
	Plume Height (meters)	Average Windspeed (meters per second)	Plume Height (meters)	Average Windspeed (meters per second)
A/1.5	150	1.7	156	1.7
B/3	322	3.6	345	3.6
C/4.5	101	5.2	105	5.2
D/4.5	99	5.5	103	5.5
E/3	102	5.0	106	5.1
F/1.5	271	5.9	287	6.1

Note: To convert meters to feet, multiply by 3.281.

As can be seen, the lowest predicted height of rise is 99 meters (rounded to 100 meters [330 feet]), with only a small difference between the heights for the truck and railcar fire. Subsequent analyses are simplified by assuming that the height of plume rise is 100 meters in all conditions of atmospheric stability and windspeed for both truck and railcar fires. This is a conservative assumption for the purposes of this risk analysis.

Parameters of Interest

Table D–61 presents the values for various parameters determined in this analysis.

Note that the calculation of the fraction of the fire energy required to vaporize the mercury was performed to ensure that only a small fraction of the rate of release of heat used in the plume rise equations was consumed in evaporating the mercury.

Table D–61. Estimated Values for Various Parameters of Interest in Truck and Railcar Fire Modeling–Wooden Pallet Fire

Parameter	Truck Fire	Railcar Fire
Molecular weight (MW)	200.6	200.6
Boiling point (°F)	674	674
T (boiling point) (K)	630	630
Vapor pressure at *T*	760	760
Windspeed (m/s)	4.5	4.5
Spill area (ft^2)	384	448
Spill area (m^2)	35.7	41.6
Fire area (ft^2)	384	590
Fire area (m^2)	35.7	54.8
Heat input (cal/s)	1.25×10^6	1.46×10^6
Duration of pallet fire/mercury release(s)	762	1,308
Release rate (mg/s) windspeed 4.5 m/s[a]	1.3×10^6	1.6×10^6
Plume rise (m)[b]	99	103
Average windspeed (m/s)	5.52	5.55
Specific heat (cal/gram K)	0.033	0.033
Heat of vaporization (cal/mole)	13,599.1	13,599.1
Heat of vaporization (cal/gram)	67.8	67.8
Total heat input (cal)	9.52×10^8	1.91×10^9
Total mass released (grams)	9.91×10^5	2.09×10^6
Total energy to raise mass from 294 to 630 K[c] (cal)	1.10×10^7	2.32×10^7
Total energy to boil the mass at 630 K (cal)	6.72×10^7	1.42×10^8
Sum of energy to raise temperature and boil mass (cal)	8.82×10^7	1.65×10^8
Percentage of fire energy needed to boil mass of mercury	9.3	8.6

[a] The release rate at a different windspeed is so proportional to $u^{0.78}$ (see equation 7-19). For u=1.5 m/s, the predicted evaporation rates for truck and railcar fires are 5.5×10^5 and 6.8×10^5 mg/s, respectively.

[b] Plume rise for Atmospheric Stability Class D and windspeed of 4.5 m/s. As noted above, 100 meters (330 feet) is used as the height of plume rise for all weather conditions; see Table D–60.

[c] Equivalent to 17 to 357 °C or 61 to 673 °F.

Key: °C=degrees Celsius; °F=degrees Fahrenheit; cal=calories; ft^2=square feet; K=Kelvin; lbs=pounds; m=meters; m^2=square meters; mg=milligrams; min=minute; s=second.

Observations on Plume Radius

As described above, a height of 100 meters (330 feet) was used as the starting point for Gaussian dispersion modeling of truck and railcar fire scenarios using SAPLUME. Also needed is the plume radius. A simple model for the radius *r* of a buoyant plume is (Briggs 1984):

$$dr/dt = \beta . dz/dt \tag{7–28}$$

Integrating this gives:

$$r(h)-r(0) = \beta\Delta h \tag{7–29}$$

The symbols in Equations 7–28 and 7–29 have the following meanings:

r	=	Plume radius (meters)
h	=	Final plume height (meters)
$r(h)$	=	Plume radius at height h (meters)
$r(0)$	=	Radius immediately above the fire (meters)
Δh	=	Height of plume rise (meters)
z	=	Distance above ground (meters)
t	=	Time (seconds)
β	=	Entrainment coefficient (dimensionless)

The coefficient β for a buoyant plume is typically 0.6.[16] For Δh = 100 meters and neglecting $r(0)$, the radius at a plume height of 100 meters (330 feet) is approximately 60 meters (197 feet). As the mercury rises, it entrains air. At 100 meters, the plume would be traveling horizontally through a circle of this radius at the average windspeed across that circle. For purposes of simplicity, that is assumed to be the windspeed at a height of 100 meters, u_{100} (m/s). In that case, the volume flux V_f of air through the circle of radius 60 meters is:

$$V_f = \pi\ (60)^2\ u_{100}\ \text{m}^3/\text{s} \qquad (7–30)$$

The resultant mass flux through the 60-meter-radius circle is:

$$M_f = 1.205\ V_f\ \ \text{kg/s} \qquad (7–31)$$

where 1.205 kg/m^3 is the density of air at 293 K (20 °C). Another parameter needed for SAPLUME input is the momentum flux (MOM_f) where:

$$MOM_f = M_f .\ u_{100}\ \text{kilogram-meters per square second (kg-m/s}^2\text{)} \qquad (7–32)$$

Table D–62 gives values of these parameters for three representative conditions of atmospheric stability class and windspeed: A, 1.5 m/s; D, 4.5 m/s; and F, 1.5 m/s; the windspeeds are measured at a height of 10 meters (33 feet).

Table D–62. Windspeed, Initial Airflow, and Momentum Flux at 100-Meter Plume Height, Railcar Fire

Weather Condition Stability Class, Windspeed	Windspeed at 100 Meters (u_{100}) (m/s)	Mass Flux (M_f)(kg/s)	Momentum Flux (MOM_f) (kg-m/s^2)
A, 1.5 m/s	2.1	28,600	60,000
D, 4.5 m/s	6.2	84,500	120,000
F, 1.5 m/s	2.2	30,000	66,000

Note: To convert meters to feet, multiply by 3.281, kilograms to pounds, by 2.2046.
Key: kg-m/s^2=kilogram-meters per square second; kg/s=kilograms per second; m/s=meters per second.

As a final note, a rising plume is well defined and has a sharp boundary at the radius, so that the concentration under a rising plume at ground level is zero. This situation persists until the plume stops rising. However, to use the results of the plume rise calculations as input to SAPLUME calculations, it is assumed that the initial state at a height of 100 meters (330 feet) is a Gaussian plume with the 10 percent concentration at the radius. That being the case, the starting value of the standard deviation is r/2.14, and there would be some initially calculated concentration under the plume before SAPLUME moves it downwind. This is a conservatism in the calculation.

[16] This is only true if initial momentum jet effects can be neglected, as is true in this case.

