DOE/EIS-0286D2

Revised Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement Richland, Washington

Volume I
Sections 1 through 7

U.S. Department of Energy
Richland Operations Office
Richland, Washington

March 2003

Cover Photographs:

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RESPONSIBLE AGENCY: **COVER SHEET**

U.S. Department of Energy, Richland Operations Office

TITLE:

Revised Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Benton County, Washington (DOE/EIS-0286D2)

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ABSTRACT:

The revised draft of the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) provides environmental and technical information concerning U.S. Department of Energy (DOE) proposed waste management practices at the Hanford Site. DOE issued the Notice of Intent to prepare the EIS on October 27, 1997, and held public meetings during the scoping period that extended through January 30, 1998. The HSW EIS updates analyses of environmental consequences from previous documents and provides evaluations for activities that may be implemented consistent with the Waste Management Programmatic Environmental Impact Statement (WM PEIS) Records of Decision (RODs). Waste types considered in the HSW EIS include operational low-level radioactive waste (LLW), mixed low-level waste (MLLW), immobilized low-activity waste (ILAW), and transuranic (TRU) waste. MLLW contains chemically hazardous components in addition to radionuclides. In April 2002, DOE issued the first draft of the HSW EIS. During the public comment period that started in May 2002, DOE received a large number of comments from regulators, area tribes, stakeholders, and the public. The revised draft of the HSW EIS was prepared to address these public comments and add the ILAW scope. Alternatives for management of these wastes at the Hanford Site, including the alternative of No Action, are analyzed in detail. The LLW, MLLW, and TRU waste alternatives are evaluated for a range of waste volumes, representing quantities of waste that could be managed at the Hanford Site. A single maximum forecast volume is evaluated for ILAW waste. The No Action Alternative considers continuation of ongoing waste management practices at the Hanford Site and ceasing some operations when the limits of existing capabilities are reached. The No Action Alternative provides for continued storage of some waste types. The other alternatives evaluate waste management practices including treatment and disposal of most wastes. The potential environmental consequences of the alternatives are generally similar. The major differences occur with respect to the consequences of disposal versus continued storage and with respect to the range of waste volumes managed under the alternatives. The revised draft HSW EIS is being issued for public review and comment, after which DOE will prepare the final EIS. Dates, times, and locations for public meetings will be announced in the *Federal Register* and local media. The RODs will be published in the *Federal Register* no sooner than 30 days after publication of the Environmental Protection Agency Notice of Availability of the final EIS. DOE's preferred alternative is to dispose of LLW, MLLW, and ILAW in a single, lined facility on Hanford's Central Plateau; treat MLLW using a combination of onsite and offsite facilities; and certify TRU waste using a combination of existing and upgraded facilities onsite.

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Acronyms/Abbreviations

AADT	annual average daily traffic
ADT	annual average daily traffic
AEA	Atomic Energy Act
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ALE	Fitzner/Eberhardt Arid Lands Ecology (Reserve)
ANSI	American National Standards Institute
APL	Accelerated Process Line
ARAR	applicable or relevant and appropriate requirement
ATG	Allied Technology Group, Inc.
BCAA	Benton Clean Air Authority
BCF	bioconcentration factor
BDAT	best demonstrated available technology
BHI	Bechtel Hanford, Inc.
BLS	Bureau of Labor Statistics
BNSF	Burlington Northern Santa Fe (railroad)
BPA	(U.S. Department of Energy) Bonneville Power Administration
BRMiS	Hanford Site Biological Resources Mitigation Strategy
BRMaP	Hanford Site Biological Resources Management Plan
BWIP	Basalt Waste Isolation Project
C3T	cleanup, constraint, and challenges team
CAA	Clean Air Act
CAIRS	Computerized Accident/Incident Reporting System
Cat 1	Category 1 (low-level waste)
Cat 3	Category 3 (low-level waste)
CBC	Columbia Basin College
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFEST	Coupled Fluid, Energy, and Solute Transport (computer code)
CFR	Code of Federal Regulations
CH	contact-handled
Ci	curie(s)
CNSS	Council of the National Seismic System
CO	carbon monoxide
CRCIA	Columbia River Comprehensive Impact Assessment
CSB	Canister Storage Building
CWC	Central Waste Complex

D&D	decontamination and decommissioning
dB	decibel(s)
dBA	A-weighted decibel(s)
DCG	derived concentration guide
DEIS	Draft Environmental Impact Statement
D_l	longitudinal dispersivity
DOE	U.S. Department of Energy
DOE-ORP	U.S. Department of Energy, Office of River Protection
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
D_t	transverse dispersivity
DWS	drinking water standard
EA	environmental assessment
ECAMP	Ecological Compliance Assessment Management Plan
ECEM	Ecological Contaminant Exposure Model (computer code)
Ecology	Washington State Department of Ecology
EDE	effective dose equivalent
EDNA	environmental designation for noise abatement
EHQ	environmental hazard quotient
EIS	environmental impact statement
EM	U.S. Department of Energy Office of Environmental Management
EMI	environmental management integration
EMSL	Environmental and Molecular Sciences Laboratory
ENCO	enterprise companies
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
E/Q	dispersion factor(s)
ERDA	U.S. Energy Research and Development Administration
ER	environmental restoration
ERDF	Environmental Restoration Disposal Facility
ERPG	Emergency Response Planning Guideline
ERTC	Effluent Retention and Treatment Complex
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ET	evapotranspiration
ETF	200 Area Effluent Treatment Facility
FEMA	Federal Emergency Management Agency
FFS	focused feasibility study
FFTF	Fast Flux Test Facility
FH	Fluor Hanford, Inc.
FONSI	finding of no significant impact

FR	*Federal Register*
FRAMES	Framework for Risk Analysis in Multimedia Environmental Systems (computer code)
FTE	full-time equivalent (or full-time employee)
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GIS	geographic information system
GOCO	government-owned contractor-operated
GPS	global positioning system
GTC3	greater than Category 3 (low-level waste)
GTCC	greater than Class C
HAMMER	Hazardous Materials Management and Emergency Response Facility (Volpentest Training and Education Center)
HCP EIS	Hanford Comprehensive Land-Use Plan Environmental Impact Statement
HCRC	Hanford Cultural Resources Case
HCRL	Hanford Cultural Resources Laboratory
HDW EIS	Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes Environmental Impact Statement
HEHF	Hanford Environmental Health Foundation
HEPA	high-efficiency particulate air
HIC	high-integrity container
HLW	high-level (radioactive) waste
HMS	Hanford Meteorology Station
HPMP	Hanford Performance Management Plan
HPPE	high-density polyethylene
HSRAM	Hanford Site Risk Assessment Methodology
HSSWAC	Hanford Site solid waste acceptance criteria
HSW	Hanford solid waste
HSW EIS	Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement
HTWOS	Hanford Tank Waste Operating System
HW	hazardous waste
HWMA	Washington State Hazardous Waste Management Act
HWMP	Hanford Waste Management Program
HWVP	Hanford Waste Vitrification Project
Hz	hertz
I&I	irreversible and irretrievable
ICRP	International Commission on Radiological Protection
IDLH	Immediately Dangerous to Life and Health
ILAW	immobilized low-activity waste
IPABS	Integrated Planning, Accountability and Budgeting System

ISCST3	Industrial Source Complex Short-Term Model, version 3 (computer code)
ISO	International Standards Organization
ISS	interim safe storage
K_d	distribution coefficient for partitioning of contaminants in soil
LCF	latent cancer fatality
LC50	chemical concentration reported to be lethal to 50 percent of the exposed organisms after some period of exposure, usually a few hours to a few days
LD50	dose reported to be lethal to 50 percent of the exposed organisms after some period of exposure, usually a few hours to a few days
LDR	Land Disposal Restriction
LEPC	Local Emergency Planning Committee
LERF	Liquid Effluent Retention Facility
LIGO	Laser Interferometer Gravitational Wave Observatory
LLBG	Low Level Burial Ground
LLW	low-level (radioactive) waste
LLWMA	low-level waste management area
LMF	lined modular facility
LOA	line of analysis
LOEC	lowest observed effects concentration
LOEL	lowest observed effects level
LOS	level of service
LWC	lost workday case
LWD	lost workday
M&O	management and operations
MASS2	Modular Aquatic Simulation System 2 (computer code)
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
MEI	maximally exposed individual
MEK	methyl ethyl ketone
MEPAS	Multimedia Environmental Pollutant Assessment System
MLLW	mixed low-level waste
MMEDE	Multimedia-Modeling Environmental Database Editor (computer code)
MMI	Modified Mercalli Intensity
MT	metric ton(s) (tonnes)
MTCA	Model Toxics Control Act
MTG	minimum technology guidance
MTU	metric tons of uranium
NAAQS	National Ambient Air Quality Standards
National Register	National Register of Historic Places
NDA	non-destructive assay

NDE	non-destructive examination
ND	not detected
NE	no emissions
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NM	not measured
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAEL	no observed adverse effects level
NOC	Notice of Construction
NOE	Notice of Extension
NOI	Notice of Intent
NO_x	nitrogen oxides
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NS	no standard
NTS	Nevada Test Site
NWPF	new waste processing facility
NWS	National Weather Service
OAR	Oregon Administrative Rule
OCF	offsite commercial facility
OFM	Office of Financial Management
ORP	(U.S. Department of Energy) Office of River Protection
ORR	(U.S. Department of Energy) Oak Ridge Reservation
OSHA	U.S. Occupational Safety and Health Administration
PA	performance assessment
PCB	polychlorinated biphenyl
pCi	picocurie(s)
PEIS	Programmatic Environmental Impact Statement
PEL	permissible exposure level
PFP	Plutonium Finishing Plant
PHMC	Project Hanford Management Contract
PM	particulate matter
PM_{10}	particulate matter with aerodynamic diameters 10 µm or smaller
PNNL	Pacific Northwest National Laboratory
ppm	parts per million
PSD	prevention of significant deterioration
Pu	plutonium
PUREX	Plutonium-Uranium Extraction Facility

R	roentgen
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RCW	Revised Code of Washington
REIS	Regional Economic Information System
R_f	contaminant retardation factors
RfD	reference dose
RH	remote-handled
RIMS	Regional Input-Output Modeling System (computer code)
RL	(U.S. Department of Energy) Richland Operations Office
ROD	Record of Decision
RPP	River Protection Project

SA	safety analysis
SAC	System Assessment Capability (computer code)
SALDS	State-Approved Land Disposal Structure
SC	species of concern
SCAPA	Subcommittee on Consequence Assessment and Protective Actions
SEIS	Supplemental Environmental Impact Statement
SEPA	State (of Washington) Environmental Policy Act
SERC	State Emergency Response Commission
SI	international system of units (metric system)
SIP	state implementation plan
SLD	shallow land disposal
SNF	spent nuclear fuel
SO_2	sulfur dioxide
SO_x	sulfur oxides
SR	State Route
SRS	(U.S. Department of Energy) Savannah River Site
SST	single-shell tank
STOMP	Subsurface Transport Over Multiple Phases (computer code)
STP	site treatment plan
SWB	standard waste box
SWIFT	Solid Waste Integrated Forecast Technical (report)
SWITS	Solid Waste Information and Tracking System
SWOC	Solid Waste Operations Complex

T&E	threatened and endangered
TCP	traditional cultural property
TD	temperature difference
TEDE	total effective dose equivalent
TEDF	200 Area Treated Effluent Disposal Facility
TEEL	Temporary Emergency Exposure Limit

TI	Transportation Index
TLV	threshold limit value
TNC	The Nature Conservancy (of Washington)
TPA	Tri-Party Agreement (Hanford Federal Facility Agreement and Consent Order)
TRC	total recordable case
TRIGA	Test Reactor and Isotope Production General Atomics
TRU	transuranic waste
TRUPACT-II	Transuranic Package Transporter-II
TRUSAF	Transuranic Storage and Assay Facility
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and/or disposal
TSP	total suspended particulate
TWRS	Tank Waste Remediation System
UPR	unplanned release
UO_3	uranium trioxide
USC	United States Code
USGS	U.S. Geological Survey
UW	University of Washington
UWGP	University of Washington Geophysics Program
VADER	VADose zone Environmental Release (computer code)
VOC	volatile organic compound
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WDOH	Washington State Department of Health
WESF	Waste Encapsulation and Storage Facility
WHC	Westinghouse Hanford Company
WIF	well intercept factor
WIPP	Waste Isolation Pilot Plant
WM	waste management
WM PEIS	Waste Management Programmatic Environmental Impact Statement
WNHP	Washington Natural Heritage Program
WRAP	Waste Receiving and Processing Facility
WSU-TC	Washington State University – Tri-Cities Branch Campus
WTP	waste treatment plant

Glossary of Terms

anadromous – Migrating up rivers from the sea to breed in fresh water.

aromatic – Of, related to, or containing the six-carbon ring typical of the benzene series and related organic groups**.**

bioconcentration factor (BCF) – The ratio of the tissue concentration of an aquatic organism to the water concentration where uptake is to limited to water alone, usually derived in an experimental setting.

borrow pit – The excavation site used to obtain geological resources (such as sand, gravel, basalt rocks, or fine sediments).

caisson – As used in the HSW EIS, these structures are reinforced cylindrical steel and concrete underground vaults 2.4 m (8 ft) in diameter and 3-m (10-ft) high designed to store remote-handled waste in the low level burial grounds

candidate species – Plants and animals with a status of concern, but about which more information is needed before they can be proposed for listing as threatened species or endangered species. A state candidate species is one that is being reviewed for possible listing as a state endangered, threatened, or sensitive species as specified by the Washington State Department of Fish and Wildlife. See also endangered species, threatened species, and species of concern.

cap – A cap used to cover a radioactive burial ground with soil, rock, vegetation, or other materials as part of the facility closure process. The cap is designed to reduce migration of radioactive and hazardous materials in the waste by infiltration of water or by intrusion of humans, plants, or animals from the surface. In this EIS, the Modified RCRA Subtitle C Barrier was selected to use as a cap for LLW and MLLW disposal grounds. (Also called "cover cap" and "barrier" in this EIS.)

capping – As applied to radioactive and mixed-waste disposal facilities, the process of covering a burial ground with soil, rock, vegetation, or other materials as part of the facility closure process. The cap is designed to reduce migration of radioactive and hazardous materials in the waste by infiltration of water or by intrusion of humans, plants, or animals from the surface.

carcinogen – Any substance that can cause cancer.

cask – A heavily shielded container used to store or ship radioactive materials.

Category 1 low-level waste – Low-level radioactive waste containing radionuclide concentrations within the maximum limits defined for this waste type in the HSSWAC. These limits are site-specific, and they define the lowest activity category of low-level radioactive waste. Category 1 wastes typically do not require special packaging or treatment for disposal by shallow land burial.

Category 3 low-level waste – Low-level radioactive waste containing radionuclide concentrations greater than those defined for Category 1 waste, but within the maximum limits defined for Category 3 waste in the HSSWAC. These limits are site-specific, and are established using the performance assessment for a particular disposal facility. Category 3 wastes typically require special packaging or treatment for disposal by shallow land burial.

characterization – See waste characterization.

chemical oxidation – Oxidation of a material by adding chemicals such as peroxide, ozone, persulfates, or other oxidizing material. Commonly used for oxidation of organic constituents.

chemical reduction – Reduction of a material by adding chemicals such as sulfites, polyethylene glycol, hydrosulfide, or ferrous salts. Commonly used for the reduction of hexavalent chromium to the trivalent state. In all these cases, the reduced forms of the contaminant are much less mobile in the environment because of their low solubility and high adsorption to soils. Microbiological reduction of these waste constituents also has been found to occur naturally in sediment and aquifer environments and with addition of chemical food sources to enhance the microbe growth rates reductive biological remediation is becoming more economical.

cleanup – The term cleanup refers the full range of projects and activities being undertaken to address environmental and legacy waste issues associated with the Hanford Site.

closure – As applied to radioactive and hazardous waste disposal facilities, the process of site stabilization and placement of caps or other barriers to provide long-term confinement of the waste. Requirements for closure are defined by laws, regulations, or orders for various types of waste management facilities.

contact-handled (CH) waste – Generally, packaged waste whose external surface dose rate does not exceed 200 mrem/hr and does not create a high radiation area (>100 mrem/hr at 30 cm). See also remote-handled waste.

crib – An underground structure designed to receive liquid waste that can percolate into the soil directly and/or after traveling through a connected tile field.

criteria pollutants – Six pollutants (carbon monoxide, suspended particulates of specified sizes, sulfur dioxide, lead, nitrogen oxide, and ozone) known to be hazardous to human health or structures and for which the U.S. Environmental Protection Agency (EPA) sets National Ambient Air Quality Standards under the Clean Air Act (40 CFR 50[a]).

cullet – Granular glass particles similar to coarse sand.

(a) 40 CFR 50. "National Primary and Secondary Ambient Air Quality Standards." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr50_01.html.

cumulative impacts (effects) –Impact on the environment that results from the incremental impact of 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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

dangerous waste – Solid waste designated in WAC 173-303-070[(a)] through WAC 173-303-100 as dangerous or extremely hazardous waste, or mixed waste.

deactivation – As applied to waste treatment, the removal of the hazardous characteristics of a waste due to its ignitability, corrosivity, and or reactivity.

decibel – A standard unit of sound pressure. The decibel is a value equal to 10 times the logarithm of the ratio of a sound pressure squared to a standard reference sound-pressure level (20 micropascals) squared.

decommissioning – Final actions taken to reduce the potential health and safety impacts of U.S. Department of Energy (DOE)-contaminated facilities, including activities to stabilize, reduce, or remove radioactive and hazardous materials, or to demolish the facilities.

decontamination – The removal, reduction, or neutralization of radionuclides and/or hazardous materials from contaminated facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

deterministic analysis – A single calculation using only a single value for each of the model parameters. A deterministic system is governed by definite rules of system behavior leading to cause and effect relationships and predictability. Deterministic calculations do not account for uncertainty in the physical relationships or parameter values. See stochastic analysis.

disposal – As generally used in this document, placement of waste with no intent to retrieve. Statutory or regulatory definitions of disposal may differ.

dose – The accumulated radiation or hazardous substance delivered to the whole body, or a specified tissue or organ, within a specified time interval, originating from an external or internal source.
effluent – Airborne and liquid wastes discharged from a DOE site or facility. This term does not include solid wastes, wastes for shipment offsite, wastes that are contained (for example, underground nuclear test debris) or stored (for example, in tanks) or wastes that are to remain onsite through treatment or disposal.

endangered species (Federal) – Plants or animals that are in danger of extinction throughout all or a significant portion of their ranges and have been listed as endangered 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[b]).

(a) WAC 173-303. "Dangerous Waste Regulations." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=173-303-040.

(b) 50 CFR 424. "Listing Endangered and Threatened Species and Designating Critical Habitat." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/50cfr424_01.html.

endangered species (State) – Washington State defines endangered species as any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state (WAC 232-12-297[a]). See also candidate species and threatened species.

eolian – Pertaining to, caused by, or carried by the wind.

ERPG-1 – The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

ERPG-2 – The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

ERPG-3 – The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

Evolutionarily Significant Unit (ESU) – A distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout.

Federal species of concern – Species whose conservation standing is of concern to the U.S. Fish and Wildlife Service but for which status information still is needed.

fluvial – Produced by the action of flowing water.

french drain – A rock-filled encasement with an open bottom to allow seepage of liquid waste into the ground.

generator – Within the context of this document, generators refer to organizations within DOE or managed by DOE whose act or process produces low-level waste, mixed low-level waste, or transuranic waste.

graded approach – A process by which the level of analysis, documentation, and actions necessary to comply with a requirement are commensurate with 1) the relative importance to safety, safeguards, and security; 2) the magnitude of any hazard involved; 3) the life cycle stage of a facility; 4) the programmatic mission of a facility; 5) the particular characteristics of a facility; and 6) any other relevant factor.

greater than Category 3 (GTC3) low-level waste – Low-level radioactive waste that exceeds the maximum radionuclide concentrations as defined for Category 3 low-level waste. See also Category 3 waste.

(a) WAC 232-12-297. "Endangered, threatened, and sensitive wildlife species classification." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=232-12-297.

Hanford Federal Facility Agreement And Consent Order – See Tri-Party Agreement.

hazardous waste – Waste that contains chemically hazardous constituents regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA), as amended (40 CFR 261[a]) and regulated as a hazardous waste and/or mixed waste by the EPA. May also include solid waste designated by Washington State in WAC 173-303-070[(b)] through WAC 173-303-100 as dangerous or extremely hazardous waste, or mixed waste. See also mixed low-level waste.

high-integrity container (HIC) – A container that provides additional confinement for high-activity low-level waste, typically constructed of concrete or other durable material.

high-level (radioactive) waste (HLW) – High-level waste is the highly radioactive waste material resulting from the processing of spent nuclear fuel, including liquid waste produced directly in processing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require isolation.

immobilization – Placing the waste within a material such as concrete or a glass to immobilize (reduce dispensability and leachability of) the radioactive or hazardous components within the waste. See also stabilization.

immobilized low-activity waste – A specific mixed waste stream resulting from the immobilization of low-activity waste (LAW) generated during the planned treatment and immobilization of Hanford tank wastes in the Waste Treatment and Immobilization Plant (WTP) or in other supplemental treatment processing of tank wastes. Most of the non-radioactive materials in the tank waste will be separated into the LAW stream, while most of the radioactive materials will be separated into a much smaller amount of high-level waste (HLW).

lacustrine – Of or pertaining to lakes.

land-use designations:

Industrial-Exclusive – An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, non-radioactive wastes, and related activities.

Conservation (Mining) – An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining (for example, quarrying for sand, gravel, basalt, and topsoil for governmental purposes only) could occur as a special use (i.e., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. This designation includes related activities.

(a) 40 CFR 261. "Identification and Listing of Hazardous Waste." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr261_01.html.

(b) WAC 173-303. *Dangerous Waste Regulations*. Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=chapterdigest&chapter=173-303.

latent cancer fatality (LCF) – A cancer death postulated to result from, and occurring some time after, exposure to ionizing radiation or other carcinogens.

As applied to populations, the postulated number of fatal cancers in a given population due to the calculated or measured collective dose to that population as a result of a given action or activity.

As applied to individuals, the probability of a fatal cancer in a given individual due to the calculated or measured dose received by that individual as a result of a given action or activity.

leachate – As applied to mixed low-level waste trenches, any liquid, including any suspended components in the liquid, that has percolated through or drained from hazardous waste.

lost workday cases (LWCs) – Represent the number of cases recorded resulting in days away from work or days of restricted work activity, or both, for affected employees.

lost workdays (LWDs) – The total number of workdays (consecutive or not), after the day of injury or onset of illness, during which employees were away from work or limited to restricted work activity because of an occupational injury or illness.

low-activity waste – The waste that remains after separating from high-level waste as much of the radioactivity as practicable and that when solidified may be disposed of as low-level waste in a near surface facility according to DOE requirements.

low-income person – A person living in a household that reports an annual income less than the United States official poverty level, as reported by the U.S. Census Bureau.

low-level (radioactive) waste (LLW) – Radioactive waste, including accelerator-produced waste, that is not high-level waste, spent nuclear fuel, transuranic waste, byproduct material (as defined in section 11e[2] of the Atomic Energy Act of 1954, as amended), or naturally occurring radioactive material.

macroencapsulation – Treatment method applicable to debris wastes as defined by RCRA. Refers to application of surface coating materials, such as polymeric organics (for example, resins and plastics) or of a jacket of inert material to reduce surface exposure to potential leaching media.

maximally exposed individual (MEI) – The maximally exposed individual is a hypothetical person who has a lifestyle, and is in a location, such that that any other individual would be unlikely to receive a higher exposure to radiation or hazardous materials. The MEI may be an individual who resides or works near the Hanford Site, or who is temporarily at a publicly accessible location where the maximum dose from a short-term event would occur.