D.7.4.2 Intentional Destructive Acts – Truck Fire and Railcar Fire

As described in Section D.2.6, the assumed IDA scenario is one in which a gasoline tanker is crashed into a truck or railcar containing mercury. Table D–63 shows the parameters of interest for these scenarios in two weather conditions: Atmospheric Stability Class D with a windspeed of 4.5 m/s and Class F with a windspeed of 1.5 m/s.

Table D–63. Parameters for Estimating Emissions of Mercury During an Intentional Destructive Act Gasoline Tank Truck Fire

Parameter	Mercury Truck	Mercury Railcar
Molecular weight (MW)	200.6	200.6
Boiling point (°F)	674	674
T (boiling point) (K)	630	630
Vapor pressure at *T*	760	760
Windspeed (m/s), stability class	4.5, D or 1.5, F	4.5, D or 1.5, F
Spill area (ft^2)	463	568
Spill area (m^2)	43	52.8
Fire area (ft^2)	463	568
Fire area (m^2)	43	52.8
Heat input (cal/s)	2.47×10^7	3.03×10^7
Duration of gasoline/mercury release(s)	8,682	10,660
Quantity released (lbs/min)		
4.5 m/s, D[a]	211.2	258.5
1.5 m/s, F[a]	97.7	117.1
Release rate (mg/s)		
4.5 (m/s), D[a]	1.6×10^6	2.0×10^6
1.5 m/s, F[a]	6.9×10^5	8.5×10^5
Minimum released quantity (lbs)		
4.5 m/s, D[a]	35,200	37,400
1.5 m/s, F[a]	16,280	16,940
Plume rise (m)		
4.5 m/s, D[a]	235	251
1.5 m/s, F[a]	244.4	259

a Windspeed, atmospheric stability class.

Key: °F=degrees Fahrenheit; cal=calories; ft^2=square feet; K=Kelvin; lbs=pounds; m=meters; m^2=square meters; mg=milligrams; min=minute; s=second.

As was the case for accidental fires, the predicted rate and duration of release are somewhat greater for the railcar fire than they are for the truck fire, so the Railcar Scenario is taken as bounding for the truck scenarios.

Table D–63 shows that the predicted plume rise in both weather conditions is about 250 meters (820 feet). However, for Atmospheric Stability Class F and a windspeed of 1.5 m/s, SAPLUME has an inversion lid hardwired into it at 260 meters (850 feet). This and other assumptions about windspeed as a function of height and quantities such as the Monin-Obukhov length, are the same as those used in SLAB, a widely used atmospheric dispersion model (Ermak 1990). SAPLUME assumes that the plume cannot rise through the inversion lid: rise is terminated when the upper edge of the plume reaches the inversion lid. In practice, in Class F conditions, SAPLUME does not accept a centerline plume rise of greater than about 120 meters (390 feet). This value is used as a conservative estimate of plume rise (i.e., leading to increase estimates of ground-level concentrations) in Class F conditions. Table D–64 provides initial data on airflow and momentum flux.

Table D–64. Windspeed at Height of Plume Rise, Initial Airflow and Momentum Flux, IDA Fire

Weather Condition Stability Class Windspeed	Windspeed at Height of Plume Rise (U_h) (m/s)	Mass Flux (M_f) (kg/s)	Momentum Flux (MOM_f) (kg-m/s^2)
D, 4.5 m/s	U_{250} = 6.8	580,000	390,000
F, 1.5 m/s	U_{120} = 2.3	45,100	104,000

Note: To convert meters to feet, multiply by 3.281; kilograms to pounds, by 2.2046.
Key: IDA=intentional destructive act; kg-m/s^2=kilogram-meters per square second; kg/s=kilograms per second; m/s=meters per second.

D.8 REFERENCES

Albin, L., D. McBaugh, and S. May, 2009, *Hanford Wildfire Response and Lessons Learned*, Washington State Department of Health, accessed through http://www.crcpd.org/PDF/Debra_McBaugh.pdf.

Armenian, H.K., A. Melkonian, E.K. Noji, and A.P. Hovanesian, 1997, "Deaths and Injuries Due to the Earthquake in Armenia: A Cohort Approach," *International Journal of Epidemiology*, Vol. 26, No. 4.

Army (U.S. Army), 1980, *Handbook for Chemical Hazard Prediction*, Handbook No. 385-2.1-80, U.S. Army Material Development and Readiness Command, Alexandria, Virginia, February.

ATSDR (Agency for Toxic Substances and Disease Registry), 1999, *Toxicological Profile For Mercury*, U.S. Department of Health and Human Services, Public Health Service, Washington, D.C., March.

ATSDR (Agency For Toxic Substances and Disease Registry), 2009a, *Health Consultation Proposed Mercury Clean-Up Level For The East Fork Poplar Creek Flood Plain Soil, Oak Ridge, Tennessee*, U.S. Department of Health and Human Services, Public Health Service, accessed through http://www.atsdr.cdc.gov/HAC/pha/efork2/oak_p1.html, November 12.

ATSDR (Agency For Toxic Substances and Disease Registry), 2009b, *Public Health Consultation: Y–12 Weapons Plant Chemical Releases into East Fork Poplar Creek*, *Oak Ridge, Tennessee*, U.S. Department of Health and Human Services, Public Health Service, accessed through http://www.atsdr.cdc.gov/hac/pha/efork1/y12_p1.html, November 12.

Ayer, J.E., et al., 1988, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*, NUREG-1320, U.S. Nuclear Regulatory Commission, Washington, D.C., May.

Baes, C.F. III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor, 1984, *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture*, ORNL-5786, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Bloxam, R., 1995, *Modeling Mercury Atmospheric Transport, Chemistry and Deposition*, Ontario Ministry of Environment and Energy, Air Resources Branch.

Briggs, G.A., 1984, *Plume Rise and Buoyancy Effects*, in *Atmospheric Science and Power Production*, DOE/TIC-27601 (DE84005177), U.S. Department of Energy, Washington, D.C.

Brooks, W.E., and G.R. Matos, 2006, *Mercury Recycling in the United States in 2000*, U.S. Geological Survey, Reston, Virginia.

Brooks, W.E., E. Sandoval, M.A. Yepez, and H. Howard, 2007, *Peru Mercury Inventory 2006*, Open File Report 2007-1252, U.S. Geological Survey, accessed through http://pubs.usgs.gov/of/2007/1252/.

Brown, H.P., 2009, E C/R Incorporated, memo to D. Jones, EPA, *Updated Cost Impacts Associated with Conversion Production Utilizing Mercury Cell Chlor-Alkali Technology to Membrane Cell Technology*, June 5.

CCPS (Center for Chemical Process Safety), 1992, *Guidelines for Hazard Evaluation Procedures, Second Edition with Worked Examples*, American Institute of Chemical Engineers, New York, New York.

CCPS (Center for Chemical Process Safety), 1996, *Guidelines for Use of Vapor Cloud Dispersion Models, Second Edition*, American Institute of Chemical Engineers, New York, New York.