Microbiotic (cryptogamic) crusts – generally occur in the top 1 to 4 mm of soil and are formed by living organisms and their by-products, creating a crust of soil particles bound together by organic materials.

microencapsulation – The encapsulation of waste components in the atomic structure of compounds or materials such as glass, cement, or polymer waste forms.

minority – Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

mixed low-level waste (MLLW) – Low-level waste determined to contain both source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954, as amended, and a hazardous component subject to the Resource Conservation and Recovery Act (RCRA), as amended, or state dangerous waste regulations. See also hazardous waste, dangerous waste.

modular facility – As used in this HSW EIS, a modular disposal facility would consist of a number of expandable segments or areas within an overall master facility. Each module would be designed to handle certain waste types or forms. For example remote handled wastes might be in a different area or "module" than standard packages of contact handled low-level waste or mixed low-level waste.

neutralization – Changing the pH of a solution to near 7 by adding an acidic or basic material.

no action alternative – In this EIS, the no action alternative consists of continuing ongoing activities, but does not include development of new capabilities to manage wastes that cannot currently be disposed of.

noise – Sound waves that are unwanted and perceived as a nuisance by humans.

non-standard (packaging) – Non-standard waste packages refer to specially designed waste containers or packages used for large, or odd shaped low-level waste, mixed low-level waste or transuranic waste items or items with high dose rates or other unique conditions. See also standard (packaging).

normal operations – As used in this HSW EIS, normal operations refers to routine waste management activities, for example, waste treatment activities (including processing), packaging and repackaging, storage, and final disposal of waste.

order of magnitude – An order of magnitude is an exponential change of plus-or-minus 1 in the value of a quantity or unit. The term is generally used in conjunction with power-of-10 scientific notation.

operational waste – Solid wastes that are generated in support of cleanup activities, including such items as contaminated personnel protective clothing, disposable laboratory supplies, and failed tools and equipment.

physical extraction – Separation or removal of materials or components based on size or material characteristic.

PM_{10} – Particulates with an aerodynamic diameter less than or equal to a nominal diameter of 10 micrometers.

$PM_{2.5}$ – Particulates with an aerodynamic diameter less than or equal to a nominal diameter of 2.5 micrometers.

pore water – The amount of water effectively trapped or retained by a volume of soil.

processing – As used in this HSW EIS, refers to any activity necessary to prepare waste for disposal. Processing waste may consist of repackaging, removal, or stabilization of non-conforming waste, or treatment of physically or chemically hazardous constituents in compliance with state or federal regulations.

radioactive waste – In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or by-product material is subject to regulation as radioactive waste under the Atomic Energy Act. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

release – Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment. Statutory or regulatory definitions of release may differ.

remedial action – Activities conducted to reduce potential risks to people and/or harm to the environment from radioactive and/or hazardous substance contamination. (See also cleanup.)

remote-handled (RH) waste – Packaged radioactive waste for which the external dose rate exceeds that defined for contact-handled waste (generally 200 mrem/hr at the container surface). These wastes require handling using remotely controlled equipment, or placement in shielded containers, to reduce the potential for human exposures during routine waste management activities. See also contact-handled waste.

retrievably stored waste – Waste stored in a configuration that is intended to permit retrieval at a future time.

review 1 species – A plant taxon of potential concern that is in need of additional field work before a status can be assigned.

shrub-steppe – Plant community consisting of short-statured, widely spaced, small-leaved shrubs, sometimes aromatic, with brittle stems and an understory dominated by perennial bunchgrasses.

sensitive species – A taxon that is vulnerable or declining and could become endangered or threatened in Washington without active management or removal of threats. The federal listings classify species as listed (endangered/threatened), candidate, or proposed.

seep – 1) On the Columbia River, seepage occurs below the river surface and exposed riverbank, particularly noticeable at low-river stage. The seeps flow intermittently, apparently influenced primarily by changes in the river level. 2) "Seeps" also corresponds to releases of radionuclides and chemicals to the unsaturated soil beneath the LLBGs that may occur as the waste packages degrade and water (from rain and snow melt) “seeps” through the waste.

site – A geographic entity comprising leased or owned land, buildings, and other structures required to perform program activities.

species of concern – Plants identified by the Washington Natural Heritage Program as sensitive (vulnerable or declining and could become endangered or threatened), Review 1 (more field work needed), or Review 2 (unresolved taxonomic problems). See also endangered species and threatened species. The federal listings classify species as listed (endangered/threatened), candidate, or proposed.

stabilization – Mixing an agent such as Portland cement with the waste to increase the mechanical strength of the resulting waste form and decrease its leachability.

standard (packaging) – Standard waste packages refer to the common forms of waste packages (such as drums and boxes) used for low-level waste and mixed low-level waste. See also non-standard (packaging).

stochastic analysis – Set of calculations performed using values randomly selected from a range of reasonable values for one or more parameters; in contrast, see deterministic analysis. In the HSW EIS, the median value was reported.

stochastic variability – Natural variation of a measured quantity; for example, in a room full of people, there is an average height with some being taller and some shorter; the stochastic variability of that group is described by the differences between the individuals’ heights and the average.

storage – The holding of waste for a temporary period, at the end of which the waste is treated, disposed of, or stored elsewhere.

taxa – Plural of taxon.

taxon – A group of organisms sharing common characteristics in varying degrees of distinction that constitute one of the categories of taxonomic classification, such as a phylum, class, order, family, genus, or species.

TEEL-1 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

TEEL-2 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

TEEL-3 – The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

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 which 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[a]). Washington State defines threatened species as any wildlife species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state (WAC 232-12-297[b]). See also candidate species and endangered species.

teleost fish – Of or belonging to the Teleostei or Teleostomi, a large group of fishes with bony skeletons, including most common fishes. The teleosts are distinct from the cartilaginous fishes such as sharks, rays, and skates.

total recordable cases (TRCs) – Work-related deaths, illnesses, or injuries resulting in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid.

Toxic Substances Control Act (TSCA) waste – Any waste, including polychlorinated byphenyl commingled waste, regulated under the TSCA requirements codified in 40 CFR 761.[c]

toxicological impact – Impact on human health, due to exposure to, or intake of, chemical materials. These impacts are typically described in terms of damage to affected organs.

transuranic isotope – Any element having an atomic number greater than 92 (the atomic number of uranium).

transuranic (TRU) waste – Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for the following:

(a) 50 CFR 424. "Listing Endangered and Threatened Species and Designating Critical Habitat." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/50cfr424_01.html.

(b) WAC 232-12-297. "Endangered, threatened, and sensitive wildlife species classification." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=232-12-297.

(c) 40 CFR 761. "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, and Use Prohibitions." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr761_01.html.

- high-level radioactive waste
- waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations

waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.[a]

Tri-Party Agreement (TPA) – Informal title for the "Hanford Federal Facility Agreement and Consent Order," an agreement between the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology. The agreement establishes milestones to bring operating DOE facilities into compliance with the RCRA, and to coordinate cleanup of Hanford's inactive disposal sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

treatment – The physical, chemical, or biological processing of dangerous waste to make such waste non-dangerous or less dangerous, safer for transport, amenable for energy or material resource recovery, amenable for storage, or reduced in volume, with the exception of compacting, repackaging, and sorting as allowed under WAC 173-303-400[b] and 173-303-600.[b]

trench grouting – In-trench grouting involves placing the waste on a cement pad or on spacers, installing reinforcement steel and forms around the waste, and covering the waste with fresh concrete to encapsulate the waste within a concrete barrier.

vadose zone – The soil layer between the ground surface and the top of the saturated zone.

waste characterization – The identification of waste composition and properties, whether by review of process knowledge, or by non-destructive examination, non-destructive assay, or sampling and analysis, to determine appropriate storage, treatment, handling, transportation, and disposal requirements.

waste certification – A process by which a waste generator certifies that a given waste or waste stream meets the waste acceptance criteria of the facility to which the generator intends to transfer waste for treatment, storage, or disposal.

(a) 10 CFR 61. "Licensing Requirements for Land Disposal of Radioactive Waste." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_02/10cfr61_02.html.

(b) WAC 173-303. "Dangerous Waste Regulations." Washington Administrative Code. Olympia, Washington. Online at: http://www.mrsc.org/mc/wac/WAC%20173%20%20TITLE/WAC%20173%20-303%20%20CHAPTER/WAC%20173%20-303%20-400.htm.

waste container – Any portable device in which a material is stored, transported, treated, disposed, or otherwise handled (WAC 173-303-040[(a)]). A waste container may include any liner or shielding material that is intended to accompany the waste in disposal. At Hanford, waste containers typically consist of 55-gal (208-L) or 85-gal (320-L) drums and standard waste boxes. Other sizes and styles of containers may also be employed depending on the physical, radiological, and chemical characteristics of the waste.

waste disposal – See disposal.

waste life cycle – The life of a waste from generation through storage, treatment, transportation, and disposal.

waste stream – A waste or group of wastes from a process or a facility with similar physical, chemical, or radiological properties. In the context of this document, a waste stream is defined as a collection of wastes with physical and chemical characteristics that will generally require the same management approach (that is, use of the same storage, treatment, and disposal capabilities).

waste type – In the context of this document, three waste types managed by the solid waste program are defined: low-level waste, mixed low-level waste, transuranic waste, and waste treatment plant waste (ILAW and melters).

Watch List species – A category of plant species of concern as identified by the Washington Natural Heritage Program. Watch List species consist of those plant taxa of concern that are more abundant and/or less threatened than previously assumed.

(a) WAC 173-303040. "Dangerous Waste Regulations." Washington Administrative Code, Olympia, Washington. Online at: http://www.mrsc.org/mc/wac/WAC%20173%20%20TITLE/WAC%20173%20-303%20%20CHAPTER/WAC%20173%20-303%20-400.htm.

Glossary of Terms Related to Radioactivity, Radiation Dose, and Exposure

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absorbed dose – The energy absorbed by matter from ionizing radiation per unit mass of irradiated material at the place of interest in that material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

becquerel (Bq) – A unit of radioactivity equal to 1 disintegration per second. See also curie.

collective dose – The sum of the total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem (or person-sievert).

committed dose equivalent – The dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert).

committed effective dose equivalent – The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

curie (Ci) – A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity. See also becquerel.

dose (radiological) – A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, or total effective dose equivalent, as defined elsewhere in this glossary.

dose equivalent – The product of absorbed dose in rad (or gray) in tissue, a quality factor, and other modifying factors. Dose equivalent is expressed in units of rem (or sievert).

effective dose equivalent – The summation of the products of the dose equivalent received by specified tissues of the body and the appropriate weighting factor. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rem (or sievert).

external dose or exposure – That portion of the dose equivalent received from radiation sources outside the body (i.e., “external sources”).

half-life (radiological) – The time in which one-half of the atoms of a specific radionuclide decay into another nuclear form or energy state. Half-lives for different radionuclides range from fractions of a second to billions of years.

gray – The SI (International System of Units) unit of absorbed dose. One gray (Gy) is equal to an absorbed dose of 1 joule/kg (1 Gy = 100 rads). (The joule in the SI unit of energy, abbreviated as J.) (See also rad.)

internal dose or exposure – That portion of the dose equivalent received from radioactive material taken into the body (i.e., "internal sources").

millirem (mrem) – A subunit of a rem. One mrem equals 1/1000th (0.001) of a rem. See also sievert.

person-rem – Unit of collective total effective dose equivalent.

quality factor – The principal modifying factor used to calculate the dose equivalent from the absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate quality factor. The quality factors to be used for determining dose equivalent in rem are shown in the following table:

Quality Factors[a]

Radiation type	Quality factor
X-rays, gamma rays, positrons, electrons (including tritium beta particles)	1
Neutrons, ≤ 10 keV	3
Neutrons, > 10 keV	10
Protons and singly-charged particles of unknown energy with rest mass greater than one atomic mass unit	10
Alpha particles and multiple-charged particles (and particles of unknown charge) of unknown energy	20

When spectral data are insufficient to identify the energy of the neutrons, a quality factor of 10 shall be used.

(ii) When spectral data are sufficient to identify the energy of the neutrons, the following mean quality factor values may be used:

Quality Factors for Neutrons

[Mean quality factors, Q (maximum value in a 30-cm dosimetry phantom), and values of neutron flux density that deliver in 40 hours, a maximum dose equivalent of 100 mrem (0.001 sievert).]

Neutron energy (MeV)	Mean quality factor	Neutron flux density (cm^2s^{-1})
2.5×10^{-8} thermal	2	680
1×10^{-7}	2	680
1×10^{-6}	2	560
1×10^{-5}	2	560
1×10^{-4}	2	580
1×10^{-3}	2	680
1×10^{-2}	2.5	700
1×10^{-1}	7.5	115
5×10^{-1}	11	27
1	11	19
2.5	9	20
5	8	16
7	7	17
10	6.5	17
14	7.5	12
20	8	11
40	7	10
60	5.5	11
1×10^{2}	4	14
2×10^{2}	3.5	13
3×10^{2}	3.5	11
4×10^{2}	3.5	10

(a) Source: 10 CFR 835.

rad – A unit of radiation absorbed dose (such as, in body tissue). One rad is equal to an absorbed dose of 0.01 joule/kg (1 rad = 0.01 gray). See also gray.

radiation – Ionizing radiation such as alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions.

radioactive decay – The decrease in the amount of any radioactive material with the passage of time, due to spontaneous nuclear disintegration (i.e., emission from atomic nuclei of charged particles, photons, or both).

radioactivity – The property or characteristic of radioactive material to spontaneously "disintegrate" or "decay" with the emission of energy in the form of radiation. The unit of radioactivity is the curie (or becquerel).

rem – The special unit of radiation effective dose equivalent (1 rem = 0.01 Sievert). See also sievert.

roentgen (R) – The special unit of X- or gamma- radiation exposure. One roentgen equals 2.58×10^{-4} coulombs per kilogram of air.

sievert (Sv) – The SI (International System of Units) unit of radiation effective dose equivalent (1 Sv = 100 rem). See also **rem**.

total effective dose equivalent (TEDE) – The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). Total effective dose equivalent is expressed in units of rem (or sievert).

weighting factor – The fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to a specific tissue. The dose equivalent to each tissue is multiplied by the appropriate weighting factor to obtain the effective dose equivalent contribution from that tissue. The weighting factors are as follows:

Weighting Factors For Various Tissues[a]

Organs or tissues	Weighting factor
Gonads	0.25
Breasts	0.15
Red bone marrow	0.12
Lungs	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder[b]	0.30
Whole body[c]	1.00

(a) Source: 10 CFR 835.
(b) "Remainder" means the five other organs or tissues with the highest dose (for example, liver, kidney, spleen, thymus, adrenal, pancreas, stomach, small intestine, and upper large intestine). The weighting factor for each remaining organ or tissue is 0.06.
(c) For the case of uniform external irradiation of the whole body, a weighting factor equal to 1 may be used in determination of the effective dose equivalent.

Units of Measure

The principal units of measurement used in this Environmental Impact Statement (EIS) are SI units, an abbreviation for the International System of units, a metric system accepted by the International Organization of Standardization as the legal standard at a meeting in Elsinore, Denmark, in 1966. In this system, most units are made up of combinations of six basic units, of which length in meters, mass in kilograms, and time in seconds are of most importance in the EIS. The exception is radiological units that use the English system (e.g., rem, millirem).

Numerical (Scientific or Exponential) Notation

Numbers that are very small or very large are often expressed in scientific or exponential notation as a matter of convenience. For example, the number 0.000034 may be expressed as 3.4×10^{-5} or 3.4E-05 and 65,000 may be expressed as 6.5×10^{4} or 6.5E+04. In the EIS, numerical values less than 0.001 or greater than 9999 are generally expressed in exponential notation, or 1.0E-03 and 9.9E+03, respectively.

Multiples or sub-multiples of the basic units are also used. A partial list of prefixes that denote multiples and sub-multiples follows, with the equivalent multiplier values expressed in scientific and exponential notation:

Name	Symbol	Value Multiplied by:		
atto	a	0.000000000000000001	or 1×10^{-18}	or 1E-18
femto	f	0.000000000000001	or 1×10^{-15}	or 1E-15
pico	p	0.000000000001	or 1×10^{-12}	or 1E-12
nano	n	0.000000001	or 1×10^{-9}	or 1E-09
micro	µ	0.000001	or 1×10^{-6}	or 1E-06
milli	m	0.001	or 1×10^{-3}	or 1E-03
centi	c	0.01	or 1×10^{-2}	or 1E-02
kilo	k	1,000	or 1×10^{3}	or 1E+03
mega	M	1,000,000	or 1×10^{6}	or 1E+06
giga	G	1,000,000,000	or 1×10^{9}	or 1E+09
tera	T	1,000,000,000,000	or 1×10^{12}	or 1E+12

The following symbols are occasionally used in conjunction with numerical expressions:

< less than

≤ less than or equal to

> greater than

≥ greater than or equal to

Basic Units and Conversion Table

Unit of Measure	English Unit	Symbol	Metric Unit	Symbol
Length	inches	in	centimeters	cm
	feet	ft	meters	m
	yards	yd	kilometers	km
	miles	mi		
Area	square feet	ft^2	square meters	m^2
	acres	ac	hectares	ha
	square miles	mi^2	square kilometers	km^2
Volume (dry)	cubic feet	ft^3	cubic meters	m^3
	cubic yards	yd^3		
Volume (liquid)	gallons	gal	liters	L
Mass	ounces	oz	grams	g
	pounds	lb	kilograms	kg
Concentration	parts per million	ppm	grams per liter	g/L
Radioactivity	curies	Ci	becquerels	Bq
Radiation Absorbed Dose	rad	rad	Gray	Gy
Radiation Effective Dose Equivalent	rem	rem	Sievert	Sv
Temperature	degrees Fahrenheit	°F	degrees Centigrade	°C

Base Unit	Multiply By	To Obtain	Base Unit	Multiply By	To Obtain
in	2.54	cm	cm	0.394	in
ft	0.305	m	m	3.28	ft
yd	0.914	m	m	1.09	yd
mi	1.61	km	km	0.621	mi
ft^2	0.093	m^2	m^2	10.76	ft^2
ac	0.405	ha	ha	2.47	ac
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.3	ft^3
yd^3	0.765	m^3	m^3	1.31	yd^3
gal	3.77	L	L	0.265	gal
oz	28.349	g	g	0.035	oz
lb	0.454	kg	kg	2.205	lb
ppm	0.001	g/L	g/L	1000	ppm
Ci	3.7×10^{10}	Bq	Bq	2.7×10^{-11}	Ci
rad	0.01	Gy	Gy	100	rad
rem	0.01	Sv	Sv	100	rem
°F	(°F - 32) x 5/9	°C	°C	(°C x 9/5) + 32	°F

Radionuclide Nomenclature[a,b]

Symbol	Radionuclide	Half-Life	Symbol	Radionuclide	Half-Life
Ac-227*	actinium-227	22 yr	Pu-240	plutonium-240	6537 yr
Ag-110m	silver-110m	250 d	Pu-241	plutonium-241	14 yr
Am-241	americium-241	432 yr	Pu-242	plutonium-242	3.7×10^{5} yr
Ba-137m	barium-137m	2.6 min	Pu-244	plutonium-244	8.1×10^{7} yr
Be-7*	beryllium-7	53 d	Ra-224*	radium-224	3.7 d
Bi-212*	bismuth-212	61 min	Ra-226*	radium-226	1600 yr
Bi-214*	bismuth-214	20 min	Ra-228*	radium-228	5.8 yr
C-14*	carbon-14	5730 yr	Rb-87*	rubidium-87	4.8×10^{10} yr
Cd-113m*	cadmium-113m	15 yr	Rh-106	rhodium-106	30 sec
Ce-144	cerium-144	285 d	Ru-106	ruthenium-106	374 d
Cl-36	chlorine-36	3.0×10^{5} yr	Sb-125	antimony-125	2.8 yr
Cm-244	curium-244	18 yr	Sb-126m	antimony-126m	11 sec
Co-60	cobalt-60	5.3 yr	Se-75	selenium-75	120 d
Cs-137	cesium-137	30 yr	Se-79	selenium-79	6.5×10^{5} yr
Eu-152	europium-152	14 yr	Sm-147*	samarium-147	1.1×10^{11} yr
Eu-154	europium-154	8.6 yr	Sm-151	samarium-151	90 yr
Eu-155	europium-155	4.8 yr	Sn-126	tin-126	1.0×10^{5} yr
Fe-55	iron-55	2.7 yr	Sr-90	strontium-90	29 yr
H-3*	tritium	12 yr	Tc-99	technetium-99	2.1×10^{5} yr
I -125	iodine-125	59 d	Th-228*	thorium-228	1.9 yr
I -129	iodine-129	1.6×10^{7} yr	Th-229	thorium-229	7880 yr
K-40*	potassium-40	1.3×10^{9} yr	Th-230*	thorium-230	7.5×10^{4} yr
Mn-54	manganese-54	312 d	Th-232*	thorium-232	1.4×10^{10} yr
Mo-93	molybdenum-93	4000 yr	Th-234*	thorium-234	24 d
Nb-94	niobium-94	2.0×10^{4} yr	U-232	uranium-232	69 yr
Ni-59	nickel-59	7.6×10^{4} yr	U-233	uranium-233	1.6×10^{5} yr
Ni-63	nickel-63	100 yr	U-234*	uranium-234	2.5×10^{5} yr
Np-237	neptunium-237	2.1×10^{6} yr	U-235*	uranium-235	7.0×10^{8} yr
Pa-231*	protactinium-231	3.3×10^{4} yr	U-236	uranium-236	2.3×10^{7} yr
Pb-210*	lead-210	22 yr	U-238*	uranium-238	4.5×10^{9} yr
Pb-212*	lead-212	11 hr	W-185	tungsten-185	75 d
Pd-107	palladium-107	6.5×10^{6} yr	Y-90	yttrium-90	2.7 d
Pr-144	praseodymium-144	17 m	Zn-65	zinc-65	244 d
Pu-238	plutonium-238	88 yr	Zr-93	zirconium-93	1.5×10^{6} yr
Pu-239	plutonium-239	2.4×10^{4} yr	Zr-95	zirconium-95	64 d

(a) From *CRC Handbook of Chemistry and Physics*. 74th edition. ed. David R. Lide, CRC Press, Boca Raton, Florida 1993.
(b) Listing includes radionuclides evaluated in this document. Metastable isomers are indicated by the addition of an *m*. Short-lived decay products are not shown.
* Indicates naturally occurring radionuclides.

Reference Citations

Throughout the text of this document, in-text reference citations are presented where information from the referenced document was used. These in-text reference citations are contained within parentheses and provide a brief identification of the referenced document. This brief identification corresponds to the complete reference citation located in the reference lists, which are located at the end of each section and appendix in the HSW EIS. The references are listed in alphabetical or numeric order and not the order of their appearance in the text.

An example of an in-text reference citation is (DOE 1997a), which corresponds to the complete reference citation provided in section or appendix reference lists. In the reference list, DOE 1997a, DOE 1997b, and DOE 1997c are listed in the following manner (based on the alphabetical order of the document title, not the order in which they might appear in the text):

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

DOE. 1997b. *Integrated Data Base Report – 1996: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics*. DOE/RW-0006, Rev. 13, U.S. Department of Energy, Office of Environmental Management, Washington, D.C.

DOE. 1997c. *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement.* DOE/EIS-0026-S-2, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, New Mexico.

1.0 Introduction

This revised draft *Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement* (HSW EIS) provides environmental and technical information concerning the U.S. Department of Energy's (DOE's) ongoing and proposed waste management practices at the Hanford Site in Washington state. The draft HSW EIS was initially issued in April 2002 for public comment (DOE 2002b). The HSW EIS updates previous environmental analyses prepared for waste management operations at the Hanford Site. It also addresses local decisions related to implementing decisions resulting from the Waste Management Programmatic EIS (WM PEIS, DOE 1997c). This revised draft HSW EIS has been issued to address new waste management alternatives that have been proposed since the initial draft HSW EIS was prepared. It also addresses comments received during the public review period for the first draft. As a result of those comments and other considerations, DOE decided to prepare this revised draft HSW EIS, which incorporates alternatives for disposal of immobilized low-activity waste (ILAW) from the treatment of Hanford Site tank waste in the waste treatment plant (WTP) currently under construction, an activity that was not included in the first draft (68 FR 7110).

This revised draft HSW EIS describes the environmental consequences of alternatives for constructing, modifying, and operating facilities to store, treat, and/or dispose of low-level (radioactive) waste (LLW), transuranic (TRU) waste, ILAW, and mixed low-level waste (MLLW) including WTP melters at Hanford. In addition, the potential long-term consequences of LLW, MLLW, and ILAW disposal on groundwater and surface water are evaluated for a 10,000-year period, although the DOE performance standards only require assessment for the first 1000 years after disposal (DOE 2001g). This document does not address non-radioactive waste that contains "hazardous" or "dangerous" waste, as defined under the Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901) and Washington State Dangerous Waste regulations (WAC 173-303). Following a previous National Environmental Policy Act (NEPA, 42 USC 4321) review (DOE 1997d), DOE decided to dispose of TRU waste in New Mexico at the Waste Isolation Pilot Plant (WIPP), a repository that meets the requirements of 40 CFR 191 (63 FR 3623). This HSW EIS is being prepared in accordance with NEPA, the DOE implementing procedures for NEPA (10 CFR 1021), and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508).

1.1 Organization of the HSW EIS

The organization and content of this revised draft HSW EIS are described briefly as follows:

- **Section 1.0 – Introduction**: Provides an introduction, organization of the EIS, a statement of the purpose and need for DOE action and description of the proposed action, an overview of Hanford Site cleanup operations including solid radioactive and mixed waste management activities, a discussion of related DOE programs and documents including Hanford's accelerated cleanup performance management plan, NEPA documents related to the HSW EIS, and the NEPA process for developing and finalizing the HSW EIS.

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- **Section 2.0 – HSW EIS Waste Streams and Waste Management Facilities**: Describes Hanford waste management operations, waste types, waste streams, existing facilities, and proposed facilities related to the proposed action and alternatives.

- **Section 3.0 – Description and Comparison of Alternatives**: Describes alternative actions that could be taken at Hanford to manage solid radioactive and mixed waste (waste that contains both radioactive and hazardous constituents), including alternative management strategies for each waste type, and the No Action Alternative. This section also provides a comparison of environmental impacts among the alternatives.

- **Section 4.0 – Affected Environment**: Discusses the human and physical environment that might be affected by radioactive and mixed waste management operations at Hanford.

- **Section 5.0 – Environmental Consequences**: Identifies the potential impacts on the human and physical environment that might result from implementation of the alternatives for waste management at Hanford. This section also addresses environmental justice, cumulative impacts, irreversible and irretrievable commitment of resources, the relationship between short-term uses of the environment and the maintenance or enhancement of long-term productivity, and potential mitigation measures.

- **Section 6.0 – Regulatory Framework**: Identifies regulations and permits that apply to radioactive and mixed waste management operations at Hanford.

- **Section 7.0 – List of Preparers and Contributors**: Identifies key persons who contributed to the preparation of the HSW EIS.

- **Index –** Provides an alphabetized list of key names, terms, and subjects in this EIS and the sections in which each item is mentioned.

- **Vol. II Appendixes –** Provide additional information regarding specific sections of the EIS and discusses key issues identified during the scoping process for the ILAW SEIS.

- **Vol. III Comment-Response Document –** explains DOE's role in the cleanup process at Hanford; discusses key issues raised during the public comment process and responses to those key issues, including changes incorporated into this revised draft HSW EIS; and presents over 3800 comments from federal agencies; State, local, and tribal governments; public and private organizations; and individuals; and DOE's response to each comment.

1.2 Purpose and Need and Proposed Action

DOE needs to provide capabilities to continue, or modify, the way it treats, stores, and/or disposes of existing and anticipated quantities of solid LLW, MLLW, TRU waste, and ILAW at the Hanford Site in order to protect human health and the environment; facilitate cleanup at Hanford and other DOE facilities; take actions consistent with decisions reached by DOE under the WM PEIS; comply with local, State, and

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To address anticipated needs for waste management capabilities, DOE proposes to do the following:

- continue to operate existing treatment, storage, and disposal facilities for LLW and MLLW, and treatment and storage facilities for TRU waste
- construct additional disposal capacity for LLW
- develop capabilities to treat MLLW
- construct additional disposal capacity for MLLW
- construct disposal capacity for ILAW and WTP melters
- close onsite disposal facilities and provide for post-closure stewardship of disposal sites
- develop additional capabilities to certify TRU waste for disposal at WIPP.

Alternatives proposed to accomplish the purpose and need are described in Section 3. The No Action Alternative is also evaluated as required by NEPA. For purposes of analysis in this HSW EIS, the No Action Alternative is defined as continuing ongoing activities, or as implementing previous NEPA decisions where those activities have not commenced.

1.3 Overview of Hanford Site Operations and DOE Waste Management Activities

The Hanford Site occupies approximately 1517 km^2 (586 mi^2), principally in Benton and Franklin counties of south-central Washington state (Figure 1.1). The Columbia River flows through the northern and eastern parts of the site, which extends about 46 km (25 mi) north from Richland, Washington.

DOE and its predecessors, the Manhattan Project, the U.S. Atomic Energy Commission (AEC), and the U.S. Energy Research and Development Administration (ERDA), have operated the Hanford Site since the 1940s. From the beginning through the 1980s, the primary mission at Hanford was to produce nuclear materials in support of United States defense, research, and biomedical programs. Operations associated with those programs used facilities for fabrication of nuclear reactor fuel, reactors for nuclear materials production, chemical separation plants, nuclear material processing facilities, research laboratories, and waste management facilities. Plutonium production at Hanford has ceased, and DOE activities at the site currently include research, environmental restoration, and waste management. Additional historical information regarding the Hanford Site is available on the Internet at http://www.hanford.gov.

In addition to the DOE activities at Hanford, there are several facilities operated by other agencies at the site. The Laser Interferometer Gravitational Wave Observatory (LIGO) is an advanced scientific observatory for measuring gravity waves at extremely low levels. The project involves the California Institute of Technology, the Massachusetts Institute of Technology, and the National Science Foundation. The Hanford Site was selected for the LIGO because of its available space and seismic stability. A federal laws and regulations; and meet other obligations such as the Hanford Federal Facility Agreement and Consent Order (also referred to as the Tri-Party Agreement, or TPA) (Ecology et al. 1989).

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Figure 1.1. Hanford Site Location Map

commercial nuclear power plant, the Columbia Generating Station, also operates within the Hanford Site. That facility is located on property leased to Energy Northwest, a consortium of regional public utilities.

The largest non-DOE federal agency at Hanford is the U.S. Fish and Wildlife Service, which co-manages with DOE the 195,000-acre Hanford Reach National Monument, which was established by presidential proclamation on June 9, 2000. The monument includes the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE), Saddle Mountain Wildlife Refuge, Wahluke Slope, White Bluffs, the sand dune area northwest of the Energy Northwest Site, historic structures (including homesteads from small towns established along the riverbanks in the early 20^{th} century), and land 0.4 km (¼ mi) inland on the south and west shores of the 82-km (51-mi) long Hanford Reach, the last free-flowing, non-tidal stretch of the Columbia River. Also included were the McGee Ranch and Riverlands area and the federally owned islands within that portion of the Columbia River.

US Ecology, Inc. operates a commercial low-level radioactive waste disposal facility on 40.5 hectares (100 acres) of the Hanford Site near the 200 East Area leased by Washington State from DOE. The facility is licensed by the U.S. Nuclear Regulatory Commission (NRC) and the State of Washington, not DOE. The US Ecology facility is one of three commercial LLW disposal facilities in the United States. It currently accepts waste from two state compacts established to manage radioactive waste from nuclear power plants and other commercial facilities: the Northwest Compact (Washington, Idaho, Oregon, Montana, Wyoming, Utah, Alaska, and Hawaii) and the Rocky Mountain Compact (Colorado, Nevada, and New Mexico). Waste is received from hospitals, universities, research facilities, commercial nuclear power operations, and other industries within the compact states. The reactor vessel from the Trojan plant, a commercial nuclear power reactor in Oregon, was buried at the site during 2000. Of the total waste receipts at the facility between 1996 and 2001, the state of Oregon accounted for the largest share by volume (65%) and by radioactivity (95%).

1.3.1 DOE National Waste Management

When DOE established the Office of Environmental Management (EM) in 1989, it defined cleanup of DOE sites as a top priority and committed itself to addressing the challenges of waste management. EM is responsible for waste management activities at all DOE sites, including Hanford, and needs to address them on a nationwide basis. This section provides an overview of DOE nationwide plans for management of radioactive and hazardous waste, including waste from the Hanford Site. The nationwide distribution of sites that dispose of one or more types of DOE radioactive waste are shown in Figure 1.2. The DOE nationwide strategy for managing radioactive, hazardous, and mixed waste is provided by the WM PEIS (DOE 1997c) and associated Records of Decision (RODs) (63 FR 3629, 63 FR 41810, 64 FR 46661, 65 FR 10061, 65 FR 82985, 66 FR 38646, 67 FR 56989). Other NEPA documents related to those activities are discussed in Section 1.5.

1.3.1.1 Spent Nuclear Fuel and High-Level Waste

DOE is required by *The Nuclear Waste Policy Act of 1982*, as amended (42 USC 10101) to provide disposal capacity for spent nuclear fuel (SNF) generated by commercial nuclear power plants and DOE, as well as high-level waste (HLW) generated by atomic energy defense activities. Spent nuclear fuel is fuel that has been irradiated in a reactor but has not been processed to separate potentially useful materials. High-level waste consists of certain process residues (liquids, solids, or sludges) that result from processing irradiated reactor fuel to recover plutonium and uranium. DOE sites that currently manage HLW and spent nuclear fuel are in the process of stabilizing and storing those materials until a permanent disposal facility is available. DOE is planning to develop a geologic repository at Yucca Mountain in Nevada for disposal of DOE and commercial spent nuclear fuel and HLW from processing of defense materials production reactor fuel (DOE 2002d). The repository is scheduled to open around 2010.

> ***Spent Nuclear Fuel (SNF)***
> Fuel that has been irradiated in a nuclear power plant or other reactor. Spent fuel is generally thermally hot and highly radioactive.

> ***High-Level Waste (HLW)***
> High-level waste is the highly radioactive waste material that results from processing of spent nuclear fuel, including liquid waste produced directly in processing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require isolation.

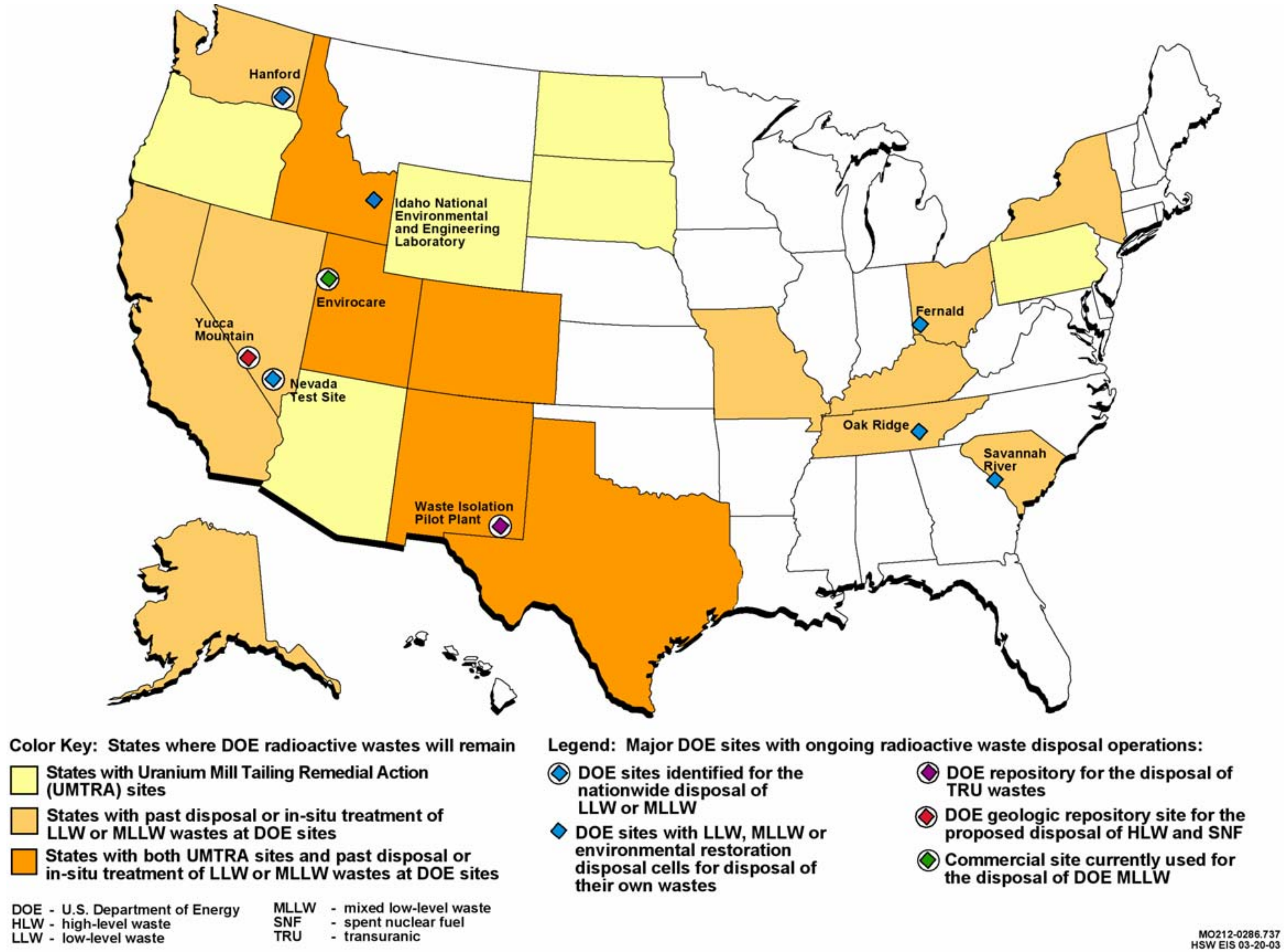

Figure 1.2. States with Radioactive Waste Disposal Activities

1.3.1.2 Transuranic Waste

DOE has a repository for disposal of TRU waste in New Mexico at WIPP. WIPP opened in 1999 and received the first shipments of TRU waste from Hanford in 2000. To date, about 80 m^3 (2800 ft^3) of TRU waste from Hanford have been sent to WIPP. Some TRU waste will also be sent to Hanford for temporary storage from other DOE sites to take advantage of existing and planned capabilities to process and certify TRU waste for disposal at WIPP. All TRU waste sent to Hanford will be shipped to WIPP.

> **Transuranic (TRU) Waste**
>
> Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for the following:
>
> - high-level radioactive waste
> - waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations
> - waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61 (DOE 2001g).

Some TRU waste may also contain hazardous components (mixed TRU waste) and would be managed under applicable state and federal hazardous waste regulations. For purposes of evaluation in the HSW EIS, mixed TRU waste has not been identified as a separate waste type from other TRU waste. DOE's hazardous waste permit for WIPP, issued by the State of New Mexico Environment Department, authorizes disposal of some types of mixed TRU waste.

1.3.1.3 Low-Level Waste and Mixed Low-Level Waste`

DOE plans to continue treating and disposing of LLW and MLLW at facilities that currently have capabilities to manage those wastes (DOE 1997c; 65 FR 10061). Under that ROD, Hanford and the Nevada Test Site (NTS) will continue to receive LLW from other facilities that do not have the capacity to treat or dispose of it. Hanford and NTS were also identified as sites that would treat and dispose of MLLW from other sites. DOE sites also have the option to send waste to commercial disposal facilities, such as Envirocare in Utah. Envirocare received over 56,000 m^3 (2,000,000) of DOE LLW and MLLW between 1993 and 2000 (Envirocare 2000a, b, c). DOE plans to continue shipping some LLW and MLLW to Envirocare. NTS received about 65,000 m^3 (2,300,000 ft^3) of LLW during 2002 and expects to receive an additional 360,000 m^3 (13,000,000 ft^3) through 2006. By comparison, existing forecasts through 2046 indicate that DOE's

> ***Low-Level Waste (LLW)***
>
> Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct material (as defined in Section 11e.(2) of the Atomic Energy Act of 1954, as amended), or naturally occurring radioactive material.

> ***Mixed Low-Level Waste (MLLW)***
>
> Mixed low-level waste is LLW that contains both radionuclides subject to the Atomic Energy Act of 1954, as amended (42 USC 2011), and a hazardous component subject to the Resource Conservation and Recovery Act or Washington State Dangerous Waste Regulations.

Hanford Solid Waste Program could receive up to 220,000 m^3 (7,800,000 ft^3) of LLW and up to 140,000 m^3 (4,900,000 ft^3) of MLLW from offsite DOE generators. Total LLW and MLLW annual volumes from offsite generators are not expected to exceed 45,000 m^3 (1,600,000 ft^3).

The Tank Waste Remediation System (TWRS) EIS summarized formal discussions between DOE and NRC on tank waste classification and how the low-activity portion of the waste might be regulated (DOE and Ecology 1996). Although those consultations were carried out in the context of low-activity waste (LAW) disposal in a grout matrix (Kincaid et al. 1995), the logic was applied to vitrified LAW as well. Based on an NRC published opinion (Bernero 1993; 58 FR 12342), the TWRS EIS analysis concluded that the LAW stream could be classified as incidental waste and subjected to disposal requirements for LLW. A second NRC review subsequent to the TWRS EIS indicated that the vitrified waste form selected in the ROD (62 FR 8693) also would provisionally meet criteria for classification as LAW, based on available information provided at that time (NRC 1997).

Low-Activity Waste (LAW)

Low-activity waste is the waste that remains after separating from high-level waste as much of the radioactivity as practicable, and that when solidified may be disposed of as low-activity waste in a near-surface facility in accordance with DOE requirements (DOE 2001g).

Immobilized Low-Activity Waste (ILAW)

Immobilized low-activity waste is the solidified low-activity waste from the treatment and immobilization of Hanford tank waste. The ILAW would be disposed of on the Hanford Site or at a qualified offsite facility.

1.3.2 DOE Waste Management Activities at Hanford

Waste generated by past Hanford Site activities contains a variety of radionuclides and non-radioactive hazardous constituents. Those materials range from highly radioactive wastes that must be managed in specialized facilities to less radioactive waste that can be managed by more conventional means, such as shallow land disposal. EM activities at the Hanford Site involve radioactive waste and other radioactive materials. These wastes and materials require different management approaches depending on their specific characteristics, location, and legal and regulatory requirements.

DOE’s waste management policy includes reducing the hazards of waste to people and the environment by minimizing generation of new waste, by treating waste, by placing waste in safer configurations, and by removing waste from environmentally sensitive areas, such as along the Columbia River.

The Hanford programs for spent nuclear fuel, HLW, environmental restoration, liquid waste and groundwater protection are covered under other NEPA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 USC 9601) reviews. However, they influence the scope of this HSW EIS as generators of waste that would ultimately be managed under the resulting decisions. The relationship of the HSW EIS to the major EM activities at the Hanford Site is outlined here (see Appendix N for additional information):

- Spent nuclear fuel: Sludge generated during removal of spent fuel and cleanout of the K Basins would be stored at T Plant until a facility is available to process and certify it for shipment to WIPP. In addition, LLW, MLLW, and TRU waste may be generated during activities at the K Basins.

- High-level waste treatment: ILAW and melters from the WTP would be disposed of in near-surface facilities at Hanford. Waste from WTP operations would also require disposal, including equipment removed from HLW tanks during retrieval of HLW and waste generated during operation of the WTP.

- Environmental restoration activities: TRU waste retrieved during CERCLA cleanup of the 618-10 and 618-11 burial grounds would be processed and certified for shipment to WIPP, and other operational waste from cleanup activities may require treatment and disposal. The Environmental Restoration and Disposal Facility (ERDF) may also be selected as a potential disposal site for LLW, MLLW, melters, and ILAW. Under DOE policy, NEPA values are integrated into the CERCLA process prior to making remediation decisions (DOE 1994).

- Liquid waste: Leachate from lined disposal trenches would be treated at the Effluent Treatment Facility (ETF), and some solids from ETF would be returned to the Low Level Burial Grounds (LLBGs) for disposal. Other operational waste generated during liquid waste treatment may also be disposed of at Hanford.

1.3.2.1 Groundwater Protection

Groundwater in the unconfined aquifer beneath the Hanford Site ultimately surfaces at springs near or in the Columbia River, which traverses the northern and eastern parts of the site. Some of the groundwater is contaminated by radionuclides and hazardous chemicals as a result of past liquid disposal practices, leaks, and spills. Past practices that contributed to groundwater contamination have been discontinued, including disposal of untreated liquids to the ground. Programs are underway to stabilize and clean up remaining materials, soil, and groundwater plumes that could present a threat to human health and the environment in the future. Ongoing radioactive and hazardous waste management practices comply with applicable standards, and they are evaluated on a continuing basis to minimize environmental degradation.

Groundwater monitoring at Hanford is being addressed under milestones established by the TPA independently of this HSW EIS. Groundwater monitoring requirements would apply to whatever actions DOE decides to implement as a result of the analyses conducted under this HSW EIS.

DOE and a team of contractors have developed, and are implementing, a sitewide program that integrates all assessment and remediation activities that address key groundwater, vadose zone, and related Columbia River issues. This effort is coordinated by the Groundwater Protection Program to support cleanup and closure decisions for the Hanford Site and protection of the Columbia River. Information developed under that program was used to evaluate long-term impacts of LLW and MLLW disposal in this revised draft HSW EIS. Additional information can be found in Appendix N and at http://www.bhi-erc.com/projects/vadose/.

1.3.2.2 The Tri-Party Agreement

Beginning in 1986, DOE, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) began to examine how best to bring the Hanford Site into compliance with RCRA, CERCLA, and applicable State hazardous waste regulations. The regulatory agencies and DOE agreed to develop one compliance agreement establishing milestones for conducting Hanford Site cleanup activities under CERCLA and for bringing operating facilities into compliance with RCRA. Negotiations concluded in late 1988, and the TPA was signed by the three participating agencies on January 15, 1989 (Ecology et al. 1989). The TPA includes a process for revising milestones by mutual agreement of the agencies. Milestones established under the TPA influence some activities proposed in this revised draft HSW EIS. The TPA is discussed further in Section 6.2.

1.3.2.3 DOE Decisions Related to Waste Management at Hanford

Several decisions have already been made that affect the management of various wastes and other nuclear materials at Hanford. Some of the decisions described in this section are being implemented, and other actions are scheduled to begin at a future time. The relationship between those activities and the alternatives for waste treatment, storage, and disposal as discussed in this HSW EIS is depicted in Figure 1.3. The NEPA and CERCLA reviews that resulted in the decisions illustrated in the figure are also listed. The relationship of the HSW EIS to other documents is further discussed in Section 1.5.

- HLW in Hanford storage tanks will be retrieved and vitrified at an onsite facility. DOE plans to dispose of HLW in a geologic repository at Yucca Mountain in Nevada (DOE 2002d). The TWRS EIS ROD (62 FR 8693) calls for ILAW to be placed in concrete vaults on the Hanford Site.

- Spent nuclear fuel stored in the Hanford K Basins near the Columbia River will continue to be dried and moved to the 200 East Area until it can be sent to the Yucca Mountain repository. A small quantity of other reactor fuel currently stored at Hanford will also be stored in the 200 East Area until it can be disposed of at Yucca Mountain.