CCPS (Center for Chemical Process Safety), 2001, *Layer of Protection Analysis: Simplified Process Risk Assessment*, American Institute of Chemical Engineers, New York, New York.

CDC (Centers for Disease Control and Prevention), 2002, *Documentation for Immediately Dangerous to Life or Health Concentrations*, and *1988 OSHA PEL Project Documentation*, accessed through http://www.cdc.gov/niosh/database.html.

Chew (Chew & Associates, Inc.), 2003, *Assessment of Aircraft Crash Frequency for the Hanford Site 200 Area Tank Farms*, RPP-11736, Rev. 0, March.

Chlorine Institute, 2008, *Eleventh Annual Report to EPA*, Arlington, Virginia, September.

COVO (Commission for the Safety of the Population at Large, Netherlands), 1976, *Risk Analysis of Six Potentially Hazardous Industrial Objects in the Rijnmond Area, A Pilot Study*, D. Reidel Publishing Company, Dordrecht/Boston/London.

de Gennes, P-G., F. Brochard-Wyart; and D. Quéré , 2002, *Capillary and Wetting Phenomena — Drops, Bubbles, Pearls, Waves*, Springer, ISBN 0-387-00592-7.

DLA (Defense Logistics Agency) 2004a, *Final Mercury Management Environmental Impact Statement*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DLA (Defense Logistics Agency), 2004b, *Human Health and Ecological Risk Assessment Report for the Mercury Management EIS*, Defense National Stockpile Center, Fort Belvoir, Virginia, March.

DOE (U.S. Department of Energy), 1999, *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement*,” DOE/EIS-0309, January.

DOE (U.S. Department of Energy) 2000, *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, DOE/EIS-0306, Office of Nuclear Energy, Science and Technology, Washington, D.C., July.

DOE (U.S. Department of Energy) 2001a, *Final Site-Wide Environmental Impact Statement for the Y–12 National Security Complex*, DOE/EIS-0309, September.

DOE (U.S. Department of Energy) 2001b, *Savannah River Site Salt Processing Alternatives Final Supplemental Environmental Impact Statement*, DOE/EIS-0082-S2, June.

DOE (U.S. Department of Energy), 2002a, *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-0319, National Nuclear Security Administration, Washington, D.C., August.

DOE (U.S. Department of Energy), 2002b, *Final Environmental Impact Statement for Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250, Office of Civilian Radioactive Waste Management, Yucca Mountain Site Characterization Office, North Las Vegas, Nevada, February.

DOE (U.S. Department of Energy) 2005, *Final Site-Wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement*, DOE/EIS-0348, DOE/EIS-0236-S3, March.

DOE, (U.S. Department of Energy), 2006, *Need to Consider Intentional Destructive Acts in NEPA Documents*, memorandum, U.S. Department of Energy, Office of NEPA Policy and Compliance, accessed through http://www.gc.energy.gov/NEPA/documents/terrorism--interim_nepa_guidance.pdf, December 1.

DOE (U.S. Department of Energy) 2008, *Final Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0380, National Nuclear Security Administration, May.

DOE (U.S. Department of Energy), 2009a, *U.S. Department of Energy Interim Guidance on Packaging, Transportation, Receipt, Management, and Long-Term Storage of Elemental Mercury*, Oak Ridge, Tennessee, November 13.

DOE (U.S. Department of Energy), 2009b, Subcommittee on Consequence Assessment and Protective Actions (SCAPA), *Protective Action Criteria for Chemicals – Including AEGLs, ERPGs, & TEELs*, accessed through http://orise.orau.gov/emi/scapa/teels.htm, November 9.

DOE and NYSERDA (U.S. Department of Energy and New York State Energy Research and Development Authority), 2008, *Revised Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Decommissioning Project and Western New York Nuclear Service Center*, DOE/EIS-0226-D (Revised), West Valley, New York, November.

Dourson, M.L., S.P. Felter, and D. Robinson, 1996, "Evolution of Science-Based Uncertainty Factors in Noncancer Risk Assessment," *Regulatory Toxicology and Pharmacology*, 24, 108–120.

Efroymson, R.A., M.E. Would, and G.W. Suter, II, 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision*, ES/ER/TM-126/R2, Lockheed Martin Energy Systems, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Efroymson, R.A., M.E. Would, G.W. Suter, II, and A.C. Wooten, 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*, ES/ER/TM-126/R3, Lockheed Martin Energy Systems, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Engineering Statistics Handbook, 2009, *Poisson Distribution*, accessed through http://www.itl.nist.gov/div898/handbook/eda/section3/eda366j.htm, November 18.

Engineering Toolbox, 2009a, *Properties of Air*, accessed through http://www.engineeringtoolbox.com /air-propertiesd_156.html.

Engineering Toolbox, 2009b, *Properties of Saturated Liquid Mercury*, accessed through http://www.engineeringtoolbox.com/mercury-D_1002.html.

EPA (U.S. Environmental Protection Agency), 1987, *Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances*, December.

EPA (U.S. Environmental Protection Agency), 1993, *Wildlife Exposure Factors Handbook*, Vol. 1, EPA/600/R-93/187, Office of Research and Development, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 1997a, *Mercury Study Report to Congress*, Vol. I, *Executive Summary*, EP9-452/R-97-003, Washington, D.C., December.

EPA (U.S. Environmental Protection Agency), 1997b, *Mercury Study Report to Congress*, Vol. III, *Fate and Transport of Mercury in the Environment*, EP9-452/R-97-005, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 1997c, *Volume I - General Factors Exposure Factors Handbook Update to Exposure Factors Handbook*, EPA/600/8-89/043, May 1989, EPA/600/P-95/002Fa.

EPA (U.S. Environmental Protection Agency), 1997d, *Mercury Study Report to Congress*, Vol. V, *Health Effects of Mercury and Mercury Compounds*, EPA-452/R-97-07, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 1998, *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities Vol. 1*, EPA 530-D-98-001A, Washington, D.C., July.

EPA (U.S. Environmental Protection Agency), 1999a, *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Vol. 1,* Peer Review Draft, EPA/530/D-99/001A, August.

EPA (U.S. Environmental Protection Agency), 1999b, *RMP Series Risk Management Program Guidance for Offsite Consequence Analysis*, EPA 550-B-99-009, Washington, D.C., April.

EPA (U.S. Environmental Protection Agency), 2001, *Water Quality Criterion for the Protection of Human Health: Methylmercury,* EPA-823-R-01-001, Washington, DC.

EPA (U.S. Environmental Protection Agency), 2002a, *Integrated Risk Information System (IRIS) Full IRIS Summary Methylmercury (CASRN 22967-92-6)*, accessed through http://www.epa.gov/iris/subst/0073.htm.

EPA (U.S. Environmental Protection Agency), 2002b, *Integrated Risk Information System (IRIS) Full IRIS Summary Mercuric Chloride (CASRN 7487-94-7)*, accessed through http://www.epa.gov/iris/subst/0692.htm.