- The Hanford Site will manage TRU waste from onsite operations, such as stabilization of plutonium materials at former processing facilities, and from some other DOE sites that do not have capabilities to manage TRU waste. In addition, TRU waste will be retrieved from the 618-10 and 618-11 Burial Grounds near the 400 Area, and retrievably stored TRU waste will be retrieved from the 200 Area LLBGs. TRU waste will be treated as necessary and certified for disposal at WIPP near Carlsbad, New Mexico.

- LLW and MLLW from Hanford and other DOE sites will continue to be stored, treated, and/or disposed of at Hanford.

- Reactor compartments from decommissioned naval vessels will continue to be disposed of in a dedicated facility at Hanford.

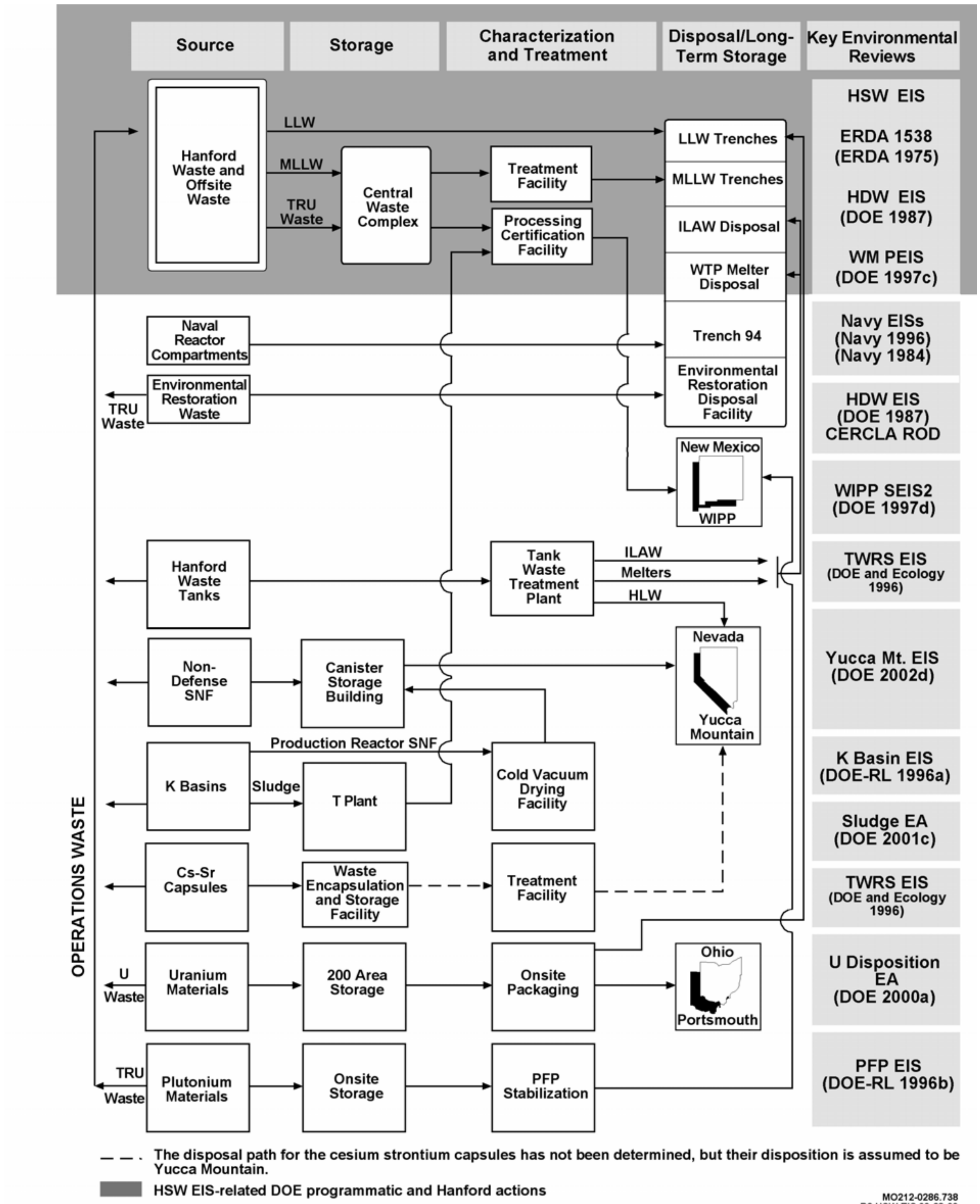

Figure 1.3. Relationship of the HSW EIS to Other Hanford Cleanup Operations, Material Management Activities, and Key Environmental Reviews

- Contaminated areas along the Columbia River will continue to be cleaned up, especially sites near closed reactors in the 100 Areas and near fuel fabrication facilities in the 300 Area. Closed reactors will be placed into interim safe storage (a process referred to as “cocooning”) to protect people and the environment from the reactor cores until they can be safely removed. Most LLW and MLLW generated during Hanford environmental restoration projects will be sent to a dedicated onsite disposal facility, the Environmental Restoration Disposal Facility (ERDF).

The activities described in this section will result in most of the radioactive materials at Hanford being relocated to offsite facilities for disposal or other disposition. Figure 1.4 shows DOE’s radioactive material disposition plans at Hanford based on their radioactive material content.

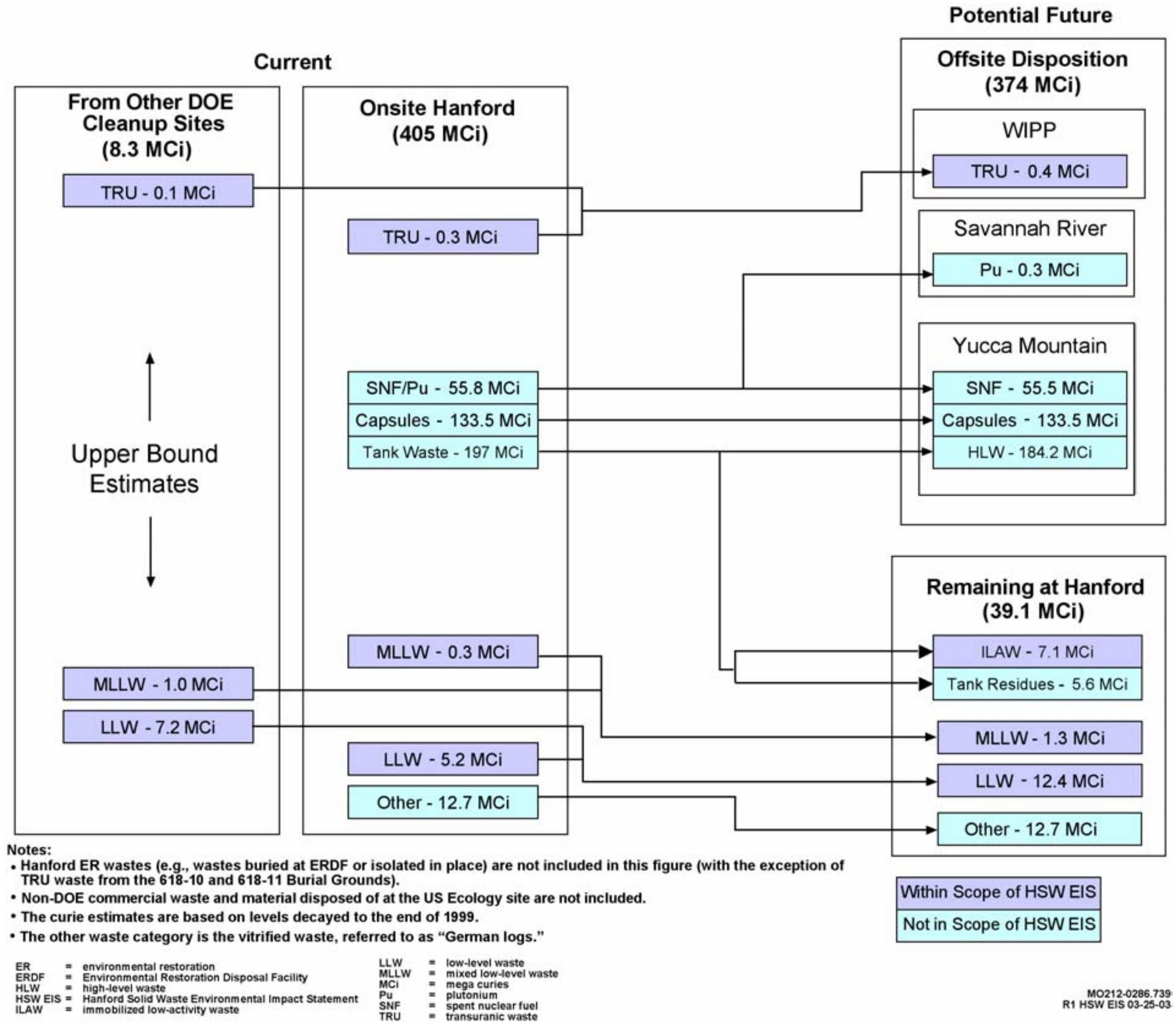

Figure 1.4. Radioactive Material Disposition at Hanford in Terms of Waste Activity (MCi)

1.4 Related Department of Energy Initiatives at the Hanford Site

Recent DOE management initiatives have provided a framework for alternatives being evaluated in this EIS. These initiatives are summarized in the following sections; additional information is provided in Appendix N.

1.4.1 EM Top-to-Bottom Review

In 2001, DOE reviewed its efforts to clean up 114 sites nationwide that are managed as part of DOE's Environmental Management Program (DOE 2002a). Cleanup of 74 of those sites is complete, and cleanup efforts at other sites are well underway. However, costs and schedules for the more extensive cleanup efforts, including Hanford, were expected to increase unless there were major changes in the way cleanup work was being managed. That review, referred as the Top-to-Bottom Review, was intended to identify problems and recommend improvements to accelerate cleanup, reduce risks, and reduce costs.

The review concluded that DOE's emphasis was on managing risks to people and the environment rather than reducing those risks. The review identified 12 issues and related recommendations, some of which could change current plans for managing waste at Hanford if they are implemented. Some of the recommendations made in the Top-to-Bottom Review could be implemented immediately. Some, including the possible changes to waste management activities at Hanford, would require additional planning. Prior to implementation of any of the recommendations, appropriate environmental documentation would be prepared.

1.4.2 DOE Cost Report

In 2002, DOE prepared a life-cycle cost analysis addressing the disposal of DOE's low-level waste (DOE 2002e). Life-cycle disposal costs include those related to transportation, disposal, closure, and long-term stewardship. The report discussed facilities for the disposal of LLW from cleanup actions under CERCLA (e.g., the Environmental Restoration Disposal Facility) as well as facilities used for other LLW disposal (e.g., the LLBGs). The report was prepared to address congressional concerns regarding the cost of LLW disposal, the extent to which DOE fee structures reflect actual life-cycle costs, and the impact of DOE disposal facilities on commercial LLW disposal.

The report concluded that pre-disposal costs, such as packaging and transportation, offer the greatest opportunity for cost savings. DOE disposal facilities established for CERCLA cleanup actions typically had the lowest life-cycle disposal costs per unit of waste because of the nature of wastes disposed of at those facilities. Commercial facilities may be more cost-effective for some types of waste; however, DOE facilities provide services that are not available at commercial facilities. In general, the report recommended that all elements of life-cycle costs in addition to disposal fees be considered in making decisions regarding LLW disposal.

1.4.3 Cleanup, Constraints, and Challenges Team (C3T)

In 2001, the DOE Richland Operations Office (DOE-RL), its contractors, EPA, and Ecology began a series of discussions to better identify, characterize, and resolve constraints and barriers to Hanford cleanup. These discussions, referred to as the Cleanup, Constraints, and Challenges Team (C3T) process, are designed to be an informal forum where ideas and concepts could be discussed openly. Ideas are developed and evaluated to determine whether they could accelerate cleanup; reduce costs; or protect workers, the public, and the environment. The C3T process is not intended to replace legal or regulatory requirements, or to change formal commitments such as the TPA. Some concepts identified during the C3T process might be suitable for immediate implementation. However, most would probably require further planning, changes to existing permits and TPA Milestones, changes to existing contracts, and preparation of additional NEPA or CERCLA reviews. Additional information can be found in Appendix N and at http://www.hanford.gov/docs/rl-2002-65. rl-2002-65.pdf.

1.4.4 Hanford Performance Management Plan (HPMP)

Drawing on recommendations contained in the Top-to-Bottom Review and from ideas emerging from the C3T process (DOE-RL 2002a), a plan was prepared to accelerate cleanup at Hanford (DOE-RL 2002b). The plan describes higher-level strategic initiatives as well as specific goals for completing Hanford cleanup by 2035, which is 35 years earlier than previously planned.

Some of the acceleration activities described in the HPMP could be implemented immediately. Others could be implemented as a result of reviews performed under this HSW EIS. Some, however, would require further planning, changes to existing permits and TPA milestones, and preparation of additional NEPA or CERCLA reviews. Implementation of some of the accelerated cleanup proposals is discussed in Section 3. However, the plans and schedules associated with many HPMP proposals were not sufficiently well developed for detailed analysis at the time this EIS was prepared. Therefore, the analyses of environmental impacts presented in Section 5 do not necessarily reflect all activities, or the timing of some activities, as described in the HPMP.

1.5 Relationship of the HSW EIS to Other Hanford and DOE NEPA Documents

A number of other DOE programmatic and Hanford actions are related to this HSW EIS. The relationships of these actions and associated NEPA documents to the HSW EIS are described in the following sections and were illustrated previously in Figure 1.2.

1.5.1 Interim Actions During Preparation of the Draft HSW EIS

During the preparation of the draft HSW EIS, DOE determined that several actions within or related to the scope of the EIS met the criteria for permissible interim actions under 40 CFR 1506.1. These actions are described in the following documents:

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- **Offsite Thermal Treatment of Low-Level Mixed Waste (DOE/EA-1135 May 1999)**

  This Environmental Assessment (EA) analyzed the use of Allied Technology Group, Inc. (ATG), a commercial treatment facility in Richland, Washington, to thermally treat a portion of MLLW stored at the Hanford Site (DOE 1999a). DOE considered the use of ATG for treatment of a limited quantity of MLLW from Hanford as a demonstration project. This EA analyzed impacts of transporting the MLLW from Hanford to ATG, treatment of the waste in the ATG facility, and transportation of the treated waste back to Hanford for disposal. Construction and operation of the ATG treatment facility was evaluated in a State Environmental Policy Act (SEPA) EIS (City of Richland 1998). Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a finding of no significant impact (FONSI) on May 6, 1999.

- **Non-Thermal Treatment of Hanford Site Low-Level Mixed Waste (DOE/EA-1189 September 1998)**

  This EA considered the use of a commercial treatment facility to stabilize or encapsulate a portion of Hanford MLLW to allow disposal of the waste (DOE 1998). Regulatory requirements for treatment of MLLW to allow land disposal vary depending upon the nature of the waste. Wastes considered in this EA consisted of those that did not require thermal treatment. The ATG facility was also considered for thermal treatment of a portion of the Hanford MLLW (DOE 1999a). Construction and operation of the ATG treatment facility was evaluated in a SEPA EIS (City of Richland 1998). Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on September 29, 1998.

- **Widening Trench 36 of the 218-E-12B Low-Level Burial Ground (DOE/EA-1276 February 1999)**

  This EA was prepared to assess potential environmental impacts associated with the proposed action to widen and operate the existing and unused Trench 36 in the 218-E-12B LLBG for disposal of bulk LLW (DOE 1999c). The existing V-type LLW trenches were designed before 1976 and were analyzed in a previous Environmental Statement (ERDA 1975). DOE determined the trench design was inefficient for disposal of bulk waste. The V-type trenches are narrow at the bottom and are generally less than about 5 m (16 ft) deep. DOE determined that widening the trenches would more efficiently use LLBG space. Given trenches of equivalent depth, the wider trenches allow more waste to be placed per square foot of surface area. This pattern not only saves trench construction costs but also decreases closure cover size and cost for disposal of a given volume of waste. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on February 11, 1999.

- **K Basins Sludge Storage at 221-T Building, Hanford Site, Richland, Washington (DOE/EA-1369 June 2001)**

  This EA was prepared to assess potential environmental impacts associated with modification of the 221-T Building (part of the T Plant Complex) to receive and store sludge from the 100-K Area fuel storage basins at the Hanford Site (DOE 2001b). The proposed action included modification of the pool cell and other shielded cells within the facility to store the sludge. The sludge would ultimately be designated as RH TRU waste and transferred to the Hanford Solid Waste Program for storage, processing at an onsite facility, and shipment to WIPP for disposal. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on June 20, 2001.

- **(Draft) Environmental Assessment for Trench Construction and Operation in the 218-E-12B and 218-W-5 Low Level Burial Grounds, Hanford Site, Richland, Washington (DOE/EA-1373 February 2001)**

  This draft EA was prepared to assess potential environmental impacts associated with the proposed action to construct four new LLW disposal trenches in the Hanford Site 200 East and 200 West Areas (DOE 2001a). Additional trench capacity was determined to be necessary over the short-term for operational efficiency in disposing of different physical types of LLW at Hanford. The scope of the document has been changed, and comments on the draft EA are being considered.

1.5.2 Related NEPA Documents

Solid waste management operations at Hanford have been previously assessed in a number of documents. This section briefly describes a number of other NEPA documents related to the HSW EIS. They offer background material for understanding the HSW EIS and its purpose.

- **Final Environmental Statement, Waste Management Operations, Hanford Reservation, Richland, Washington (ERDA-1538 December 1975)**

  The U.S. Energy Research and Development Administration (ERDA) prepared an Environmental Statement for use in planning and decision making to ensure that future waste management practices would minimize adverse environmental consequences (ERDA 1975). Treatment and disposal of waste from onsite and offsite sources were addressed. This document was written for the Waste Management Operations Program at the Hanford Site. Because this document predated the CEQ NEPA regulations, a formal ROD was not issued. Hanford waste management programs still rely upon the analyses conducted in ERDA-1538. The HSW EIS provides an updated analysis and revisits potential alternatives for Hanford Solid Waste Program operations.

- **Disposal of Decommissioned Defueled Naval Submarine Reactor Plants EIS (U.S. Department of the Navy 1984)**

  This EIS considered the disposal of defueled naval submarine reactor compartments in the Hanford LLBGs (Navy 1984). The EIS was prepared by the U.S. Department of the Navy and was adopted by DOE. The EIS analyzed preparation of the reactor compartments at the Puget Sound Naval Shipyard, transportation to Hanford, and disposal in the 200 Areas. The ROD was published in the Federal Register on December 6, 1984 (49 FR 47649).

- **Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington (DOE/EIS-0113 December 1987)**

  In 1987, DOE prepared the Hanford Defense Waste (HDW) EIS to examine potential impacts storing and preparing TRU waste, and tank waste, as well as future wastes, for disposal (DOE 1987). Most LLW and wastes associated with decommissioning of existing surplus or retired Hanford Site facilities were not considered in the HDW EIS. In the 1988 ROD (53 FR 12449), DOE decided to dispose of or store double-shell tank waste and cesium and strontium capsules. Retrievably stored TRU waste in the 200 Area LLBGs would be retrieved and disposed of with other newly generated TRU waste. A decision was also made to retrieve buried suspect TRU-contaminated waste from the 618-11 Burial Ground. As part of that decision, DOE decided to construct and operate a facility for vitrification of HLW, facilities for grout stabilization and disposal of the low-activity fraction from processing tank waste, and the Waste Receiving and Processing (WRAP) facility for processing, certification, and shipment of TRU waste. Subsequent to preparation of the HDW EIS, the TPA was established to implement many of the actions discussed in the ROD. The agreement also ensures compliance with RCRA and CERCLA requirements. This HSW EIS provides an updated analysis for some Hanford Solid Waste Program operations previously evaluated in the HDW EIS.

- **Environmental Assessment for Battelle Columbus Laboratories Decommissioning Project (DOE/EA-0433 June 1990)**

  This EA evaluated decommissioning of radiological laboratories operated by Battelle Memorial Institute (DOE 1990). Waste, including TRU waste generated during the cleanup of 15 buildings at two sites, would be shipped to Hanford for processing or disposal. TRU waste was assumed to be stored until it could be accepted at WIPP. DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on June 14, 1990.

- **Environmental Assessment – Hanford Environmental Compliance Project, Hanford Site, Richland Washington (DOE/EA-0383 March 1992)**

  This EA included an evaluation for construction and operation of the ETF in the Hanford Site 200 East Area (DOE 1992). This facility would receive leachate collected from the MLLW trenches, in addition to other liquid waste generated at Hanford. The EA also evaluated construction of additional storage buildings at the Central Waste Complex (CWC). Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on March 11, 1992.

- **Solid Waste Retrieval Complex, Enhanced Radioactive and Mixed Waste Storage Facility, Infrastructure Upgrades, and Central Waste Complex (DOE/EA-0981 September 1995)**

In this EA, DOE proposed to construct and operate the Solid Waste Retrieval Complex and the Enhanced Radioactive Mixed Waste Storage Facility, to expand the CWC, and to upgrade the associated Hanford infrastructure (DOE 1995b). These facilities were to be located in the 200 West Area to support the Solid Waste Operations Complex (SWOC) operation. The proposed action was to address retrieval of TRU waste, storage capacity for retrieved and newly generated TRU waste, and upgrading the infrastructure network in the 200 West Area to enhance operational efficiencies and reduce the cost of operating the existing SWOC. Actions evaluated in the EA included

- construction and operation of the Retrieval Complex and the Enhanced Radioactive Mixed Waste Storage Facility

- expansion of the CWC

- upgrading associated infrastructure (that is, utilities and roads) in the 200 West Area to support the SWOC

- retrieval of TRU waste in the solid waste LLBGs and the construction, operation, and maintenance of a complex of facilities to be used for the retrieval

- construction of a regulatory-compliant storage facility for greater than Category 3 (GTC3) waste, retrieved TRU waste and newly generated TRU waste awaiting processing in the WRAP, and for processed waste awaiting shipment to WIPP

- construction of two pre-engineered metal solid waste management support buildings.

In addition, the proposed action included a mitigation strategy to address lost shrub-steppe habitat. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on September 8, 1995. This revised draft HSW EIS considers post-retrieval processing, certification, and shipment to WIPP for retrievably stored TRU waste in the LLBGs.

- **Environmental Assessment. Shutdown of the Fast Flux Test Facility. Hanford Site, Richland, Washington (DOE/EA-0993 May 1995)**

This EA was prepared to assess environmental impacts from shutdown of the Fast Flux Test Facility, a liquid-metal cooled research reactor located in the Hanford Site 400 Area (DOE 1995a). Deactivation would consist of removing fuel, draining and de-energizing the systems, removing the stored radioactive and hazardous materials, and performing other actions to place the facility in a safe shutdown state. Deactivation of this facility could generate LLW, MLLW, or TRU waste that would be processed or disposed of in facilities considered under the HSW EIS. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on May 1, 1995.

- **Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington (DOE/EIS-0245 January 1996)**

  This EIS evaluated alternatives for treatment and interim storage of irradiated fuels from the Hanford production reactors (DOE-RL 1996a). After the reprocessing of production reactor fuels for weapons material at Hanford was suspended, a substantial quantity of unprocessed irradiated fuel remained in the fuel storage basins at the 100-K Area. As a result of the EIS analysis, DOE decided to stabilize the stored fuel using a cold vacuum drying process, package the fuel into storage canisters, and place the canisters into storage in the 200 East Area at Hanford. The EIS also addressed cleaning out the 100-K Area fuel storage basins following removal of the fuel. The EIS evaluated storage of the retrieved sludge in underground tanks for eventual treatment with other Hanford tank wastes, or alternatively, grouting the sludge fractions that could be disposed of at Hanford. A ROD was issued in the Federal Register on March 15, 1996 (61 FR 10736). The draft HSW EIS evaluates storage and treatment of the sludge by the Hanford Solid Waste Program, an alternative not considered in the K Basin EIS. The treated sludge ultimately would be disposed of at WIPP with other Hanford TRU waste.

- **Plutonium Finishing Plant Stabilization Final Environmental Impact Statement (DOE/EIS-0244-F May 1996)**

  The Plutonium Finishing Plant (PFP) in the Hanford Site 200 West Area was constructed to process plutonium nitrate into the metallic form used in nuclear weapons. The PFP includes production and recovery areas, laboratories for routine analysis and research, and secure vaults for storage of plutonium. PFP operations ceased in 1989. DOE prepared the PFP EIS (DOE-RL 1996b) to evaluate consequences from

  - stabilization of plutonium-bearing materials at the PFP to a form suitable for interim storage

  - removal of readily retrievable, plutonium-bearing materials left behind in process equipment, process areas, and air and liquid waste management systems as a result of historic uses

  - placement of stabilized fissile material in existing vaults at the PFP for interim storage.

  The alternatives for stabilization included processing the plutonium-bearing materials into a form suitable for interim storage in existing PFP vaults. The EIS also evaluated options for removing and stabilizing plutonium-bearing wastes and material in holdup at the PFP. A ROD was issued in the *Federal Register* on June 25, 1996 (61 FR 36352). Stabilization of the PFP materials and deactivation of the facility have been, and will continue to be, major sources of TRU waste managed by the Hanford Solid Waste Program.

- **Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants (DOE/EIS-0259 April 1996)**

  This EIS considered the disposal of certain defueled Naval Reactor plants in a Hanford LLBG. The EIS was prepared by the U.S. Department of the Navy (1996). The EIS analyzed preparation of the reactor compartments at the Puget Sound Naval Shipyard, transportation to Hanford, and disposal in the 218-E-12B Burial Ground in the Hanford 200 East Area. DOE participated as a cooperating agency in the development of the EIS on this federal action and has adopted the EIS. The ROD was issued in the *Federal Register* on August 9, 1996 (61 FR 41596).

- **Tank Waste Remediation System EIS (DOE/EIS-0189 August 1996)**

  In the TWRS EIS, DOE examined the management and disposal of the contents of 177 HLW tanks, as well as cesium and strontium capsules (DOE and Ecology 1996). In the ROD, DOE decided to retrieve, separate, vitrify, and dispose of the tank waste (62 FR 8693). The low-activity waste fraction from the separation process would be placed in concrete vaults onsite. The HLW would be disposed of at a repository. A decision on the disposition of cesium and strontium capsules was deferred. Programs for retrieval and treatment of the tank waste are expected to be major generators of LLW and MLLW sent to the Hanford Solid Waste Program for disposal in Hanford LLBGs. Disposal of ILAW, melters, and operational waste from the treatment facility are considered in the waste streams evaluated for this HSW EIS.

- **Supplemental Environmental Impact Statement for Disposal of Immobilized Low-Activity Wastes from Hanford Tank Waste Processing (DOE/EIS-0189-S1)**

  As part of the TWRS EIS decision, DOE planned to place ILAW into concrete vaults in the 200 East Area. DOE began examining alternatives for disposing of ILAW onsite in near-surface facilities. Following a supplement analysis of disposal options for ILAW (DOE 2001i), DOE decided additional NEPA review was required, and a Notice of Intent to prepare a Supplemental Environmental Impact Statement (SEIS) was issued on July 8, 2002 (67 FR 45104). Subsequently, based on public comments received, DOE decided to combine the ILAW disposal SEIS with this revised draft HSW EIS. The HSW EIS now provides the NEPA review for ILAW disposal in addition to waste management operations conducted by the Hanford Solid Waste Program (68 FR 7110).

- **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)**

  DOE recently announced its intent to prepare a follow-on EIS to the TWRS EIS for retrieval, treatment, and disposal of Hanford tank waste, and for closure of 149 single-shell tanks (68 FR 1052). That EIS would evaluate alternative treatment processes for some tank waste and disposal of low-activity waste forms other than those considered in this HSW EIS.

- **Waste Management Programmatic EIS (DOE/EIS-0200 May 1997)**

The WM PEIS is a DOE nationwide study examining the environmental impacts of managing more than 2,000,000 m^3 (2,700,000 yd^3) of radioactive wastes from past, present, and future DOE activities (DOE 1997c). The DOE goal in preparing the WM PEIS was to develop a national strategy to treat, store, and dispose of the wastes in a safe, responsible, and efficient manner that minimizes the impacts to workers, the public and the environment. DOE used the analyses in the WM PEIS to decide on a programmatic approach to managing its waste, and to select a configuration of DOE sites for waste management activities based on those analyses and other factors. The level of analysis in the WM PEIS was judged appropriate for making broad programmatic decisions on which DOE sites should be selected for waste management missions. However, at the programmatic level, it was not possible to take into account special requirements for particular waste streams, different technologies that are, or may be, available to manage specific wastes, or site-specific environmental considerations such as the presence of culturally important resources or endangered species at a given location on a site. DOE is relying on other NEPA reviews for those analyses, primarily ones that evaluate particular locations or projects. Decisions regarding specific locations for waste management facilities at DOE sites, or the waste management technologies to be used, will be made on the basis of sitewide or project-level NEPA reviews.

Wastes analyzed in the WM PEIS result primarily from nuclear weapons production and related activities. They include MLLW, LLW, TRU waste, HLW, and hazardous waste. The WM PEIS provides information on the impacts of various alternatives that DOE evaluated to decide at which sites to consolidate or decentralize treatment, storage, and disposal activities for each waste type. The WM PEIS evaluated a total of 36 alternatives for the 5 waste types. The alternatives represented different configurations for managing each waste type at varying numbers of DOE facilities. The alternatives were described as decentralized, regionalized, or centralized, depending on the degree to which waste management activities were consolidated or distributed across the DOE waste generator sites. A no action alternative was also evaluated, in which only existing waste management capabilities would be used. In the decentralized alternatives, each site that generates waste would manage the waste onsite. Unlike the no action alternative, the decentralized alternatives would involve construction of new waste management facilities at a larger number of sites than in the other alternatives (5-37 sites, depending on the waste type and activity). At least two regionalized alternatives were evaluated for each waste type, where waste management activities would be consolidated at a smaller number of sites than in the decentralized alternatives, but at a greater number of sites than in the centralized alternatives (1-12 sites, depending on the waste type and activity). The sites identified as regionalized waste management sites for a given waste type were expected to generate relatively large quantities of that waste, and they generally had existing waste management facilities and capabilities. The centralized alternatives evaluated consolidated management of each waste type at the smallest number of sites (1-7 sites, depending on the waste type and activity), again representing sites that were expected to generate the largest quantities of a particular waste.

The WM PEIS evaluated Hanford as a receiving site for both regionalized and centralized alternatives within each waste type. Therefore, the analyses for waste coming to Hanford encompassed a range of waste volumes that represented Hanford-generated waste in the decentralized alternatives to quantities that represented a substantial fraction of a particular waste type to be generated at DOE sites across the nation in the centralized alternatives. For LLW, the waste volumes ranged from 89,000 m^3 generated at Hanford to 1,500,000 m^3 generated at all DOE sites. The corresponding MLLW volumes were 36,000 m^3 for Hanford to 219,000 m^3 for all DOE sites. The range for TRU waste was 52,000 m^3 from Hanford to 132,000 m^3 from all DOE sites. The range of waste volumes evaluated in the WM PEIS therefore encompasses the range of waste volumes considered in this HSW EIS for LLW, MLLW, and TRU waste (see Section 3.3 and Appendixes B and C).

Management of CERCLA waste generated by DOE environmental restoration activities was reviewed, but not analyzed, in the WM PEIS. The Natural Resources Defense Council and other non-governmental groups filed a lawsuit in 1997 to require DOE to prepare a programmatic EIS for its environmental restoration program. The lawsuit was settled in 1998 when DOE and the other parties agreed to develop tools that would enhance public understanding of DOE site cleanup. Under the terms of the settlement, no changes were made to the PEIS. DOE agreed to complete the following items:

1. Develop and deploy a Central Internet Database with information on waste, materials, facilities, and contaminated media. (see: http://cid.em.gov/)

2. Conduct a study on long-term stewardship (DOE 2001f).

3. Establish a $6.25 million fund for technical and scientific reviews by citizen and tribal organizations.

The draft WM PEIS was issued in September 1995, followed by a 150-day public comment period. The Final WM PEIS was issued in May 1997, and decisions for each waste type analyzed in the WM PEIS were issued between 1998 and 2002. Major decisions resulting from the WM PEIS are summarized by waste type as follows:

- **TRU Waste**. DOE decided that, with one exception, TRU waste at DOE sites would be treated and stored at the generator sites prior to disposal at WIPP (63 FR 3629). The decision was later revised to transfer small quantities of TRU waste to other sites that have existing storage and treatment capabilities (65 FR 82985, 66 FR 38646, 67 FR 56989). In one of those revisions (67 FR 56989), DOE decided that about 36 m^3 of TRU waste from facilities in Ohio and California would be transferred to Hanford for storage and processing before being shipped to WIPP.

- **Low-Level Waste and Mixed Low-Level Waste.** Under this decision, DOE will continue to rely on sites that have existing capacity to treat or dispose of LLW and MLLW (65 FR 10061). Hanford and the Nevada Test Site (NTS) were identified in the ROD to receive LLW and MLLW from other DOE sites that do not have capabilities to dispose of their wastes. The Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory, the Oak Ridge Reservation (ORR), and the Savannah River Site (SRS) would continue to dispose of LLW generated at those sites. DOE also identified Hanford, the INEEL, ORR, and SRS as regional MLLW treatment facilities that could accept waste from other sites for treatment. Those decisions generally represent a continuation of ongoing treatment and disposal activities at the identified sites and do not affect DOE's ability to send waste to commercial disposal facilities.

- **Non-Wastewater Hazardous Waste.** The hazardous waste treatment ROD (63 FR 41810) announced a DOE decision to continue to use commercial facilities for the treatment of non-wastewater hazardous waste generated at DOE sites.

- **High-Level Waste.** The HLW storage ROD determined that HLW should be stored at the generator sites pending disposal in a geologic repository (64 FR 46661).

- **Relocation and Storage of Isotopic Heat Sources (DOE/EA-1211 June 1997)**

  In this EA, DOE proposed construction and operation of a storage site at the CWC in the 200 West Area of the Hanford Site for storage, pending future disposal decisions, of isotopic heat sources that were previously stored in the 324 Building (DOE 1997a). The material includes 34 isotopic sources: 30 sealed isotopic heat sources manufactured in the 324 Building as part of a bilateral agreement between the Federal Republic of Germany and DOE; 2 production demonstration canisters; and two instrumented canisters. The agreement was for developing processes for the treatment and immobilization of HLW. Subsequently, the need for the sources was eliminated and Germany and DOE entered into another agreement for the storage and disposition of the materials. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on June 6, 1997.

- **Trench 33 Widening in 218-W-5 Low Level Burial Ground (DOE/EA-1203 July 1997)**

  In this EA, DOE proposed to widen and operate the existing and unused disposal Trench 33 within the 218-W-5 LLBG in the 200 West Area for disposal of LLW (DOE 1997b). The existing V-type LLW trenches were designed before 1976 and were analyzed in a previous Environmental Statement (ERDA 1975). The widening of Trench 33 increased the disposal capacity and allowed for disposal of both boxed and large packages of Category (Cat) 1 LLW that would not efficiently fit in the existing V-type trench configuration. The proposed action provided for more cost-effective land use and increased the capacity of the LLBG without increasing the footprint. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on July 28, 1997.

- **Waste Isolation Pilot Plant Disposal Phase Final Supplemental EIS (DOE/EIS-0026-S-2 September 1997)**

  DOE prepared the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental EIS* (WIPP SEIS2) to consider disposal of TRU waste at the WIPP (DOE 1997d). The supplement evaluated transportation methods, the disposal inventory, and the level of treatment required for disposal or storage (repackaging to meet planning basis WIPP waste acceptance criteria, thermal treatment, or treatment by shred and grout). The Hanford Site was considered for treatment of TRU waste by any of the three methods, and for storage of TRU waste (either without disposal at WIPP or pending disposal). The ROD was issued on January 23, 1998, to dispose of Hanford and other sites' TRU waste at WIPP (63 FR 3623), after treatment to meet WIPP waste acceptance criteria. The HSW EIS evaluates the impact of processing Hanford's TRU waste prior to its ultimate disposal at WIPP.

- **Final Hanford Comprehensive Land-Use Plan EIS (DOE/EIS-0222F September 1999)**

DOE prepared a *Final Hanford Comprehensive Land-Use Plan EIS* (HCP EIS, formerly named *Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan*) to evaluate the potential environmental impacts associated with implementing a comprehensive land-use plan for the Hanford Site for at least the next 50 years (DOE 1999b). Working with federal, State, and local agencies and tribal governments, DOE evaluated six land-use alternatives. In the ROD for the HCP EIS, DOE decided to designate the 200 Areas for Industrial-Exclusive use and Area C for Conservation-Mining (64 FR 61615). Radioactive and hazardous waste treatment, storage, and disposal activities, as described in this draft HSW EIS, are consistent with the Industrial-Exclusive land use selected for the 200 Areas and use of Area C as a borrow pit consistent with the Conservation-Mining land use selected for that area in the HCP EIS decision. (See Figure 4.2 in the HSW EIS for a land-use map.)

- **Environmental Assessment for the Offsite Transportation of Certain Low-level and Mixed Radioactive Waste from the Savannah River Site for Treatment and Disposal at Commercial and Government Facilities (DOE/EA-1308 February 2001)**

This EA was prepared to evaluate near-term offsite treatment and disposal options for LLW and MLLW because onsite treatment and disposal capabilities for these waste forms were not available at the Savannah River Site and/or it was more beneficial to dispose of the waste at another location (DOE 2001d). These waste forms would comprise an estimated volume of approximately 136,057 m^3 (4,804,282 ft^3). Transport by either truck or rail to seven potential treatment or disposal facilities was considered, including the Hanford Site. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI.

- **Environmental Assessment for Transportation Low-level Radioactive Waste from the Oak Ridge Reservation to Off-Site Treatment or Disposal Facilities. (DOE/EA-1315)**

The EA evaluates the potential environmental impacts associated with transportation of legacy and operational LLW from the Oak Ridge Reservation in Tennessee for treatment or disposal at various locations in the United States (DOE 2001e). The proposed action was to package as needed, load, and ship existing (about 40,000 m^3 [1,410,000 ft^3]) and forecasted (about 7700 m^3/yr [271,000 ft^3/yr]) ORR LLW to existing or future facilities at other DOE sites, including Hanford, or to licensed commercial nuclear waste treatment or disposal facilities. Transport by truck, by rail, or by intermodal carrier (i.e., truck and rail combination) was considered. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on October 29, 2001.

- **Environmental Assessment – Disposition of Surplus Hanford Site Uranium, Hanford Site, Richland, Washington (DOE/EA-1319 June 2000)**

An EA was prepared to assess environmental impacts associated with the disposition of surplus Hanford Site uranium. DOE identified about 1865 metric tons of uranium (MTU) on the Hanford Site as surplus (DOE 2000a). DOE decided to relocate approximately 900 MTU of potentially sale-able uranium materials to DOE's Portsmouth site near Portsmouth, Ohio, for future beneficial use. The remaining materials consisted of approximately 140 MTU that were subsequently disposed of onsite, and approximately 825 MTU, which would be consolidated and stored in the 200 Areas pending final HSW EIS decisions on its disposition. The materials designated for onsite management may ultimately be transferred to the Hanford Solid Waste Program for disposal in the Hanford Site LLBGs, and are included in the forecasts used to determine waste volumes in this EIS. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on June 15, 2000.

- **Environmental Assessment – Use of Existing Borrow Areas, Hanford Site, Richland, Washington (DOE/EA-1403 October 2001)**

This EA evaluated potential environmental consequences of operating existing borrow areas at the Hanford Site to provide soil, sand, gravel, and rock for construction projects, site maintenance activities, and closure of solid waste burial sites (DOE 2001c). Although the total quantities of material necessary for final closure of the 200 Area LLBGs were not included in this EA, the locations evaluated included likely sources for these materials in the foreseeable future. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on October 10, 2001.

- **Environmental Assessment – Transuranic Waste Retrieval from the 218-W-4B and 218-W-4C Low-Level Burial Grounds, Hanford Site, Richland, Washington (DOE/EA-1405 March 2002)**

This EA was prepared to evaluate alternatives for retrieval of some suspect TRU waste retrievably stored in the LLBG trenches (DOE 2002c). The activity would involve recovery of up to 15,200 208-L (55-gal) drums and a small number of miscellaneous other containers of suspect TRU waste buried in the 200 West Area LLBGs. The contents of each container would be evaluated and containers determined not to be TRU waste would remain in the LLBGs. Drums that contain TRU waste would ultimately be processed and certified at WRAP and shipped to WIPP for disposal. Based on analyses in the EA, DOE determined the proposed action was not a major federal action significantly affecting the quality of the human environment and issued a FONSI on March 22, 2002.

- **Draft Environmental Assessment for the Accelerated Tank Closure Demonstration Project (DOE/EA-1462 December 2002)**

  This EA was prepared for a project that would collect engineering and technical information to support preparation of the proposed Tank Closure EIS (DOE-ORP 2002). One source of such information would be the interim closure of Single-Shell Tank 241-C-106 located in the 241-C Tank Farm under RCRA and the TPA. Activities associated with this Accelerated Tank Closure Demonstration project include stabilization of residual tank waste, following retrieval, and interim tank closure.

1.5.3 Related State Environmental Policy Act (SEPA) Documents

This section describes non-DOE documents for facilities that may be used as part of the overall Solid Waste Program for management of Hanford Site LLW and MLLW.

- **Draft Environmental Impact Statement. Commercial Low-Level Radioactive Waste Disposal Site, Richland, Washington, Washington State Department of Health (WDOH) and Washington State Department of Ecology (August 2000)**

  WDOH and Ecology (2000) evaluated potential environmental consequences of operating a commercial LLW disposal facility located near the Hanford Site 200 East Area. The EIS evaluated renewal of the facility's operating license, establishing an upper limit on disposal rate for some types of LLW, and approval of the site stabilization and closure plan. The Hanford Site could dispose of some LLW at commercial facilities if there were cost or environmental benefits to using non-DOE disposal capacity. The final SEPA EIS had not been issued at the time of publication of this revised draft HSW EIS.

- **Environmental Impact Statement for Treatment of Low-Level Mixed Waste, City of Richland (February 1998)**

  The City of Richland, Washington, published a final SEPA EIS (City of Richland 1998) for operation of a MLLW treatment facility by ATG. The EIS analyzed impacts of construction and operation of the facility in Richland for treatment of MLLW from federal and private customers, including Hanford and potentially other DOE sites. The consequences of treating limited quantities of Hanford MLLW at this facility were also evaluated separately (DOE 1998, 1999a).

1.5.4 Related CERCLA Documents

- **Record of Decision. U.S. DOE Hanford Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington (January 1995)**

  DOE and EPA decided to construct the Environmental Restoration Disposal Facility to dispose of radioactive and mixed waste from cleanup of the Hanford Site (DOE, EPA, and Ecology 1995). The

ROD was subsequently amended to expand the facility (DOE, EPA, and Ecology 1997) and to delist the leachate collected at the facility (DOE and EPA 1999).

- **Record of Decision, U.S. Department of Energy, Hanford 300 Area, Hanford Site, Benton County, Washington (April 2001)**

  DOE, EPA, and Ecology decided that interim remedial actions for portions of the 300 Area would include removal of contaminated soil, structures, and associated debris; treatment, if needed, to meet waste acceptance criteria at an acceptable disposal facility; disposal of contaminated materials at ERDF, WIPP, and other EPA-approved disposal facilities; recontouring and backfilling excavated areas followed by infiltration control measures; institutional controls to ensure that unanticipated changes in land use that could result in unacceptable exposures to residual concentration do not occur; ongoing groundwater and ecological monitoring to ensure effectiveness of remedial actions; and the regulatory framework for accelerating future remediation decisions (EPA 2001). The cleanup plan and schedules would include specific commitments regarding the decontamination and decommissioning of facilities and aboveground structures needed to complete cleanup of underlying waste sites in the 300 Area Complex and the remediation plans for the 618-10 and 618-11 Burial Grounds.

1.6 NEPA Process for the HSW EIS

The formal NEPA process for preparing the HSW EIS is described in the following sections. The typical process begins with DOE issuing a Notice of Intent (NOI) to prepare an EIS, followed by the scoping period, during which public input is sought on the scope of the EIS. The draft EIS is prepared following the scoping period, and the draft is issued for public comment. EPA publishes a Federal Register Notice of Availability (NOA) for the draft EIS at the beginning of the public comment period, which lasts a minimum of 45 days. Following public comment on the draft, the final EIS is prepared, ultimately leading to a Record of Decision on the proposed action. The ROD is published no sooner than 30 days after the EPA Notice of Availability for the final EIS, after which DOE may proceed with the activity under consideration.

1.6.1 Scoping for the Draft HSW EIS

The scope of an EIS consists of the range of actions, alternatives, and impacts to be considered (40 CFR 1508.25). Scoping is a public process used by DOE to help identify significant issues related to a proposed action. As part of that process, DOE invited comments and recommendations from interested parties on the scope of this HSW EIS.

DOE decided to prepare the HSW EIS in early 1997, following publication of the draft WM PEIS, but before DOE issued the final WM PEIS in May of 1997. The formal Notice of Intent to prepare the HSW EIS was published in the October 27, 1997 *Federal Register* (62 FR 55615), in accordance with applicable NEPA regulations. The NOI announced the schedule for the public scoping process and summarized the proposed alternatives and environmental consequences to be considered in the EIS.

ROD was subsequently amended to expand the facility (DOE, EPA, and Ecology 1997) and to delist the leachate collected at the facility (DOE and EPA 1999).

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- **Public Comment Period –** Originally scheduled from October 27, 1997 through December 11, 1997, the comment period was extended to 95 days by DOE through January 30, 1998 in response to a request from the State of Oregon. The Notice of Extension appeared in the December 11, 1997 *Federal Register* (62 FR 65254).

- **Public Scoping Meetings –** Scoping meetings were held in Richland, Washington, on November 12, 1997, followed by a meeting in Pendleton, Oregon, on November 13, 1997. Opportunities were provided at each meeting for informal discussion, as well as formal comments, about the DOE proposed action and the scope and content of the HSW EIS.

- **Scoping Results –** Both oral and written comments were received at the public scoping meetings. Written comments were also accepted by conventional and electronic mail. All written and oral comments were given equal consideration in preparing the draft HSW EIS. Commenters provided comments on several topics: relationship to other NEPA documents and DOE activities, alternatives and activities to analyze, waste types and volumes to analyze, environmental consequences, and public involvement and government agency consultation. During preparation of the draft HSW EIS the nature of the alternatives evolved as a result of the scoping comments and publication of the WM PEIS RODs. A summary of the scoping comments and the DOE responses is included in Appendix A (in Volume II of this HSW EIS).

1.6.2 Publication of the First Draft HSW EIS

The first draft HSW EIS was approved by DOE in April 2002 (DOE 2002b), and the EPA Notice of Availability was published on May 24, 2002 (67 FR 36592). The scope of the first draft HSW EIS included storage, treatment, and disposal of LLW and MLLW (including WTP melters) at Hanford, and processing and certification of TRU waste for disposal at WIPP. The scope of transportation analysis included shipment of onsite and offsite generated waste within the Hanford Site boundary, and shipment of some MLLW to offsite facilities for treatment and return to Hanford. Most offsite transportation of LLW, MLLW, and TRU waste to Hanford was evaluated in the WM PEIS and the WIPP SEIS2 (DOE 1997c, 1997d), and the evaluation was referenced in the first draft HSW EIS.