EPA (U.S. Environmental Protection Agency), 2002c, *Integrated Risk Information System (IRIS) Full IRIS Summary Mercury, Elemental (CASRN 7439-97-6)*, accessed through http://www.epa.gov/iris/subst/0370.htm.

EPA (U.S. Environmental Protection Agency), 2005, *Global Mercury Commodity Market Study*, Office of Pollution Prevention and Toxics and Office of Solid Waste and Emergency Response, Washington, D.C., May.

EPA (U.S. Environmental Protection Agency), 2009a, *Graphical Arrays of Chemical-Specific Health Effect Reference Values for Inhalation Exposures*, EPA/600/R-09/061, Washington, D.C., September.

EPA (U.S. Environmental Protection Agency), 2009b, *Mercury Vapor Results*, AEGL Program, accessed through http://www.epa.gov/oppt/aegl/pubs/rest184.htm, February.

Ermak, D.L., 1990, *User's Manual for SLAB: An Atmospheric Dispersion Model for Denser-than-Air Releases*, UCRL-MA-105607, Lawrence Livermore National Laboratory, Livermore, California.

European Commission, 2004, *Mercury Flows in Europe and the World – The Impact of Decommissioned Chlor-Alkali Plants*, Directorate General for Environment, Brussels, January.

Fauske and Associates, 2007, *Evaporation Rate for Indoor Spills*, taken from *Process Safety News*, Fauske and Associates LLC, Summer 2007, Vol. 14, No. 3, p.7, eq.4. Based on Schlichting, H., 1987, *Boundary-Layer Theory*, 7th ed., McGraw-Hill, New York.

FMCSA (Federal Motor Carrier Safety Administration), 2006, *Large Truck Crash Facts 2004*, FMCSA-RI-06-040, Analysis Division, accessed through http://ai.fmcsa.dot.gov/CarrierResearchResults/PDFs/LargeTruckCrashFacts2004.pdf, March.

FMCSA (Federal Motor Carrier Safety Administration), 2007, *2005 Large Truck Crash Facts Overview*, FMCSA-RI-07-045, Analysis Division, accessed through http://ai.fmcsa.dot.gov/CarrierResearchResults/PDFs/2005LargeTruckCrashFactsOverview.pdf, January.

FMCSA (Federal Motor Carrier Safety Administration), 2008, *Large Truck Crash Facts 2006*, FMCSA-RI-08-001, Analysis Division, accessed through http://ai.fmcsa.dot.gov/CarrierResearchResults/PDFs/LargeTruckCrashFacts2006.pdf, January.

FMCSA (Federal Motor Carrier Safety Administration), 2009a, *Crash Statistics: National Overview*, accessed through http://ai.fmcsa.dot.gov/CrashProfile/n_overview.asp, March.

FMCSA (Federal Motor Carrier Safety Administration), 2009b, *Large Truck and Bus Crash Facts 2007*, FMCSA-RRA-09-029, Analysis Division, accessed through http://ai.fmcsa.dot.gov/CarrierResearch Results/PDFs/LargeTruckCrashFacts2007.pdf, January.

Fortune, W., 2007, *Department of Energy National Nuclear Security Administration Mercury Storage at the Y-12 National Security Complex*, Presentation to the Commodity Grade Mercury Stakeholder Meeting, U.S. Department of Energy, June 14.

FRA (Federal Railroad Administration), 2009, Office of Safety Analysis, *Table 1.01 - Accident/Incident Overview*, accessed through http://safetydata.fra.dot.gov/officeofsafety/, August.

Graney, J., 2007, *Real -Time Monitoring to Assess Mercury Emissions from Storage Activities*, Department of Geological Sciences and Environmental Studies, Binghamton University.

GreenFacts, 2009, *Scientific Facts on Mercury*, http://www.greenfacts.org/en/mercury/l-3/mercury-1.htm, December 17.

Hanna, S.B., G.A. Briggs, and R.P. Hosker, Jr., 1982, *Handbook on Atmospheric Diffusion*, DOE/TIC-11223, DE82002045, U.S. Department of Energy, Washington, D.C.

Harris, R.C., J.W.M. Rudd, M. Amyot, C.L. Babiarz, K.G. Beaty, P.J. Blanchfield, R.A. Bodaly, et al., 2007, "Whole-Ecosystem Study Shows Rapid Fish-Mercury Response To Changes In Mercury Deposition," *Proc. National Academy Sciences* 104(42): 16586–16591.

HAZWRAP (Hazardous Waste Remedial Actions Program), 1994, *Loring Air Force Base Ecological Risk Methodology*, Martin Marietta Energy Systems, Inc., Hazardous Waste Remedial Actions Program, Environmental Restoration and Waste Management Programs, Martin Marietta Energy Systems, Oak Ridge, Tennessee.

Holm, H.W., and M.F., Cox, 1975, "Transformation of Elemental Mercury by Bacteria," *Applied Microbiology* 29(4): 491–494.

Huber, M.L., A. Laesecke, and D.G. Friend, 2006, *The Vapor Pressure of Mercury*, NISTIR 6643, National Institute of Standards and Technology, Boulder, Colorado.

Johnson, P.E., and R.D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS) User's Manual*, ORNL/NTRC-006, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June.

Jones, G., and G. Miller, 2005, *Mercury and Modern Gold Mining in Nevada* , Final Report to U.S. Environmental Protection Agency Region IX, Department of Natural Resources and Environmental Sciences, University of Nevada, Reno, Nevada, October.

Jones, D.S., G.W. Suter, and R.N. Hull, 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision*, ES/ER/TM-95/R4, Lockheed Martin Energy Systems, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Kaiser, G.D., 1999, *Issues in the Development and Use of Guidance for EPA Hazard Assessments of Toxic Substances*, in Proceedings of the International Conference and Workshop on Modeling the Consequences of Accidental Releases of Hazardous Materials, Center for Chemical Process Safety of the American Institute of Chemical Engineers, New York, September.

Kaiser, G.D., J.D. Price, and J. Urdaneta, 1999, *Technical Background Document for Offsite Consequence Analysis for Anhydrous Aqueous Ammonia, Chlorine, and Sulfur Dioxide*, Chemical Preparedness and Prevention Office, U.S. Environmental Protection Agency, accessed through http://www.epa.gov/emergencies/docs/chem/backup.pdf, April.

LAFD (Los Angeles Fire Department), 2009, *LAFD Training Bulletin Number 4: Gasoline Tank Truck/Trailer Rollover Incidents*, accessed through http://www.lafdtraining.org/ists/tb004v1089.pdf, October 27.

Long, E.R., and L.G. Morgan, 1991, *The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program*, National Oceanic and Atmospheric Administration Technical Memorandum NOS OMA #52, Seattle, Washington.

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder, 1995, "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments," *Environ. Management* 19:81–97.

Munger, F., 2005, *Mercury Drops in Oak Ridge*, Knoxville News-Sentinel, Knoxville, Tennessee, June.

NCDC (National Climactic Data Center), 2009, accessed through http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms, August 17.

Nevada Bureau of Mines (Nevada Bureau of Mines and Geology), 2005, *Annual Mineral Production in Nevada, 1972-2005*, accessed through http://www.nbmg.unr.edu/lists.html, June 3, 2009.

NMA (National Mining Association), 2009, *Gold Production by State*, Washington, D.C., May.

NOAA (National Oceanic and Atmospheric Administration), 2009, *Storm Prediction Center: Fujita Tornado Damage Scale*, accessed through http://www.spc.noaa.gov/faq/tornado/f-scale.html, October 27.

NRC (National Research Council), 2000, *Toxicological Effects of Methylmercury,* National Academy Press, Washington, D.C.

NRC (National Research Council), 2001, *Standing Operating Procedures for Developing Acute Exposure Guideline Levels for Hazardous Chemicals*, Subcommittee on Acute Exposure Guideline Levels, Committee on Toxicology, Board on Environmental Studies and Toxicology, Commission on Life Sciences, National Research Council, National Academy Press, Washington, D.C.

NRC (U.S. Nuclear Regulatory Commission), 1975, *Reactor Safety Study*, WASH-1400 (NUREG-75/014), Washington, D.C.

NRC (U.S. Nuclear Regulatory Commission), 1987, *Shipping Container Response to Severe Highway and Railway Accident Conditions*, NUREG/CR-4829, accessed through http://ttd.sandia.gov/nrc/docs.htm, February.

NRC (U.S. Nuclear Regulatory Commission), 1998, *Code Manual for MACCS2: Vol. 1, User's Guide*, NUREG/CR-6613, Washington, D.C., May.

ORNL (Oak Ridge National Laboratory), 2009, *East Fork Poplar Creek, Signs of Recovery*, accessed through http://www.ornl.gov/info/ornlreview/rev27-3/text/envside1.htm, November 12.

OSHA (Occupational Safety and Health Administration), 2007, *Exposure Limits*, accessed through http://www.osha.gov/SLTC/mercury/exposure_limits.html, October 4.

Perry, R.H., and C.H. Chilton, 1973, *Chemical Engineers' Handbook*, McGraw-Hill, New York, p. 3-222.

Pfister, R.M., 1977, *Biologically Initiated Auto-Catalytic Mercury Conversion and its Effect on Elemental Mobility*, State of Ohio Water Resources Center, Engineering Experiment Station, the Ohio State University, April.

Roglans-Ribas, J., C. Mueller, B. Nabelssi, S. Folga, and M. Tompkins, 1995, *Facility Accident Analyses for Low-Level Waste Management Alternatives in the U.S. Department of Energy Waste Management Program*, Argonne National Laboratory, WM'95 Conference, March 2.

SAIC (Science Applications International Corporation), 1994, *SAIC's Computer Programs for Modeling the Atmospheric Dispersion of Large Scale Accidental Releases of Hazardous Vapors in Industrial Environments: Vol. II, SACRUNCH – The Continuous Release of Heavy Vapors at Ground Level, and Vol. IV, SAPLUME-Buoyant or Heavy Plumes from Stacks, Relief Valves and Pipework*, Reston, Virginia.

Sample, B.E., D.M. Opresko, and G.W. Suter, II, 1996, *Toxicological Benchmarks for Wildlife: 1996 Revision*, ES/ER/TM-86/R3, Lockheed Martin Energy Systems, Oak Ridge, Tennessee.

Saricks, C., and M.M. Tompkins, 1999, *State-Level Accident Rates of Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150, Argonne National Laboratory, April.

Schulze, R.H., 1991, *Practical Guide to Atmospheric Dispersion Modeling*, Trinity Consultants, Inc., Dallas, Texas, February 4.

Shim, J.S., H-N. Hsieh, and D. Watts, 2002, *Mercury Vapor Monitoring at Somerville Depot*, New Jersey, Center for Environmental Engineering and Science, New Jersey Institute of Technology, University Heights, Newark, NJ; prepared for U.S. Army Engineering and Support Center, Huntsville, Alabama, December.

Slinn, W.G.N., 1984, *Precipitation Scavenging*, in *Atmospheric Science and Power Production*, DOE/TIC-27601 (DE84005177), U.S. Department of Energy, Washington, D.C.

Suter, G.W., II, R.N. Hull, and B.E. Sample, 1994, *Ecological Risk Assessment for Comprehensive Environmental Response, Compensation, and Liability Act Sites on Federal Facilities: An Introductory Guide for Facility Managers*, DOE/HWP-152, U.S. Department of Energy.

Suter, G.W., II, and C.L. Tsao, 1996, *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*, ES/ER/TM-96/R2, Risk Assessment Program, Health Sciences Research Division, Oak Ridge National Laboratory.

Ultramar Refining, 1990, *Ultramar HF Alkylation Unit Risk Management and Prevention Program*, Wilmington, California, April.

UKHSE (United Kingdom Health and Safety Executive), 2009, *Safety Report Assessment Guide: Chlorine*, accessed through http://www.hse.gov.uk/comah/sragchl/chlorineintro.htm.

USGS (U.S. Geological Survey), 2009, *Mineral Commodity Summaries*, prepared by William E. Brooks, January.

VROM (Netherlands Ministry of Housing, Spatial Planning and the Environment), 2006, *External Safety (Establishments) Decree*, accessed through http://international.vrom.nl/docs/internationaal/External%20Safety%20Establishment.pdf.

Code of Federal Regulations

29 CFR 1910.120, Occupational Safety and Health Administration, U.S. Department of Labor, "Occupational Safety and Health Standards: Hazardous Waste Operations and Emergency Response."

29 CFR 1910.1000, Occupational Safety and Health Administration, U.S. Department of Labor, "Occupational Safety and Health Guidelines for Mercury Vapor."

40 CFR 68, U.S. Environmental Protection Agency, "General Guidance on Risk Management Programs for Chemical Accident Prevention."

49 CFR 172.101, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training: Purpose and Use of Hazardous Materials Table."

49 CFR 178.810, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, "Specifications for Packagings: Drop Test."

U.S. Department of Energy Standards

DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, July 1994.

U.S. Public Laws

P.L. 110-414, Mercury Export Ban Act of 2008.

APPENDIX E
COMMON AND SCIENTIFIC NAMES OF PLANT AND ANIMAL SPECIES

The scientific names of plant and animal species cited in Chapter 3 and throughout this *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement* are listed in Table E–1. Species are grouped by common name and listed in alphabetical order.