1.6.3 Public Comments on the First Draft HSW EIS

The public comment period for the first draft HSW EIS extended for 90 days from publication of the NOA on May 24, 2002 through August 22, 2002. Comments received after the close of the official comment period were considered to the extent practicable. Approximately 3800 comments were received from 700 individuals, organizations, or agencies via mail, electronic mail, and at public meetings. A total of six public meetings were held in Richland and Seattle, Washington, on August 6 and 7, respectively; and in LaGrande and Hood River, Oregon on July 23, and August 14, 2002, respectively. Two meetings were held in Portland, Oregon on July 30 and August 21, 2002. The public meetings provided opportunity for informal discussion before the meeting, a brief DOE presentation on the draft HSW EIS, presentations by regulatory agencies and local interest groups, and a question-and-answer session, in addition to the formal public comments. Forms for submitting written comments were also available at each meeting. Each comment was considered in preparing this revised draft HSW EIS, and many comments resulted in changes to the document.

Comments on the first draft HSW EIS generally were related to the following major issues:

- DOE's role in Hanford cleanup

- NEPA process: a number of comments indicated that the EIS questioned whether the HSW EIS complied with all NEPA requirements

- integration with other DOE programs and NEPA decisions: comments expressed concern that the HSW EIS be consistent with recent DOE proposals to accelerate cleanup at DOE sites and with recent NEPA decisions

- public involvement process: comments questioned the procedures used to notify members of the public about hearings on the draft HSW EIS, as well as the meeting process itself

- scope of transportation analysis: comments questioned the appropriateness of the WM PEIS transportation analysis and the decision not to repeat that nationwide analysis in the HSW EIS

- technical content and scope of the HSW EIS: comments 1) pointed out perceived omissions or inaccuracies in the HSW EIS technical analyses alternatives and scope of the EIS, and 2) requested evaluation of additional alternatives for waste treatment and disposal

- disposal facility design and long-term performance: there were numerous concerns regarding use of unlined trenches for disposal of LLW, as well as concerns about contamination of groundwater and the Columbia River

- importation of offsite waste to Hanford: comments expressed concern regarding the impact of additional offsite waste on the Hanford Site environment, as well as on other cleanup activities at Hanford.

An overview of the way in which DOE addressed each major issue, and the responses to specific comments received on the first draft HSW EIS, are included in the comment response volume (Volume III) of this revised draft HSW EIS.

1.6.4 Scoping for the ILAW Disposal SEIS

DOE prepared the TWRS EIS (DOE and Ecology 1996) to evaluate disposition of Hanford's high-level tank waste, as noted in the previous section. As part of the TWRS EIS ROD (62 FR 8693), DOE planned to place ILAW into concrete vaults in the 200 East Area. DOE subsequently began to examine alternative plans for disposing of ILAW in onsite near-surface facilities. Following a supplement analysis of disposal options for ILAW (DOE 2001h), DOE decided additional NEPA review was required, and a

Notice of Intent to prepare a SEIS was issued on July 8, 2002 (67 FR 45104). Alternatives under consideration included the following:

- Change ILAW form from vitrified cullet (granular glass particles similar to coarse sand) to a monolithic (single large) vitrified waste form in canisters.

- Change interim retrievable storage of ILAW in vaults to disposal in near-surface regulatory-compliant trenches of various configurations.

- Consider ILAW disposal at other potential sites within the 200 East and 200 West Areas.

The proposed changes were intended to be more cost effective and efficient with respect to land and other resource use. Worker safety and compatibility of the ILAW form with the engineered facility were also considerations.

Following the Notice of Intent to prepare the ILAW disposal SEIS, DOE held a scoping meeting in Richland, Washington, on August 20, 2002, and received oral and written comments during the 49-day scoping period. During scoping and preparation of a working draft SEIS, meetings were held in Seattle, Washington and Portland, Oregon. In addition, meetings were held with the Yakama Nation, Hanford Communities, Hanford Natural Resource Trustee Council, Oregon Office of Energy, and the Hanford Advisory Board. The scoping comments and questions centered on the following major themes:

- requests for technical information and clarification
- ILAW disposal alternatives
- long-term performance, mitigation, and stewardship
- ILAW form and treatment alternatives
- cumulative impacts
- regulatory, legal, and NEPA issues
- waste classification, definition of ILAW and HLW
- other impacts and analyses
- relationship to the HSW EIS and other NEPA documents
- public involvement process
- relationship to current DOE cleanup plans
- Native American treaty issues
- opposition to disposal or storage of ILAW at Hanford.

Appendix A in Volume II of this revised draft HSW EIS contains a summary of comments received on the scope of the ILAW SEIS. After scoping for the ILAW disposal SEIS, DOE decided to address ILAW disposal alternatives in this revised draft HSW EIS, and therefore terminated its preparation of the ILAW SEIS (68 FR 7110). The HSW EIS now provides the NEPA review for ILAW disposal in addition to Solid Waste Program operations evaluated in the first draft HSW EIS (DOE 2002b).

1.6.5 Revised Draft HSW EIS

This revised draft HSW EIS has been distributed for review and comment to the general public, members of Congress, appropriate federal agencies, interested governmental organizations, and affected State, tribal, and local governments. Stakeholders were notified of the upcoming publication of the HSW EIS, and were given the opportunity to request the document in several formats. The entire document was distributed as required or upon request. Other individuals who had requested the first draft HSW EIS or who requested this revised draft were provided a summary of this revised draft EIS with the complete document on compact disk. This revised draft HSW EIS addresses new waste management alternatives that have been developed since the first draft HSW EIS was issued in April 2002 (DOE 2002b). These alternatives were developed after review of the Hanford Site Performance Management Plan prepared in August 2002 (DOE-RL 2002b), recent discussions with regulatory agencies and stakeholders (DOE-RL 2002a), and in response to public comments. It also incorporates alternatives for onsite disposal of ILAW, as discussed in the previous section. In response to requests for additional information regarding offsite transportation risks, this revised draft HSW EIS includes an expanded discussion of transportation consequences based on the analyses in the WM PEIS and the WIPP SEIS2.

Because of the substantial changes relative to the first draft HSW EIS, DOE elected to issue this revised draft for public comment. The public involvement process is expected to be similar the one for the first draft HSW EIS. In addition to soliciting written comments, DOE will schedule public hearings to receive oral and written comments on this revised draft HSW EIS. The schedule for public review and hearings will be announced in the *Federal Register* and local media.

1.6.6 Preparation of the Final HSW EIS and Record(s) of Decision

Following the public comment period and after considering the comments received on this revised draft HSW EIS, DOE will revise the document as needed. DOE will consider all comments received during the public comment period on the revised draft HSW EIS. A final EIS or an addendum to this revised draft EIS will be issued depending on the extent and scope of revisions. Comments on the revised draft EIS will be addressed in the final EIS or the addendum.[a] The final EIS will receive a distribution similar to this revised draft EIS.

No sooner than 30 days after the EPA Notice of Availability of the final HSW EIS published in the *Federal Register*, DOE may issue one or more RODs for actions described in the final HSW EIS. In addition to the environmental consequences described in the final HSW EIS, DOE may evaluate other issues such as cost, programmatic considerations, and national needs in making its decision(s).

(a) 40 CFR 1502.19 specifies that "Agencies shall circulate the entire draft and final environmental impact statements except for certain appendices as provided in Sec. 1502.18(d) and unchanged statements as provided in Sec. 1503.4(c)." 40 CFR 1503.4(c) states "If changes in response to comments are minor and are confined to the responses described in paragraphs (a) (4) and (5) of this section, agencies may write them on errata sheets and attach them to the statement instead of rewriting the draft statement. In such cases, only the comments, the responses, and the changes and not the final statement need be circulated (Sec 1502.19)."

If mitigation measures, monitoring, or other conditions are adopted as part of a DOE decision, they will be summarized in the ROD(s), if applicable, and a mitigation action plan will be prepared. The ROD(s) and mitigation action plan, if needed, will be placed in the DOE Reading Room in Washington, D.C., and in the DOE Public Reading Room at Washington State University, Tri-Cities Campus. They will also be available to interested parties upon request.

1.7 Scope of the Revised Draft HSW EIS

This revised draft HSW EIS addresses proposed actions and alternatives for managing four major waste types: LLW, MLLW, TRU waste, and ILAW. It updates previous Hanford NEPA reviews to incorporate alternatives developed after those reviews were completed, and evaluates or updates evaluations of site-specific impacts associated with the WM PEIS (DOE 1997c). Hanford waste management operations include the three major functions of storage, treatment, and disposal. Alternatives evaluated in this EIS address continued operation and expansion of ongoing waste management operations to accommodate future waste receipts. A range of waste volumes is evaluated for each alternative in order to encompass the quantities of waste that might be received at Hanford for management in the future.

1.7.1 Waste Types Evaluated in the Revised Draft HSW EIS

The types of waste evaluated in the revised draft HSW EIS are described in the following sections. Descriptions of the specific waste streams within each waste type and their management alternatives at Hanford are presented in Section 2 and Section 3, respectively.

1.7.1.1 Low-Level Waste

LLW is waste that contains radioactive material and that does not fall under any other DOE classification of radioactive waste. DOE manages LLW and other radioactive waste under the authority of the Atomic Energy Act (AEA) of 1954 (42 USC 2011). At Hanford, LLW may be further divided into Category 1 (Cat 1), Category 3 (Cat 3), or greater than Category 3 (GTC3) LLW, depending on the specific characteristics and quantities of radioactive material that it contains, as defined in the *Hanford Site Solid Waste Acceptance Criteria* (HSSWAC) (FH 2002). LLW streams managed at Hanford are described in Section 2.1.1.

Contact-Handled (CH) and Remote-Handled (RH) Waste

Contact-handled waste containers produce radiation dose rates less than or equal to 200 millirem/hour at the container surface. RH waste containers produce dose rates greater than 200 millirem/hour. CH containers can be safely handled by direct contact using appropriate health and safety measures. RH containers require special handling or shielding during waste management operations. These designations can apply to LLW, MLLW, TRU waste, and ILAW.

LLW and other radioactive wastes are also classified as either contact-handled (CH) or remote-handled (RH), depending on radiation dose rates as measured in contact with the container surface.

If mitigation measures, monitoring, or other conditions are adopted as part of a DOE decision, they will be summarized in the ROD(s), if applicable, and a mitigation action plan will be prepared. The ROD(s) and mitigation action plan, if needed, will be placed in the DOE Reading Room in Washington, D.C., and in the DOE Public Reading Room at Washington State University, Tri-Cities Campus. They will also be available to interested parties upon request.

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LLW and other radioactive wastes are also classified as either contact-handled (CH) or remote-handled (RH), depending on radiation dose rates as measured in contact with the container surface.

1.7.1.2 Mixed Low-Level Waste

MLLW is LLW that also contains hazardous components as defined by the Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901) and applicable State regulations. Hazardous waste requirements became applicable to DOE waste in 1987. The hazardous components of MLLW are regulated under applicable RCRA or State regulations (40 CFR 260-280; WAC 173-303). The radioactive components of MLLW are regulated by DOE under the AEA (42 USC 2011). MLLW streams managed at Hanford are described in Section 2.1.2. Additional discussion of regulations for managing radioactive and hazardous wastes at Hanford is provided in Section 6.

1.7.1.3 Transuranic Waste

TRU waste contains greater than specified quantities of TRU radionuclides as defined in Section 2.1.3. TRU waste can also contain hazardous waste components. The radioactive components of all TRU waste are regulated under the AEA (42 USC 2011). The hazardous components of TRU waste are regulated under applicable RCRA or State regulations (40 CFR 260-280; WAC 173-303). TRU waste must be characterized, packaged, and certified as meeting the WIPP waste acceptance criteria before it can be shipped to that facility for disposal.

TRU waste was not defined as a separate waste type until 1970. From 1970 through 1988, waste suspected of containing TRU radionuclides was retrievably stored in the Hanford LLBGs. This waste is referred to as suspect TRU waste because only part of the stored waste contains TRU radionuclides at concentrations specified in the current definition for TRU waste. Since 1988, TRU waste has generally been stored in surface facilities until it can be processed and certified for disposal at WIPP.

DOE previously decided to characterize the retrievably stored waste and recover the containers that are determined to contain TRU waste for processing and shipment to WIPP (DOE 1987). DOE has begun to characterize the retrievably stored waste to determine which containers should be retrieved and processed as TRU waste. TRU waste managed by the Hanford Solid Waste Program is described in Section 2.1.3.

1.7.1.4 Immobilized Low-Activity Waste and Melters from the Hanford Tank Waste Treatment Plant

For purposes of analysis in this HSW EIS, ILAW and melters from the WTP are assumed to be managed and disposed of as RH MLLW. The first draft HSW EIS evaluated disposal of the WTP melters as part of the pretreated MLLW waste stream, but did not address disposal of ILAW. Under this revised draft, the melters and ILAW are evaluated separately from other MLLW because the physical requirements for onsite transport, handling, and disposal differ from those typically used for most routine operational LLW and MLLW.

Hanford tank waste is presently considered mixed waste from a regulatory perspective. Based on the *Remote-Handled Immobilized Low-Activity Waste Disposal Facility Environmental Permits and Approval Plan* (Deffenbaugh 2000), the recommended approach for ILAW disposal in this document would be to follow the normal State and RCRA permitting process. However, there are other regulatory processes that could allow DOE to dispose of ILAW consistent with RCRA requirements, including petitioning for variance, rulemaking, and/or delisting.

1.7.2 Waste Volumes Evaluated in the Revised Draft HSW EIS

Unless stated otherwise, environmental consequences in the HSW EIS have been evaluated for three waste volumes: a Hanford Only, a Lower Bound, and an Upper Bound waste volume. Because of uncertainty about future waste receipts, these alternative waste volume scenarios were evaluated to encompass the range of quantities that might be received.

- The **Hanford Only** waste volume consists of 1) the forecast volumes of LLW, MLLW, and TRU waste from Hanford Site generators, 2) the forecast ILAW and melter volumes from treatment of Hanford tank waste, and 3) existing onsite inventories of waste that are already in storage. The analysis also includes waste that has previously been disposed of.

- The **Lower Bound** waste volume consists of 1) the Hanford Only volume, and 2) additional volumes of LLW and MLLW that are currently forecast for shipment to Hanford from offsite facilities. The Lower Bound volume for TRU waste is not substantially greater than the Hanford Only volume, and is not analyzed separately in all cases.

- The **Upper Bound** waste volume consists of 1) the Lower Bound volume, and 2) estimates of additional LLW, MLLW, and TRU waste volumes that may be received from offsite generators as a result of the WM PEIS decisions.

The first draft HSW EIS evaluated consequences for the Lower and Upper Bound waste volumes. The Hanford Only waste volume was added to this revised draft HSW EIS so the incremental impacts of managing all offsite waste can be clearly evaluated. The bases for waste volumes evaluated in the HSW EIS are discussed further in Section 3.3 and Appendix C.

1.7.3 Hanford Waste Management Alternatives Evaluated in the Revised Draft HSW EIS

This revised draft HSW EIS considers a range of reasonable alternatives for management of solid LLW, MLLW, TRU waste, and ILAW at the Hanford Site. The waste management alternatives included within the scope of this revised draft HSW EIS are described briefly in the following sections. Hanford Solid Waste Program activities include storage, treatment, and disposal of LLW and MLLW, as well as storage, processing, and certification of TRU waste for shipment to WIPP. The HSW EIS also evaluates alternatives for onsite disposal of ILAW and melters from the WTP. In its final decision, DOE could choose to implement a combination of actions from any of the alternatives evaluated in this EIS. Existing and proposed waste management facilities considered in the HSW EIS alternatives are described in Section 2.2. The action and no action alternatives for managing these wastes are described further in Section 3.1. In this EIS, the no action alternative consists of continuing ongoing activities, but does not include development of new capabilities to manage wastes that cannot currently be disposed of.

1.7.3.1 Storage

Waste is generally stored while awaiting treatment or disposal. The specific storage methods used depend on the chemical and physical characteristics of the waste as well as the type and concentration of radionuclides in the waste.

In most cases, alternatives for storage of LLW, MLLW, and TRU waste consist of using existing or planned capabilities at the Central Waste Complex (CWC), T Plant, the LLBGs, or other onsite facilities. Except for the No Action Alternative, additional storage capacity is not expected to be necessary to accommodate future waste receipts. As waste in storage is treated, processed, or certified for disposal, space would become available for storage of newly received waste. The consequences of operating storage facilities needed to manage Hanford solid waste are included in the HSW EIS to provide a complete assessment and to bound the potential impacts associated with the proposed action. Conservative assumptions are used to provide flexibility in the event of future minor revisions to facility activities.

In the No Action Alternative, treatment and processing capabilities would not be available for all waste types, and any wastes that could not be disposed of would require storage. The analysis in this EIS assumes expansion of the CWC to accommodate most untreated LLW, MLLW, and TRU waste, and treated MLLW that exceeds existing disposal capacity. The No Action Alternative for ILAW includes construction of concrete vaults consistent with the TWRS EIS ROD (62 FR 8693) in the 200 East Area for interim storage.

1.7.3.2 Treatment

Treatment action alternatives examined in this revised draft HSW EIS are shown in Figure 1.5. These alternatives apply two different approaches to processing wastes for disposal.

- **The first approach** would maximize the use of offsite treatment (with full realization that because of its nature some waste would continue to be treated onsite). The alternatives that would maximize use of offsite treatment would include actions DOE previously identified as the preferred alternative for treatment of LLW, MLLW, and TRU waste in the first draft HSW EIS. In general, those actions are expected to minimize environmental impacts by using or modifying existing onsite and offsite facilities for treatment, processing, and certification of waste. Non-conforming LLW would be treated to comply with the HSSWAC at offsite commercial facilities if treatment capacity does not exist at Hanford. DOE would establish additional contracts with a permitted commercial facility (or facilities) to treat most of Hanford's CH MLLW using both thermal and non-thermal processes. For MLLW and TRU waste that cannot be treated at existing facilities, such as RH or non-standard items, DOE would develop new onsite treatment capacity by modifying facilities in the T Plant Complex.

- **The second approach** for acquiring new treatment capacity would maximize the use of onsite treatment capabilities. Under this approach, the alternatives include activities that maximize treatment of MLLW and non-conforming LLW onsite at Hanford. These alternatives are expected to result in the maximum environmental impacts for operations because they include more onsite activities and construction of a new onsite facility (or facilities) to process some LLW, MLLW and TRU waste. The new waste processing facility would be used to treat non-conforming LLW to comply with the HSSWAC if treatment capacity does not exist at Hanford. Except for the limited quantities treated under existing commercial contracts, most of Hanford's CH MLLW would be treated at a new facility using non-thermal processes (including alternatives to thermal processing for some wastes). The new facility would also be used to process MLLW and TRU waste that cannot be accepted at existing facilities, such as RH or non-standard items.

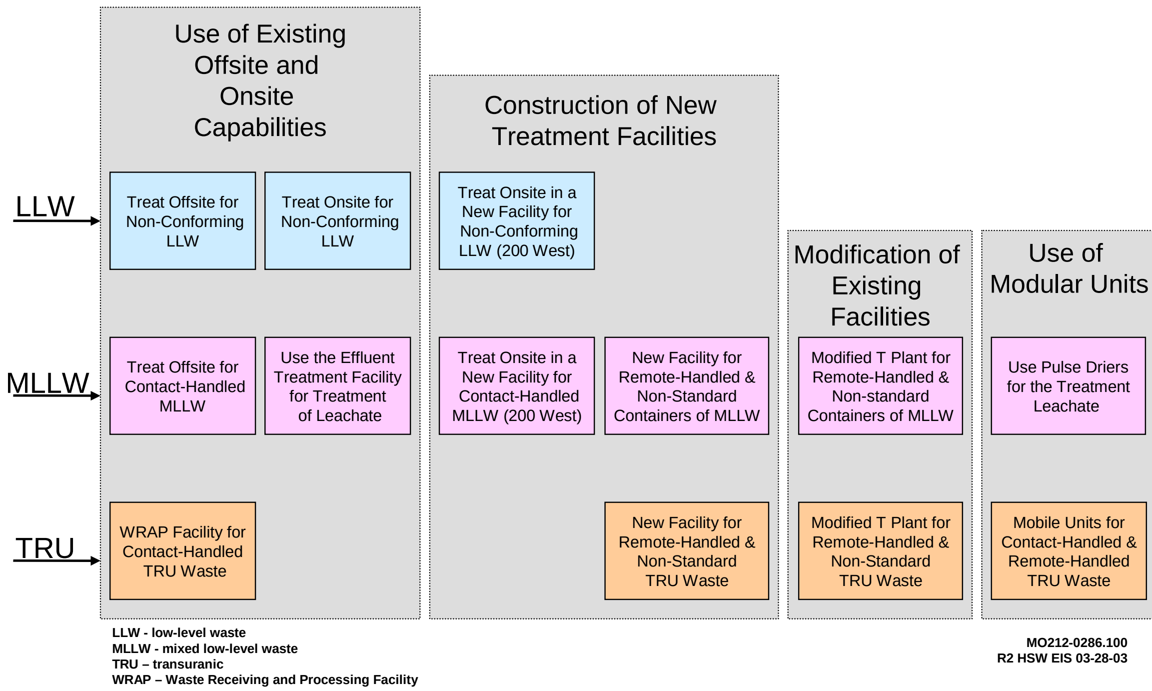

Figure 1.5. Treatment Action Alternatives (ILAW treatment alternatives are evaluated under the TWRS EIS [DOE and Ecology 1996])

In the No Action Alternative, only existing capacity for waste treatment would be used. Some non-conforming LLW, untreated MLLW, and TRU waste that cannot be processed or certified at WRAP would not be suitable for disposal, and those wastes would be stored onsite.

1.7.3.3 Disposal

The final step in the waste management process is disposal. Some types of radioactive and mixed waste can be disposed of safely in existing facilities using conventional methods such as near-surface disposal. Other types of waste require facilities that provide long-term isolation, such as a repository. Disposal facilities at Hanford accept waste suitable for near-surface disposal. Any waste from Hanford or other facilities that requires long-term isolation would ultimately be sent to a repository such as WIPP or Yucca Mountain. This EIS evaluates alternatives or updates previous plans for permanent disposal of LLW, MLLW, ILAW, and WTP melters at Hanford, including expansion, possible reconfiguration, and closure of onsite disposal facilities.

Alternatives for Waste Disposal. Alternatives in this revised draft HSW EIS assume continued use of disposal capabilities that currently exist at Hanford. DOE would construct additional disposal capacity for LLW and MLLW. New disposal facilities would also be constructed to receive ILAW and melters based on the schedule for startup and operation of the WTP. All disposal facilities would meet applicable State and federal requirements. Facilities for disposal of MLLW, ILAW, and melters would be constructed to applicable regulatory standards with double liners and leachate collection systems. LLW disposal in either lined or unlined trenches is evaluated in various alternatives. By the end of operations, all disposal facilities would be closed by applying a regulatory-compliant cap to reduce water infiltration and the potential for intrusion.