Table E–1. List of Common and Scientific Names of Plant and Animal Species

Common Name	Scientific Name
Plants	
Alkali salt grass	*Distichlis spicata*
Bald cypress	*Taxodium distichum*
Big sagebrush	*Artemisia tridentata*
Bitterbrush	*Purshia tridentata*
Buffalo grass	*Buchloe dactyloides*
Bulrush	*Scirpus spp.*
Buttonbush	*Cephalanthus occidentalis*
Cheatgrass	*Bromus tectorum*
Common plantain	*Plantago major*
Dandelion	*Taraxacum officinale*
Galleta grass	*Pleuraphis spp.*
Gray rabbitbrush	*Ericameria nauseosa*
Greenbriar	*Smilax spp.*
Hackberry	*Celtis occidentalis*
Indian ricegrass	*Achnatherum hymenoides*
Mesquite	*Prosopis spp.*
Mulberry	*Morus spp.*
Prickly pear	*Opuntia spp.*
Red ash	*Fraxinus pennsylvanica*
Red oak	*Quercus rubra*
Reed canary grass	*Phalaris arundinacea*
Rushes	*Juncus spp.*
Salt rattlepod	*Swainsona salsula*
Sand cholla	*Opuntia pulchella*
Sedges	*Carex spp.*
Siberian elm	*Ulmus pumila*
Snakeweed	*Gutierrezia sarothrae*
Snow buckwheat	*Eriogonum niveum*
Soapweed	*Yucca glauca*
Spiny hopsage	*Grayia spinosa*
Squirrelgrass	*Hordeum jubatum*
Threetip sagebrush	*Artemisia tripartita*
Watercress	*Nasturtium spp.*
Water smartweed	*Polygonum amphibium*
Water tupelo	*Nyssa aquatica*

Common Name	Scientific Name
Willow	*Salix spp.*
Winterfat	*Krascheninnikovia lanata*
Mollusks	
Giant oyster	*Crassostrea gigantissima*
Fish	
American shad	*Alosa sapidissima*
Bluehead sucker	*Catostomus discobolus*
Brook trout	*Salvelinus fontinalis*
Carp	*Cyprinus carpio*
Channel catfish	*Ictalurus punctatus*
Coho salmon	*Oncorhynchus kisutch*
Colorado pikeminnow	*Ptychocheilus lucius*
Flannelmouth sucker	*Catostomus latipinnis*
Gar	*Lepisosteus spp.*
Hickory shad	*Alosa mediocris*
King salmon	*Oncorhynchus tshawytscha*
Kokanee salmon	*Oncorhynchus nerka*
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*
Lahontan tui chub	*Gila bicolor obesa*
Lake chubsucker	*Erimyzon sucetta*
Largemouth bass	*Micropterus salmoides*
Mosquito fish	*Gambusia affinis*
Mountain whitefish	*Prosopium williamsoni*
Mud sunfish	*Acantharchus pomotis*
Rainbow trout	*Oncorhynchus mykiss*
Razorback sucker	*Xyrauchen texanus*
Redfin pickerel	*Esox americanus americanus*
Roundtail chub	*Gila robusta*
Shorthead sculpin	*Cottus confusus*
Smallmouth bass	*Micropterus dolomieui*
Speckled dace	*Rhinichthys osculus*
Steelhead trout	*Oncorhynchus mykiss*
Striped bass	*Morone saxatilis*
Tahoe sucker	*Catostomus tahoensis*
Amphibians	
Bullfrog	*Rana catesbeiana*
Great Basin spadefoot toad	*Spea intermontana*
Pacific tree frog	*Pseudacris regilla*
Spadefoot toad	*Scaphiopus multiplicatus*
Texas toad	*Bufo speciosus*
Tiger salamander	*Ambystoma tigrinum*
Woodhouse’s toad	*Bufo woodhousii*

Common Name	Scientific Name
Reptiles	
Common garter snake	*Thamnophis sirtalis*
Copperhead	*Agkistrodon contortrix*
Eastern box turtle	*Terrapene carolina*
Gopher snake	*Pituophis catenifer*
Great Basin gopher snake	*Pituophis catenifer deserticola*
Sagebrush lizard	*Sceloporus graciosus*
Sand dune lizard	*Sceloporus arenicolus*
Short-horned lizard	*Phrynosoma douglassii*
Side-blotched lizard	*Uta stansburiana*
Southern leopard frog	*Rana sphenocephala*
Southern prairie lizard	*Sceloporus undulates consubrinus*
Southern ring-necked snake	*Diadophis punctatus punctatus*
Spring peeper	*Pseudacris crucifer*
Western hognose snake	*Heterodon nasicus*
Western rattlesnake	*Crotalus viridis*
Western yellow-bellied racer	*Coluber constrictor mormon*
Whiptail lizards	*Cnemidophorus sp.*
Birds	
American robin	*Turdus migratorius*
Black vulture	*Coragyps atratus*
Carolina chickadee	*Poecile carolinensis*
Common crow	*Corvus brachyrynchus*
Common raven	*Corvus corax*
European starling	*Sturnus vulgaris*
Golden eagle	*Aquila chrysaetos*
Great blue heron	*Ardea herodias*
Greater sage grouse	*Centrocercus urophasianus*
Great-tailed grackle	*Quiscalus mexicanus*
Horned lark	*Eremophila alpestris*
House sparrow	*Passer domesticus*
Kestrel	*Falco sparverius*
Killdeer	*Charadrius vociferus*
Loggerhead shrike	*Lanius ludovicianus*
Long-billed curlew	*Numenius americanus*
Philadelphia vireo	*Vireo philadelphicus*
Pigeon	*Columba livia*
Prairie falcon	*Falco mexicanus*
Red-tailed hawk	*Buteo jamaicensis*
Sage sparrow	*Amphispiza belli*
Say’s phoebe	*Sayornis saya*
Scaled quail	*Callipepla squamata*
Scarlet tanager	*Piranga olivacea*
Summer tanager	*Piranga rubra*

Common Name	Scientific Name
Western meadowlark	*Sturnella neglecta*
Wild turkey	*Meleagris gallopavo*
Yellow-throated vireo	*Vireo flavifrons*
Mammals	
Badger	*Taxidea taxus*
Black-tailed jackrabbit	*Lepus californicus*
Bobcat	*Lynx rufus*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Desert cottontail	*Sylvilagus audubonii*
Eastern cottontail	*Sylvilagus floridanus*
Feral hog	*Sus scrofa*
Gray bat	*Myotis grisescens*
Gray fox	*Urocyon cinereoargenteus*
Gray squirrel	*Sciurus carolinensis*
Great Basin pocket mouse	*Perognathus parvus*
Mink	*Mustela vison*
Mountain lion	*Puma concolor*
Mule deer	*Odocoileus hemionus*
Opossum	*Didephis virginiana*
Ord’s kangaroo rat	*Dipodomys ordii*
Pronghorn	*Antilocapra americana*
Pygmy rabbit	*Brachylagus idahoensis*
Raccoon	*Procyon lotor*
River otter	*Lontra canadensis*
Rocky Mountain elk	*Cervus canadensis*
Short-tailed shrew	*Blarina carolinensis*
Silky pocket mouse	*Perognathus flavus*
Spotted skunk	*Spilogale putorius*
Striped skunk	*Mephitis mephitis*
Townsend’s ground squirrel	*Spermophilus townsendii*
White-tailed antelope squirrel	*Ammospermophilus leucurus*
White-tailed deer	*Odocoileus virginianus*
Yellow-bellied marmot	*Marmota flaviventris*

APPENDIX F
COOPERATING AGENCY AGREEMENTS

F.1 U.S. DEPARTMENT OF ENERGY'S CORRESPONDENCE TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Department of Energy
Washington, DC 20585

APR. 14 2009

Ms. Susan Bromm
Director, Office of Federal Activities
U.S. Environmental Protection Agency
Mail Code 2251-A
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Dear Ms. Bromm:

The purpose of this letter is to invite the U.S. Environmental Protection Agency (EPA) to participate as a cooperating agency in the Department of Energy's (DOE) preparation of an environmental impact statement, pursuant to the National Environmental Policy Act (NEPA), on alternatives for long-term management and storage of mercury. Section 5 of the Mercury Export Ban Act of 2008 (the Act), Pub. L. 110-414, 122 Stat. 4341, sets forth requirements for DOE to establish and manage a facility for the purpose of long-term management and storage of elemental mercury generated within the United States.

Section 1501.6 of the Council on Environmental Quality's implementing regulations for NEPA outlines the process for inviting other Federal agencies to participate in the NEPA process. Such involvement is based on another Federal agency having either jurisdiction by law, or possessing special expertise regarding any environmental issue to be addressed in the NEPA document. I would like to invite EPA to participate as a cooperating agency in the preparation of this EIS for the following reasons: (1) pursuant to the Act, EPA and DOE are working collaboratively to develop guidance on procedures and standards for operating a long-term mercury storage facility, and EPA (or an authorized State) is required to issue a decision regarding the Resource Conservation and Recovery Act (RCRA) permit application for such a facility; (2) EPA possesses invaluable technical and regulatory expertise concerning elemental mercury and has been working closely with DOE (on a Senior Management Steering Committee and Interagency Coordinating Workgroup) to address the requirements for implementing the Act; and (3) during the past several years, EPA led an interagency workgroup and established a stakeholder panel to assess options and issues related to the management of non-Federal commodity grade mercury.

We would like to involve EPA as early as possible in the development of the EIS; accordingly, we would appreciate your response to this invitation as soon as practicable. We anticipate issuance of a Notice of Intent (NOI) in May or June 2009 and would like to note EPA's participation as a cooperating agency in the NOI. If you or your staff has any questions or issues concerning the EIS, please contact David Levenstein of DOE's Office of Environmental Management at (301) 903-6500 or david.levenstein@hq.doe.gov. Mr. Levenstein is the DOE NEPA Document Manager for the EIS. If you have any questions about DOE's NEPA process, please contact me at 202-586-4600.

Sincerely,

Carol Borgstrom

Carol M. Borgstrom
Director
Office of NEPA Policy and Compliance

cc: David Levenstein, EM-11

F.2 U.S. ENVIRONMENTAL PROTECTION AGENCY'S CORRESPONDENCE TO THE U.S. DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAY 18 2009

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

Ms. Carol M. Borgstrom
Director, Office of NEPA Policy and Compliance
GC–20
U.S. Department of Energy
1000 Independence Avenue, SW.
Washington, DC 20585–0103

Dear Ms. Borgstrom:

Thank you for your April 14, 2009 letter inviting the U.S. Environmental Protection Agency (EPA) to participate as a cooperating agency in the Department of Energy's (DOE) preparation of an environmental impact statement (EIS) on alternatives for long-term management and storage of mercury. DOE has determined this action to be a major federal action requiring the preparation of an EIS in accordance with the National Environmental Policy Act. EPA accepts this invitation.

As a cooperating agency for this EIS, EPA will fulfill the following roles:

1. Due to the technical and regulatory experience concerning elemental mercury, EPA will provide early review and comment on select technical studies and reports in areas of EPA jurisdiction and/or expertise in the following areas:

   a. Guidance on procedures and standards for storage
   b. Designation of elemental mercury received for long-term storage
   c. Draft and final EISs

2. Participate in cooperating agency conference calls to the extent time/resources allow.

The goal of this cooperating agency collaboration is to generate a thorough, high quality environmental impact assessment containing accurate scientific analysis and experts agency comments. The extent to which EPA can assist with in these efforts will be dependent upon the availability of Agency resources and the timeliness of information sharing. Also, our agreement to serve as a cooperating agency does not affect or alter our responsibility to review the EIS pursuant to our authority under Section 309 of the Clean Air Act.

If you have any questions concerning this matter you may contact me at 202-564-5400. You may also call my staff point of contact, Marthea Rountree. She can be reached at 202-564-7141.

Sincerely,

Susan E. Bromm

Susan E. Bromm
Director
Office of Federal Activities

F.3 U.S. DEPARTMENT OF ENERGY’S CORRESPONDENCE TO THE MESA COUNTY BOARD OF COMMISSIONERS

Department of Energy
Washington, DC 20585

Mr. Steven Acquafresca
Chair, Mesa County Board of Commissioners
Mesa County Administration
PO Box 20,000
Grand Junction, CO 81502

Dear Mr. Acquafresca:

The purpose of this letter is to invite Mesa County, Colorado, to participate as a cooperating agency with the Department of Energy (DOE) in preparing an environmental impact statement (EIS) regarding the long-term management and storage of elemental mercury pursuant to the Mercury Export Ban Act of 2008, Pub. L. No. 110-414, 122 Stat. 4341.

The Mesa County Board of Commissioners (the Board) requested cooperating agency status at DOE's July 21, 2009, public scoping meeting in Grand Junction, Colorado. In accordance with sections 1501.6 and 1508.5 of the Council on Environmental Quality's (CEQ) National Environmental Policy Act implementing regulations and CEQ guidance dated January 30, 2002, DOE proposes the execution of a Memorandum of Understanding (MOU) that would establish the roles and responsibilities of both DOE and the Board in the EIS process. DOE anticipates that successful interaction between our agencies will enhance the analyses in this EIS and ensure that the scope and content of the EIS are sufficient to address the concerns of Mesa County.

A member of my staff will contact you soon to discuss establishing the Board as a cooperating agency and executing an MOU.

Sincerely,

Carol Borgstrom

Carol M. Borgstrom
Director
Office of NEPA Policy and Compliance

cc: David Levenstein, EM-11
Janet Rowland, Mesa County Board of Commissioners
Craig Meis, Mesa County Board of Commissioners
Jon Peacock, Mesa County Administrator

Printed with soy ink on recycled paper

bcc: Jeanie Loving, EM-11
William Levitan, EM-11
Jim Daniel, GC-20
William Fortune, HS-22
Gerald DiCerbo, HS-22
Robert Fleming, NA-56
Rick Ahern, GC-51
Michael Jensen, GC-51
Tracy Getz, GC-51

F.4 MEMORANDUM OF UNDERSTANDING BETWEEN OFFICE OF ENVIRONMENTAL MANAGEMENT, U.S. DEPARTMENT OF ENERGY, AND MESA COUNTY, COLORADO

MEMORANDUM OF UNDERSTANDING
between
Office of Environmental Management, U.S. Department of Energy,
and
Mesa County, Colorado

I. BACKGROUND AND OBJECTIVES

The United States Congress, in the Mercury Export Ban Act of 2008, assigned the Department of Energy (DOE) the responsibility of designating a facility or facilities for the long-term management and storage of elemental mercury generated in the United States.