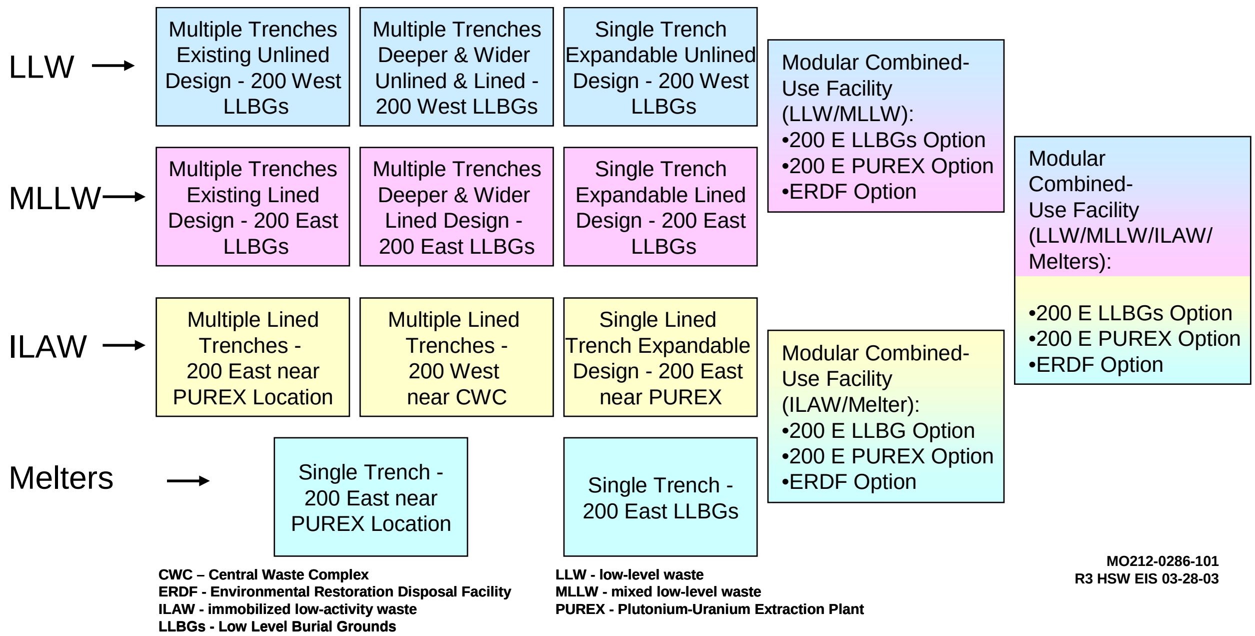

Figure 1.6. Disposal Action Alternatives

Several different configurations and locations are evaluated for new disposal facilities needed to manage each waste type. The disposal action alternatives are shown in Figure 1.6. Section 3 contains a description of these disposal alternatives as evaluated in the HSW EIS. An overview of the configuration and location alternatives is as follows:

- **Disposal Configuration Alternatives**: Alternatives for disposal configuration include various options for the number and size of trenches, including facilities dedicated to a single type of waste and options for combined disposal of two or more waste types. Alternatives for segregated disposal of LLW or MLLW consist of multiple trenches similar to those currently employed for each waste type, multiple trenches of a deeper and wider configuration, or a single expandable trench for each waste type. Similarly, ILAW disposal is evaluated using multiple trenches or a single expandable trench. The independent disposal alternative for WTP melters considers a single dedicated trench because of their relatively small overall volume, and because of constraints imposed by the size and weight of individual waste packages.

Alternatives for combined disposal of two or more waste types are also evaluated. The HSW EIS considers alternatives that include two combined-use disposal facilities: one for combined disposal of LLW and MLLW, and one for combined disposal of ILAW and melters. In addition, disposal of all waste types in a single combined-use facility is evaluated.

- **Disposal Location Alternatives**: The HSW EIS disposal alternatives consider several different locations for new or expanded disposal facilities, including use of LLBGs in the 200 West and 200 East Areas. New disposal sites in the 200 West Area near the CWC and in the 200 East Area near the PUREX Facility are also evaluated. Some alternatives involving combined-use disposal facilities evaluated the use of ERDF. However, such an arrangement would require modifications to the ERDF waste acceptance criteria, as well as to conditions specified in the TPA. A revision to the CERCLA ROD for ERDF might also be necessary.

In the No Action Alternative, LLW would continue to be disposed of in LLBG trenches of a design currently employed. The trenches would be backfilled but would not be capped. The two existing MLLW trenches would be filled to capacity and capped in accordance with applicable regulations. MLLW that exceeds the trench capacity, including WTP melters, would be stored onsite. ILAW would be placed in concrete vaults in the 200 East Area (62 FR 8693).

1.7.3.4 Grouping of Alternatives

In developing the alternatives for this HSW EIS there are a large number of combinations of the various waste streams, their potential waste volumes, and individual options for their storage, treatment, and disposal. To facilitate the analysis and presentation of impacts, these alternatives and options were combined into five primary alternative groups. Alternatives for the treatment, storage, and disposal for the different waste types were included in each alternative group, in addition to a range of potential waste volumes. The alternative groups have been identified as A, B, C, D, and E. A No Action Alternative was also evaluated as required under NEPA. For Alternative Groups D and E, several different potential locations were evaluated for the disposal facility(s) within the 200 East and 200 West Areas. With the exception of the No Action Alternative, each alternative is consistent with WM PEIS RODs. For LLW, MLLW, and TRU wastes, Alternative Group A, Alternative Group B, and the No Action Alternative are fundamentally the same as Alternative 1, Alternative 2, and the No Action Alternative, described in the first draft of this HSW EIS (DOE 2002b). Alternative Groups C, D, and E (and their options) are new and are supported by new analysis. Figure 1.7 illustrates the alternatives included in each of these alternative groups.

No Action Alternative: The No Action Alternative consists of continuing current solid waste management practices, including indefinite storage of radioactive wastes that cannot be processed for disposal. As part of the No Action Alternative, RODs and other NEPA decisions for existing facilities and operations would be implemented and ongoing activities would continue, consistent with the Council on Environmental Quality guidelines. This is the “no action” alternative for an ongoing activity, where the EIS assumes there is no change from existing operations. For example, Hanford would continue to

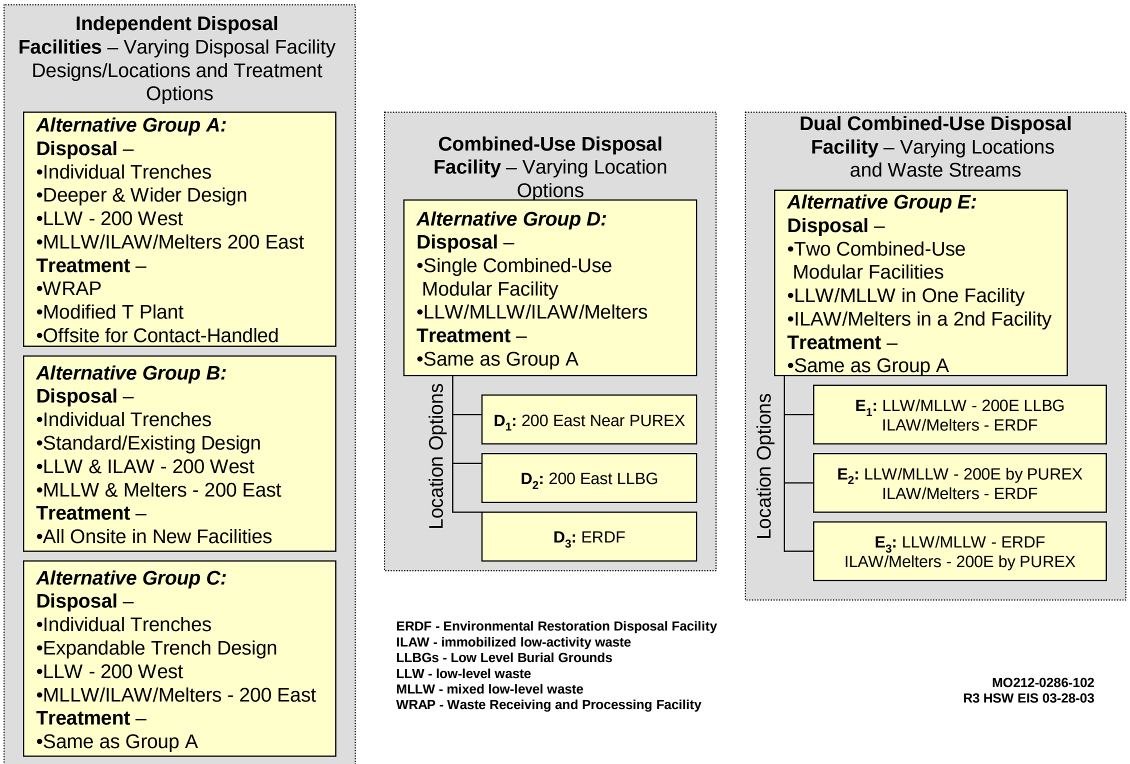

Figure 1.7. Development of Alternative Groups

dispose of LLW and MLLW within the Low Level Burial Grounds, and to certify and ship TRU waste to WIPP. A "Stop Action" scenario is also described, in which ongoing waste management operations would cease.

Alternative Group A – ***Disposal by Waste Type in Larger Disposal Facilities – Onsite and Offsite Treatment***: New LLW and MLLW disposal trenches would be deeper and wider than those currently in use. New LLW disposal capacity would be located in the 200 West Area and new MLLW, ILAW, and melter disposal facilities would be located in the 200 East Area. T Plant would be modified to provide treatment capabilities for remote-handled TRU waste, remote-handled MLLW, and waste in non-standard containers. Treatment of contact-handled MLLW would be provided at offsite facilities.

Alternative Group B – ***Disposal by Waste Type in Existing Design Disposal Trenches – Onsite Treatment***: Disposal trenches for LLW and MLLW would be of the same design as those currently in use. New LLW and ILAW trenches would be located in the 200 West Area and new MLLW and melter trenches would be located in the 200 East Area. A new facility would be built to provide treatment capabilities for remote-handled TRU waste, remote-handled and contact-handled MLLW, and waste in non-standard containers. Modular facilities (accelerated process lines, or APLs) would also be used for processing and certification of TRU waste to accelerate preparation of the waste for disposal at WIPP.

Alternative Group C – ***Disposal by Waste Type in Expandable Design Facility – Onsite and Offsite Treatment***: A single, expandable disposal facility (similar to the Environmental Restoration Disposal Facility) would be used for each waste type. New LLW facilities would be located in the 200 West Area and new MLLW, ILAW, and melter facilities would be located in the 200 East Area. Treatment alternatives would be the same as those described for Alternative Group A.

Alternative Group D – ***Single Combined-Use Disposal Facility – Onsite and Offsite Treatment***: LLW, MLLW, ILAW, and melters would be disposed of in a single facility. Disposal would occur either near the PUREX Plant (D_1), in the 200 East Area Low Level Burial Grounds (D_2), or at the Environmental Restoration Disposal Facility (D_3). Treatment alternatives would be the same as those described for Alternative Group A.

Alternative Group E – ***Dual Combined-Use Disposal Facilities – Onsite and Offsite Treatment***: LLW and MLLW would be disposed of in a single facility; ILAW and melters would be disposed of in another single facility. Disposal would occur in some combination of locations as shown in Figure 1.7. Treatment alternatives would be the same as those described for Alternative Group A.

1.7.4 Environmental Impact Analyses in the Revised Draft HSW EIS

Analyses of environmental consequences from waste management operations in the HSW EIS includes assessment of impacts in the following areas as required by NEPA:

- land use
- air quality
- water quality
- geologic resources
- ecological resources
- socioeconomics
- cultural resources
- transportation
- noise
- health and safety
- aesthetic and scenic resources
- environmental justice
- cumulative impacts
- irreversible and irretrievable commitments of resources
- unavoidable adverse impacts
- potential mitigation measures.

Analyses were expanded to include additional alternatives and the impacts from the Hanford Only waste volume. Major changes to the environmental consequences analysis in this revised draft HSW EIS include an expanded presentation of the impacts on groundwater quality and a summary of the offsite transportation consequences based on previous analyses in the WM PEIS and WIPP SEIS2. The cumulative impacts analysis is also more comprehensive.

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2.0 HSW EIS Waste Streams and Waste Management Facilities

This section describes:

- the four waste types: low-level waste (LLW), mixed low-level waste (MLLW), transuranic (TRU) waste, and Waste Treatment Plant (WTP) waste[(a)]
- the specific waste streams within the four waste types
- the waste management facilities that are currently being used
- the new or modified facilities that are being evaluated in this HSW EIS.

Additional information on Hanford waste streams and facilities is contained in Appendixes B, C, and D and the Technical Information Document (FH 2003).

2.1 Solid Waste Types and Waste Streams Related to the Proposed Action

Historically, solid LLW was disposed of in shallow-land disposal units. In 1970, a U.S. Department of Energy predecessor agency, the U.S. Atomic Energy Commission (AEC), determined that waste containing TRU radionuclides would be managed separately from LLW and stored until an appropriate disposal facility was available. Beginning at that time, the suspect TRU waste was placed into retrievable storage (hence, it is sometimes called "retrievably stored").

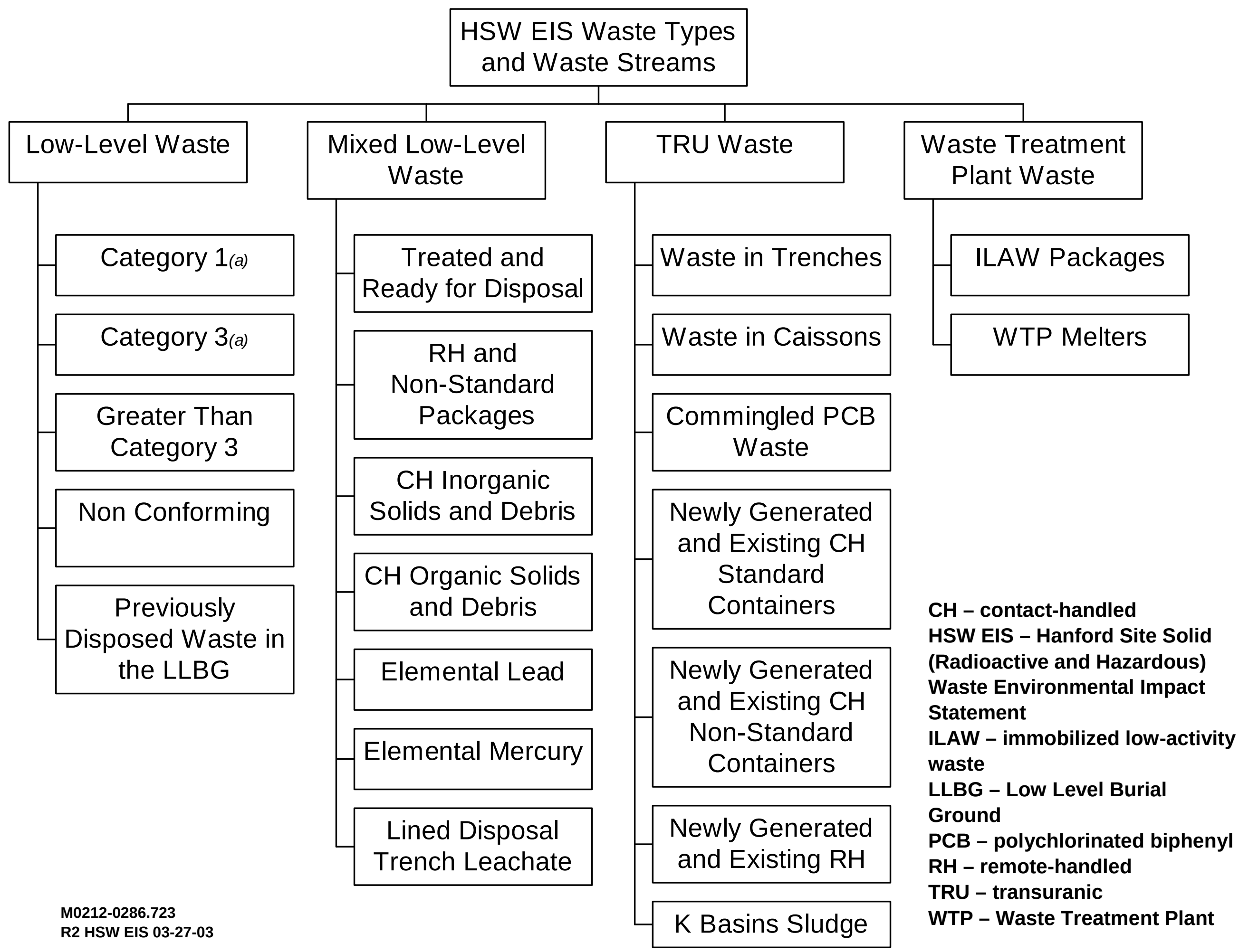
In 1987, DOE directed that radioactive waste containing chemically hazardous components, as identified under the Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901 et seq.), be separated and managed separately from LLW (10 CFR 962.3). This waste, referred to as MLLW, is placed into above ground storage facilities at Hanford until it can be treated and disposed of.

The treatment of the Hanford tank waste as part of the River Protection Project within the WTP will result in several waste streams. Of those waste streams, ILAW and melters are being specifically considered in this EIS.

Each of the four waste types has been further divided into waste streams for analysis in this HSW EIS. For the purposes of this EIS, a waste stream is defined as waste with physical and chemical characteristics that would generally require the same management approach (i.e., using the same storage, treatment, and disposal capabilities). The waste types and waste streams considered within this EIS are shown in Figure 2.1. Brief descriptions of the waste streams are contained in subsequent sections. Information on the volume of waste associated with each stream is provided in Section 3.3.

(a) The WTP wastes (immobilized low-activity waste and melters) as evaluated are MLLW, but are considered a separate waste type for the discussions in this EIS.

Radioactive waste may be contact-handled (CH) or remote-handled (RH) waste. CH waste has a dose rate less than 200 millirem/hr as measured with the detector in contact with the container and can be handled without shielding. The RH waste classification applies to containers with a contact dose rate greater than 200 millirem/hr. RH waste requires the use of additional shielding and special facilities to protect workers.



(a) Category 2 LLW is no longer considered a separate waste stream. See Section 2.1.1.2 for explanation.

Figure 2.1. Waste Types and Waste Streams Considered in the HSW EIS

2.1.1 LLW Streams

Low-level waste may be generated during the handling of radioactive materials, which results in the contamination of items and materials. Because many different activities are conducted using different types of radioactive materials and levels of radioactivity, there is a wide variation in the chemical and physical characteristics of waste and levels of contamination. Most of the LLW currently in the Low

Level Burial Grounds (LLBGs) was generated by analytical laboratories, reactors, separation facilities, plutonium processing facilities, and waste management activities. 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 purification of water in radioactive material storage basins. In the foreseeable future, analytical laboratories, research operations, facility deactivation projects, waste management activities, and other onsite and offsite activities would likely continue to generate LLW.

Typical containers used for burial of LLW include 208-L (55-gal) metal drums and boxes nominally 1.2 m by 1.2 m by 2.4 m (4 ft by 4 ft by 8 ft) in size. Other boxes are made in various sizes to accommodate specific waste items. Cardboard, wood, and fiber-reinforced plastic boxes have also been used. Large items or equipment may be wrapped in plastic. However, some bulk waste (that is, soil or rubble) is disposed of without containers.

Both onsite and offsite generators of LLW are required to meet specific criteria for their wastes to be accepted for disposal at Hanford. Those requirements are defined in the *Hanford Site Solid Waste Acceptance Criteria* (HSSWAC) (FH 2003) and include requirements on the waste package, descriptions of the contents of the waste package, the radionuclide content, physical size, and chemical composition. To verify that generators conform with the HSSWAC, a random sample of incoming CH waste is periodically selected for verification at the Waste Receiving and Processing Facility (WRAP), the T Plant Complex, or other appropriate location. Verification of RH waste is typically conducted at the generating facility. Discovery of non-conforming waste can result in rejection of the waste with its return to the generator, or the need for removal or treatment of prohibited items at the generator's expense. Most LLW is only stored for short periods of time awaiting verification or disposal.

The HSSWAC also define LLW categories summarized below by radionuclide activity level. The categories are based on site-specific performance assessments that were conducted in conformance with DOE Manual 435.1-1 (DOE 2001a). The HSSWAC should be consulted for technical details defining Category 1 (Cat 1), Category 3 (Cat 3), and greater than Category 3 (GTC3) wastes. Cat 1 wastes have lower concentrations of radionuclides than Cat 3 wastes. All Cat 1 and Cat 3 wastes that meet the HSSWAC requirements can be disposed of in the LLBGs. GTC3 wastes have even higher concentrations of radionuclides than Cat 3 wastes and require a specific analysis to determine whether they can be disposed of in the LLBGs. Cat 3 and GTC3 LLW are subject to additional disposal requirements because they contain higher concentrations of long-lived mobile radionuclides.

The U.S. Nuclear Regulatory Commission (NRC) in 10 CFR 61.55 defines four classes of LLW (A, B, C, and greater than Class C). The NRC requirements apply to all commercial LLW disposal sites. The HSSWAC only apply to Hanford and are adjusted for specific Hanford conditions. Therefore the radionuclide concentrations specified for each NRC class are not necessarily the same as those defined in the HSSWAC for LLW categories.

2.1.1.1 Low-Level Waste – Category 1

Cat 1 LLW represents the largest volume of waste expected at the Hanford Site. It has the lowest concentrations of radioactivity and can be directly placed into the LLBG trenches without treatment and in some cases without additional packaging. Cat 1 LLW can be either CH or RH waste.

2.1.1.2 Low-Level Waste – Category 3

In the original development of the waste categories, Category 2 LLW was defined. However, this category resulted in a small volume of waste and the previous Category 2 material is now managed as Cat 3 LLW. Cat 3 LLW is defined as having radionuclide concentrations greater than limits specified in the HSSWAC for Cat 1 LLW, but lower than maximum concentration limits defined for Cat 3 LLW. Cat 3 LLW is similar to Cat 1 LLW except that it has higher concentrations of certain radionuclides, and requires greater confinement for burial in the LLBGs (FH 2003). Cat 3 LLW may also be CH or RH waste. Greater confinement in the LLBGs has typically been provided either by packaging the wastes in high-integrity containers (HICs) or by in-trench grouting prior to burial (Section 2.2.3). Typical sources of the Cat 3 LLW are operation or cleanout of hot cells and canyon facilities, removal of HLW storage tank equipment, examination of irradiated reactor fuel assembly components, and other operations that handle higher activity items.

2.1.1.3 Low-Level Waste – Greater Than Category 3

GTC3 LLW exceeds the radionuclide concentration limits for Cat 3 LLW. GTC3 LLW requires a specific evaluation to demonstrate that requirements of the LLBG performance assessments would be met before it can be disposed of at Hanford. GTC3 LLW can generally be disposed of in the same manner as Cat 3 LLW in HICs or by in-trench grouting. The sources of GTC3 LLW are similar to Cat 3 LLW. No GTC3 LLW is currently forecast; however, a small volume of this waste is analyzed in this EIS to address future contingencies.

2.1.1.4 Low-Level Waste – Non-Conforming

Non-conforming LLW is waste that does not meet the current HSSWAC for burial and cannot readily be treated to meet those requirements. Waste containers may not exceed one percent free liquid by volume. Non-conforming waste needs to be processed so it conforms with the HSSWAC.

2.1.1.5 Waste Previously Disposed of in the Low Level Burial Grounds

This waste stream includes all waste that has been disposed of in the LLBGs described in Appendix D except for the retrievably stored TRU waste. The previously buried waste constitutes waste that has been disposed of. This waste is included in the EIS analysis of LLBG closure, long-term, and cumulative impacts.

2.1.2 Mixed Low-Level Waste Streams

Regulatory information for mixed wastes can be found in Sections 6.3 and 6.4. Both onsite and offsite MLLW must also meet requirements of HSSWAC. Some waste is subject to Washington State RCRA program (regulated under the Dangerous Waste Regulations, Chapter 173-303 WAC) with delegated authority for implementation of the Federal RCRA program and independent state statutory authority pursuant to the Washington State Hazardous Waste Management Act (RCW 70.105). In addition, Hanford has some LLW that also contains polychlorinated biphenyls (PCBs), which are regulated under the Toxic Substances Control Act (TSCA) of 1976 (15 USC 2601 et seq.). TSCA wastes are being managed similar to mixed wastes and are included in MLLW inventories and projections. In addition, wastes that are not considered hazardous by the U.S. Environmental Protection Agency (EPA) may be managed as MLLW because they are considered toxic, persistent, or corrosive by state regulations. MLLW was generated by activities similar to those that created LLW, and the two types of waste were not differentiated until 1987. Beginning in 1987, DOE determined that radioactive wastes mixed with hazardous wastes would be designated under RCRA, and would be managed in accordance with RCRA (10 CFR 962.3). Accordingly, DOE has acquired regulatory-compliant waste management storage facilities through building new, or modifying existing Hanford facilities.