To this end, the Office of Environmental Management, U.S. Department of Energy (DOE), is in the process of preparing the *Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement* (*Mercury Storage EIS*) (DOE/EIS-0423).

Mesa County, Colorado, is the situs jurisdiction of the Grand Junction Disposal Site location, one of the seven sites under consideration for the mercury storage mission being evaluated under the *Mercury Storage EIS.*

DOE has invited the Mesa County Board of Commissioners (Mesa County) to participate as a cooperating agency with DOE in preparing the Mercury Storage EIS.

DOE will serve as the lead agency in preparation of the *Mercury Storage EIS* in accordance with section 1501.5 of the Council on Environmental Quality regulations that implement the National Environmental Policy Act. Because the Mesa County Board of Commissioners (Mesa County) has special expertise as defined under 40 CFR § 1508.26, Mesa County will serve as a cooperating agency in preparation of this EIS in accordance with 40 CFR §§ 1501.6 and 1508.5.

II. TERMS AND CONDITIONS

Mesa County and DOE agree to the following terms and conditions:

1. As lead agency in the preparation of this EIS, DOE will make its best efforts to:

   - Provide timely information and consult with Mesa County on issues relevant to its role as a cooperating agency;
   - Provide Mesa County access to information and documents during the course of the preparation of this EIS that DOE otherwise would consider confidential and/or pre-decisional; and

- Address all formal comments and seek to resolve all issues and concerns raised by Mesa County by incorporating or otherwise responding to the views of Mesa County prior to publication of the final EIS.

2. As a cooperating agency, Mesa County will, at the request of DOE:

   - Attend (or participate by phone in) all public, project, and technical working group meetings;
   - Provide comments in a timely manner on all documents under review;
   - Use best efforts to seek to resolve all issues, concerns, and comments raised by DOE prior to publication of the final EIS;
   - Compile and provide socioeconomic data such as population, housing, and other forecasting information;
   - Transmit relevant reports and studies prepared/conducted by the county;
   - Assist with the identification of environmental issues;
   - Assist with environmental analyses;
   - Review working draft and preliminary draft documents; and
   - Assist with the preparation of responses to public comments.

3. Mesa County will protect from public disclosure all pre-decisional/deliberative process information, including working draft documents. To that end, Mesa County agrees:

   - Not to disclose information provided by DOE, that DOE considers confidential and/or pre-decisional, to third parties without the express written consent of DOE;
   - Not to disclose electronic transmissions, written materials, and documents provided by DOE, that DOE considers confidential and/or pre-decisional, to third parties without the express written consent of DOE; and
   - To notify DOE of any request to disclose materials and documents provided by DOE that DOE considers confidential and/or pre-decisional. In the event that DOE determines that the materials or documents requested to be disclosed are not appropriate for public disclosure, Mesa County agrees not to release any of the requested materials or documents.

4. This Memorandum of Understanding may be terminated by the mutual written agreement of both parties or by either party upon 30-day written notice to the other party.

5. DOE enters into this Agreement under the authority of section 646 of the Department of Energy Organization Act (Pub. L. 95-91, as amended; 42 U.S.C. § 7256).

6. This Agreement in no way restricts either of the Parties from participating in any activity with other public or private agencies, organizations or

individuals.

7. This Agreement is neither a fiscal nor a funds obligation document. Nothing in this Agreement authorizes or is intended to obligate the Parties to expend, exchange, or reimburse funds, services, or supplies, or transfer or receive anything of value.

8. This Agreement is strictly for internal management purposes for each of the Parties. It is not legally enforceable and shall not be construed to create any legal obligation on the part of either Party. This Agreement shall not be construed to provide a private right or cause of action for or by any person or entity.

9. All agreements herein are subject to, and will be carried out in compliance with, all Federal applicable laws, regulations and other legal requirements.

10. This Memorandum of Understanding shall become effective upon execution. Mesa County will transmit this Memorandum of Understanding to DOE upon execution.

Signed:

This 20th **day of** October **2009**

By: Andrew Szilagyi for

Frank Marcinowski,
Deputy Assistant Secretary
Office of Regulatory Compliance
Office of Environmental Management
U.S. Department of Energy

Signed:

This 19TH **day of** OCTOBER **2009**

By:

Craig J. Meis, Acting Chair
Mesa County Board of Commissioners
Mesa County Administration

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APPENDIX G
CONTRACTOR AND SUBCONTRACTOR
NATIONAL ENVIRONMENTAL POLICY ACT
DISCLOSURE STATEMENTS

NATIONAL ENVIRONMENTAL POLICY ACT DISCLOSURE STATEMENT FOR PREPARATION OF THE *LONG-TERM MANAGEMENT AND STORAGE OF ELEMENTAL MERCURY ENVIRONMENTAL IMPACT STATEMENT*

The Council of Environmental Quality regulations at Title 40 of the *Code of Federal Regulations* (CFR), Section 1506.5(c), which have been adopted by the U.S. Department of Energy (10 CFR 1021), require contractors and subcontractors who will prepare an environmental impact statement to execute a disclosure specifying that they have no financial or other interest in the outcome of the project.

"Financial or other interest in the outcome of the project" is defined as any direct financial benefits, such as a promise of future construction or design work in the project, as well as indirect financial benefits that the contractor is aware of.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows, to the best of their actual knowledge as of the date set forth below:

(a) X Offeror and any proposed subcontractors have no financial or other interest in the outcome of the project.

(b)__ Offeror and any proposed subcontractors have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract, or agree to the attached plan to mitigate, neutralize, or avoid any such conflict of interest.

Financial or Other Interests
1.
2.
3.

Certified by:

[signature]
Signature

Tim Bendt
Name

Operations Contracts Manager
Title

Science Applications International Corporation
Company

8/13/09
Date

NATIONAL ENVIRONMENTAL POLICY ACT DISCLOSURE STATEMENT FOR PREPARATION OF THE *LONG-TERM MANAGEMENT AND STORAGE OF ELEMENTAL MERCURY ENVIRONMENTAL IMPACT STATEMENT*

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(b)__ Offeror and any proposed subcontractors have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract, or agree to the attached plan to mitigate, neutralize, or avoid any such conflict of interest.

Financial or Other Interests
1.
2.
3.

Certified by:

[signature]
Signature

Dr. Loong Yong
Name

President
Title

SpectraTech, Inc.
Company

August 10, 2009
Date