Hanford's MLLW was generated from operations, maintenance, and cleanout of reactors, chemical separation facilities, high-level waste (HLW) tanks, and laboratories. MLLW contains the same type of materials as LLW. It typically consists of materials such as sludges, ashes, resins, paint waste, soils, lead shielding, contaminated equipment, protective clothing, plastic sheeting, gloves, paper, wood, analytical waste, and contaminated soil. Hazardous components may include lead and other heavy metals, solvents, paints, oils, other hazardous organic materials, or components that exhibit characteristics of ignitability, corrosivity, toxicity, or reactivity as defined by the dangerous waste regulations.

Extended storage of MLLW is restricted to permitted engineered facilities, such as the CWC. However, pursuant to the applicable regulations, non-permitted facilities may accumulate newly generated MLLW for periods up to 90 days before transferring them to a permitted storage or treatment facility (WAC 173-303-200). Regulatory compliant treatment (generally immobilization or destruction of the hazardous component) is required before most of the MLLW can be sent to a permitted land disposal facility. In some cases, MLLW will already be treated and regulatory compliant when it is received and can be sent directly to the disposal facility. In other cases, the waste will require treatment prior to disposal. Brief descriptions of potential mixed waste treatment technologies are included in the Technical Information Document (FH 2003). The current approach to treatment of MLLW at Hanford uses a combination of onsite and commercial treatment facilities. The Hanford Site currently has limited capacity for MLLW treatment at facilities such as WRAP and the T Plant Complex. Two contracts (discussed in Section 2.2.2.2) were placed with a commercial vendor to begin treating limited quantities of CH MLLW in the year 2000. The contracts were intended to serve as a technical demonstration for future commercial treatment of the majority of Hanford's MLLW (See Section 2.2.2.2). After the waste has been treated and meets the regulatory requirements, it can be disposed of in a regulatory-compliant disposal facility. Hanford currently has two MLLW disposal trenches located in the 200 West Area that are operating under interim status. To minimize settling of the backfill and caps on the burial ground, waste packages are required to be 90 percent full when they are received.

2.1.2.1 Mixed Low-Level Waste – Treated and Ready for Disposal

This waste stream consists of MLLW that has been treated to meet the RCRA and state requirements for land disposal. The River Protection Project (RPP) is expected to be the primary Hanford generator of MLLW. The RPP waste includes long-length equipment (see Figure 2.2) from HLW tank retrieval operations, which would be macroencapsulated. MLLW received from offsite generators is assumed to arrive in a regulatory-compliant form and ready for disposal.

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HSW EIS 12-10-02

Figure 2.2. Long-Length Equipment Being Removed from a Tank

2.1.2.2 Mixed Low-Level Waste – RH and Non-Standard Packages

Existing and forecast quantities of RH MLLW cannot easily be treated under the existing MLLW treatment contracts or at onsite facilities. This waste has physical and chemical characteristics similar to other MLLW, but requires a shielded facility and special equipment for remote handling. In the future, some non-standard packages of CH waste may also be received for which there is no treatment facility. This waste would remain in storage until treatment facilities are available.

2.1.2.3 MLLW – CH Inorganic Solids and Debris

Inorganic solid waste may include substances such as sludges, paints, and dried inorganic chemicals. Debris waste must meet criteria defined in state regulations (WAC 173-303-040). Inorganic debris wastes often contain metal, ceramic, and concrete items and may result from removal of failed or obsolete equipment or from disposal of items used during process operations. They may also result from cleanout or decommissioning of inactive facilities. These wastes generally require treatment by stabilization, or macroencapsulation before disposal.

> ***Non-Thermal Treatments***
> such as stabilization and macroen-capsulation are used to immobilize radionuclides and hazardous inorganic components using cement or plastics either as a jacket of material around the waste or as a matrix incorporating the waste.

2.1.2.4 MLLW – CH Organic Solids and Debris

Organic solid waste may include substances such as resins, organic absorbents, and activated carbon. Organic debris wastes meet the regulatory requirements for debris wastes (WAC 173-303-040) and have a greater than 10 percent organic/carbonaceous content. Typical wastes include paper, wood, or plastic. These wastes are included as organic/carbonaceous waste in WAC 173-303-140, which requires that they be thermally treated if capacity is available. There are no existing or planned Hanford facilities with thermal treatment capability for solid waste. Until thermal treatment is available within 1610 km (1000 mi) (WAC 173-303-140), DOE has been authorized by the Washington State Department of Ecology (Ecology) to treat organic debris waste by macroencapsulation.

> ***Thermal Treatments***
> are used to destroy organic constituents within the waste. Thermal treatment uses high temperatures and can include processes such as plasma arcs, incinerators, or vitrification.

2.1.2.5 MLLW – Elemental Lead

Lead metal has been used at Hanford and other DOE sites for radiation shielding and in applications where its high density is of benefit. Most of the lead waste has surface contamination and some of the lead is radioactive from neutron activation. Some lead must be treated as mixed waste by macroen-capsulation, or other approved technology, before disposal.

2.1.2.6 MLLW – Elemental Mercury

Elemental mercury is a contaminant for several different types of waste. Waste can contain liquid mercury from various items (that is, light bulbs, switches, thermometers, and chemical process equipment). Mercury can be removed from bulk waste by thermal desorption and then solidified by amalgamation. Limited

> ***Thermal Desorption***
> heats the waste to temperatures sufficient to vaporize mercury, which is subsequently condensed in a separate vessel.
>
> ***Amalgamation***
> Solidification of mercury by mixing it with sulfur or other material to form a stable solid.

amalgamation treatment capacity for mercury waste is available at existing Hanford facilities, but additional capability for treatment of the remaining waste is needed.

2.1.2.7 MLLW – Lined Disposal Trench Leachate

This waste stream is generated from operation of lined disposal trenches. It is mostly rainwater or melted snow that is trapped by the collection systems in the lined disposal trenches. It is a liquid waste and is managed differently from the other wastes discussed in this EIS. The liquid waste is currently removed from the lined trenches and trucked to the Effluent Treatment Facility (ETF) where it is treated along with other liquid mixed wastes. Solid waste resulting from the treatment is included in the solid waste streams discussed in previous sections.

2.1.3 TRU Waste Streams

The production of TRU materials, primarily plutonium, was the primary defense mission of the Hanford Site. Most of the Hanford TRU waste was produced in plutonium handling facilities for management of weapons materials or from research on plutonium fuels.

Prior to 1970, TRU waste had not been designated as a separate waste type. In 1970, the Atomic Energy Commission (AEC) determined that waste containing transuranic elements might be associated with increased hazards and should be disposed of in facilities that provide a greater level of confinement than the type of shallow-land burial typically used for disposal of LLW.

The AEC set a minimum concentration level of TRU isotopes at 10 nanocuries per gram of waste. At that time field instrumentation was not available to measure concentrations at that level. Therefore, any waste associated with the handling of plutonium was considered to be suspect TRU waste and was placed in retrievable storage. The definition of TRU waste was changed to 100 nanocuries/gram in 1984. Once it is determined that the concentration of transuranic elements is below 100 nanocuries/gram, the waste would no longer be managed as suspect TRU waste. For purposes of analysis in this EIS, it was assumed to be managed as LLW. An evaluation of the CH waste placed into retrievable storage estimated that 50 percent of the drums currently managed as TRU waste, would be reclassified as LLW (Anderson et al. 1990).

TRU waste has been stored in several different ways at Hanford. TRU waste was initially placed into retrievable storage in the LLBGs, either with or without a soil cover. After 1985 most TRU waste was no longer placed in trenches, but was stored in an existing facility near the T Plant Complex that had been retrofitted for TRU waste storage. This building was known as the Transuranic Storage and Assay Facility (TRUSAF). Waste storage in that facility was discontinued in 1998 and its inventory, along with most newly generated TRU waste, is now stored in the CWC.

TRU waste disposal began in 1999 with the opening of DOE’s Waste Isolation Pilot Plant (WIPP) in New Mexico. The Hanford Site began shipping waste to WIPP in July 2000. Wastes to be shipped to WIPP must be certified to meet the WIPP Waste Acceptance Criteria (DOE-WIPP 2002). WRAP was designed and built at Hanford to perform certification of most CH TRU waste for disposal at WIPP, along with several other functions. Currently, CH TRU drums are being removed from CWC, certified at the WRAP, and shipped to WIPP. TRU waste drums are placed in shipping casks known as Transuranic Package Transporter-II (TRUPACT-II) and are transported by truck to the WIPP (see http://www.emnrd.state.nm.us/wipp/trubig.htm for description).

In the future, some TRU waste may be shipped by rail. The consequences of transportation by truck and rail and disposal of TRU waste at WIPP were evaluated in the WIPP Supplemental Environmental Impact Statement (SEIS) II (DOE 1997b) and the WM PEIS (DOE 1997a) and, therefore, are not re-evaluated in this EIS; however, there is general discussion of transportation in Section 2.2.4 and a summary of the previous analysis in Section 5.8.

Some TRU waste also contains hazardous components (mixed TRU waste) and would be managed under RCRA or TSCA. All TRU waste is managed in the same manner, and mixed TRU waste has not been identified as a separate waste type in this EIS. Mixed TRU waste is acceptable at WIPP. DOE's hazardous waste permit for WIPP, issued by the State of New Mexico Environment Department, authorizes the disposal of CH mixed TRU waste. DOE expects to have the capability to transport, receive, and dispose of RH wastes at WIPP in approximately the 2005 timeframe (DOE 2002a).

2.1.3.1 TRU Waste – Waste from Trenches

From 1970 to 1985, the primary method for storage of TRU wastes involved placing drums or boxes of waste on asphalt pads constructed in the bottom of the trenches and covering the drums with wood, plastic, and a layer of soil (see Section 2.2.1.2). The TRU waste was expected to remain there for less than 20 years. Corrosion of the packaging has continued since they were buried and preliminary inspection of some older containers has confirmed deterioration in their condition. However, observations and monitoring of the area around the drums within the trenches have not detected the release of any alpha emitters, such as plutonium.

DOE previously decided to retrieve the TRU waste (DOE 1987; 53 FR 12449) for disposal at WIPP. Because it was previously evaluated, retrieval of the waste is not re-evaluated in this EIS, but the processing of the waste at Hanford is evaluated. The CH drums can be processed, repackaged, and certified at WRAP. However, the capability to process, certify, and ship non-standard boxes or RH wastes to WIPP is not available at the Hanford Site, at other DOE sites, or at commercial facilities. These wastes would be placed in CWC until they can be processed. Processing of these wastes would require development of new capabilities. Both the new facilities and the processing operations are evaluated in this EIS.

2.1.3.2 TRU Waste – Waste from Caissons

Beginning in 1970 through 1988, higher-activity TRU waste was placed in four caissons for retrievable storage. These TRU waste caissons are located in Burial Ground 218-W-4B as shown in Appendix D. Most of the waste in the TRU caissons originated from laboratory activities in hot cells in the 300 Area facilities. About 5500 containers were sent to these caissons. Of those, about 97 percent were 3.8-L (1-gal) cans containing residue from the examination of nuclear fuels and irradiated structural materials.

Some of the individual containers had measured radiation levels in excess of 1500 R/hr at the time of placement. Other wastes included small-scale process equipment used for radionuclide separations operations. For additional information about the caissons see Section 2.2.1.3.

DOE previously decided to retrieve this waste (DOE 1987; 53 FR 12449) for disposal at WIPP. The retrieval of this waste is not re-evaluated in this EIS; however, the processing of this waste is evaluated.

2.1.3.3 TRU Waste – Commingled PCB Waste

A small amount of TRU waste has sufficient concentrations of PCBs to make it subject to TSCA requirements. Most of the material is debris commingled with a small amount of PCBs, although some drums contain liquids with higher PCB content. Sludge from the K Basins is also TSCA regulated due to its PCB content, but is discussed separately in Section 2.1.3.7. At this time TSCA regulations require treatment of PCB wastes by incineration or other approved technology (40 CFR 761.60). TRU waste commingled with PCBs has not yet been approved for disposal at WIPP. However, DOE is preparing a permit application to allow disposal of this waste at WIPP. If WIPP is granted a permit to dispose of PCB-commingled waste, treatment may not be necessary for the debris materials. Liquid waste containing PCBs may still require thermal treatment or an approved alternative treatment before it could be accepted at WIPP. No capabilities currently exist on the Hanford Site to treat PCB waste. The wastes are expected to remain in storage in CWC until a treatment facility is available or until WIPP can accept such materials.

2.1.3.4 TRU Waste – Newly Generated and Existing CH Standard Containers

This waste stream includes CH TRU waste in standard containers stored in the CWC and future TRU waste that would be received in standard containers. This waste stream also includes the CH TRU waste that will be retrieved from the 618-10 and 618-11 burial grounds. The retrieved waste will be placed into standard containers including 208-L (55-gal) and 322-L (85-gal) drums and standard waste boxes (SWBs). The SWB is a metal box 181 cm (71 in) long, 94 cm (37 in) high, and 138 cm (54.5 in) wide that has been designed as a Type A shipping container for use in the TRUPACT-II shipping container. The waste would be inspected and certified at WRAP and would ultimately be shipped to the WIPP for disposal.

2.1.3.5 TRU Waste – Newly Generated and Existing CH Non-Standard Containers

This TRU waste is contained in non-standard boxes or containers that are not compatible with a TRUPACT-II shipping container and that cannot be handled within WRAP. Much of this waste is old equipment or gloveboxes that were removed from processing and laboratory facilities. Processing of this waste would likely include size reduction and repackaging. The Hanford Site does not currently have a facility where these wastes can be prepared for shipment to WIPP. Until they can be processed they will remain in the CWC.

2.1.3.6 TRU Waste – Newly Generated and Existing RH Containers

This TRU waste stream consists of existing and newly generated RH TRU waste, including a small quantity of waste that may be generated during retrieval from the 618-10 and 618-11 burial grounds. Existing RH TRU waste is shielded for storage in the CWC (see Section 2.2.1.1). The Hanford Site does not currently have a facility where RH TRU waste can be prepared for shipment to WIPP, nor are the WIPP waste acceptance criteria or shipping system in place. The RH TRU waste would be accepted at WIPP in accordance with the National TRU Waste Management Plan (DOE 2002a).

2.1.3.7 TRU Waste – K Basin Sludge

This sludge is a combination of corrosion debris from stored fuel elements and their containers, dust, and other materials that have accumulated in the 100 Area K Basins over many years of use. Because of the plutonium, fission product and activation product concentrations in the sludges, they have been determined to be RH TRU waste. In addition, the sludge is TSCA-regulated due to its PCB content. DOE plans to containerize the waste as it is removed from the basins and then transport it to the T Plant Complex for storage (DOE 2001b) until a facility is available to process the waste and prepare it for shipment to WIPP.

2.1.4 Waste Treatment Plant Wastes

The Waste Treatment Plant (WTP) will receive and process the retrieved Hanford tank waste. The retrieved tank waste will undergo a separations process that splits the waste stream into a smaller volume high-level waste (HLW) stream and a larger volume low-activity waste (LAW) stream. The HLW stream will be vitrified and placed into canisters that will be temporarily stored onsite in the Canister Storage Building and eventually sent offsite to the national geologic repository currently planned for Yucca Mountain. The processing of the wastes including their vitrification and the management of the HLW was previously evaluated in the TWRS EIS (DOE and Ecology 1996) and is not included in the scope of this EIS. For purposes of analysis in this EIS, the LAW stream also is assumed to be vitrified in the WTP. After vitrification, the LAW stream is called immobilized low-activity waste (ILAW). The melters used in the WTP for vitrification of both the HLW and LAW fractions will occasionally need to be replaced. These melters become their own waste stream called “WTP melters.” Because the TWRS EIS has evaluated the processing of the glass, the HSW EIS addresses only the disposal of the ILAW and the WTP melters. It should be noted that the WTP will produce other LLW, MLLW, and TRU wastes that are included in the waste streams discussed in the previous sections.

2.1.4.1 Immobilized Low-Activity Waste Packages

During processing in the WTP, the molten ILAW can be directly poured into stainless steel canisters to produce a monolithic glass waste form, or it can be poured into water to produce waste in the form of granular glass particles similar to coarse sand, called cullet. The canisters for the monolithic glass waste form would be approximately 2.3 m (7.5 ft) in height and 1.22 m (4.0 ft) in diameter and would weigh up to 10,000 kg (22,000 lb) each when filled. An estimated 81,000 canisters would be filled using the monolithic pour compared to 140,000 canisters being filled with cullet. Dose rates from the cylinders are high enough (~500 mR/hr on contact) that remote handling will be required. The principal components in ILAW glass are silica, calcium oxide, and sodium oxide, making it a soda-lime silicate glass. Other waste forms are being considered for ILAW and are being analyzed in the Tank Closure EIS (68 FR 1052).

2.1.4.2 WTP Melters

The vitrification of both HLW and LAW wastes would use large melters composed of metal structural components and ceramic refractories to contain the molten glass. With use, the refractors are slowly consumed and some metal components can become corroded. Eventually it may be necessary to replace the melters with new units and the old melters will become a waste. Packages containing the melters can have dimensions of 4.6 to 7.6 m (15 to 25 ft) in length, height, and width; can weigh 545,000 kg (600 tons); and will require special handling.

2.2 Hanford Waste Storage, Treatment, and Disposal Facilities, and Transportation Capabilities Related to the Proposed Action

This section briefly describes existing and proposed facilities for the management of Hanford solid waste. The facilities provide storage, treatment, or disposal functions and are grouped by their primary function in the following discussion (see Figure 3.2 for facility locations). (See FH 2003 for additional details on specific facilities.) Text describing new facilities or those that would be substantially modified under the alternatives described in Section 3 is presented in text boxes to distinguish those facilities from existing facilities. This section also briefly discusses the transportation of waste and the Hanford pollution prevention/waste minimization program.

2.2.1 Storage Facilities

The primary storage facility for solid radioactive and mixed waste at Hanford is the CWC. Storage also exists at WRAP, the T Plant Complex, and the LLBGs. The T Plant Complex, described in Section 2.2.2.4 as a treatment facility, would be used to store sludge from the K Basins, and potentially other RH waste, as space is available. Trenches in the LLBGs have been used for retrievable storage of TRU wastes and other materials. Additional details on the CWC, trenches and caissons in the LLBGs, and grout vaults are described in the following sections.

> ***Storage Facilities***
>
> Existing Facilities
> - Central Waste Complex
> - LLBGs
>   - Trenches
>   - Caissons
> - T Plant Complex
> - WRAP
> - Modified Grout Vaults
>
> Proposed New/Modified Facilities
> Additional CWC Buildings

2.2.1.1 Central Waste Complex

The CWC is a series of handling areas, storage buildings, and storage modules that have been built in several phases for the receipt, inspection, storage, and limited treatment (that is, absorption and solidification of free liquids, neutralization of corrosive materials, and stabilization and encapsulation in solid waste matrixes) of wastes and materials awaiting verification, high enough (~500 mR/hr on contact) that remote handling will be required. The principal components in ILAW glass are silica, calcium oxide, and sodium oxide, making it a soda-lime silicate glass. Other waste forms are being considered for ILAW and are being analyzed in the Tank Closure EIS (68 FR 1052).

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>
> Existing Facilities
> - Central Waste Complex
> - LLBGs
>   - – Trenches
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> - T Plant Complex
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>
> Proposed New/Modified Facilities
> Additional CWC Buildings

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The CWC is a series of handling areas, storage buildings, and storage modules that have been built in several phases for the receipt, inspection, storage, and limited treatment (that is, absorption and solidification of free liquids, neutralization of corrosive materials, and stabilization and encapsulation in solid waste matrixes) of wastes and materials awaiting verification, treatment, or disposal. The primary waste types of interest to the HSW EIS, with respect to storage, are MLLW and TRU waste, because most LLW is sent directly to burial. An aerial view of the CWC is shown in Figure 2.3. The Solid Waste Inventory Tracking System lists CWC inventory at the end of 2001 as a total of about 9200 m^3 (325,000 ft^3), composed mainly of MLLW 7350 m^3 (260,000 ft^3) and TRU waste 1560 m^3 (55,000 ft^3) (FH 2003). Its capacity is estimated to be 16,700 m^3 (589,000 ft^3). Most MLLW and TRU waste received since 1987 is now stored in the CWC, including TRU waste relocated from other facilities at Hanford. The CWC could be expanded as needed for future receipts of waste that require storage, including any retrievably stored waste removed from the LLBGs.

The CWC waste is segregated by content to assure compatibility of the contents of the various storage containers (for example, acidic and basic materials are stored separately). In addition to MLLW and TRU waste, some non-conforming LLW and GTC3 LLW may also be stored in CWC. All waste containers must be CH or shielded to CH levels to be accepted at CWC. Some RH waste is stored at CWC by shielding it to CH levels. Most of the waste is packaged in 208-L (55-gal) drums; however, other package sizes can also be stored.

Typically, four drums are banded onto a pallet to allow easy handling by forklifts and stacked up to three layers high. Aisles are provided to gain access to the drums for required routine visual inspections. See Figure 2.4. The packages have identifying numbers (bar codes) for tracking their location and contents. Waste remains within the CWC until it is shipped to other facilities for processing or disposal.

2.2.1.2 Retrievable Storage of Suspect TRU Waste in LLBG Trenches

Beginning in 1970, suspect TRU waste, primarily CH but also some RH waste, was placed in retrievable storage at the Hanford Site in specific trenches in Burial Grounds 218-W-3A, 218-W-4B,

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Figure 2.3. Aerial View of the Central Waste Complex

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HSW EIS 12-10-02

Figure 2.4. Storage of Waste Drums in CWC

Proposed New/Modified Storage Facility: Additional CWC Buildings

Additional storage buildings would be constructed at CWC as part of the No Action Alternative. The new buildings would be similar to the larger existing buildings. Each new building would be about 37 m (120 ft) wide by 55 m (180 ft) long by 6.1 m (20 ft) high to the eaves, and would hold about 4,600 208-L (55-gal) drums. The interior floors would be sloped with raised perimeter curbing to contain and direct spilled liquids to collection sumps. The floors would be sealed with impervious epoxy resins to reduce the impacts of any liquid spills.

218-W-4C, and 218-E-12B. From 1972 to 1973, drums of TRU waste were placed in a concrete V-trench (218-W-4B) with a metal cover. After 1974, drums and boxes were stored in trenches on either asphalt pads or plywood and covered with wood sheathing, tarps, and plastic. A layer of at least 1.2 m (4 ft) of earth was placed over the tarp cover. After 1985, most TRU waste was sent to an aboveground storage facility. However, small amounts of TRU waste have occasionally been added to the trench inventory. A small volume of this waste was never covered with dirt and has recently been removed from the trenches and placed in the CWC. About 14,600 m^3 (516,000 ft^3) of suspect TRU waste remain in the trenches (FH 2003).

2.2.1.3 Retrievable Storage of TRU Waste in LLBG Caissons

The waste caissons, designed to store RH waste, are reinforced cylindrical steel and concrete vaults 2.4 m (8 ft) in diameter and 3 m (10 ft) high. Four caissons have received TRU waste. These four caissons were buried in Trench 14 of Burial Ground 218-W-4B. The caissons have an offset connecting chute between the caisson and the soil surface to reduce radiation dose to workers as the waste was deposited. Gases from the caissons are passively filtered through high-efficiency particulate air (HEPA) filters. Caisson configuration is illustrated in Figure 2.5. Waste containers similar to 3.8-L and 18.9-L (1- and 5-gal) paint cans were dropped into the loading chute from a shielded shipment cask. Each caisson has been limited to a total plutonium-239 inventory equivalent of 5 kg (11 lb). Radiation levels in the caissons have been measured at 1500 to 10,000 R/hr (FH 2003).

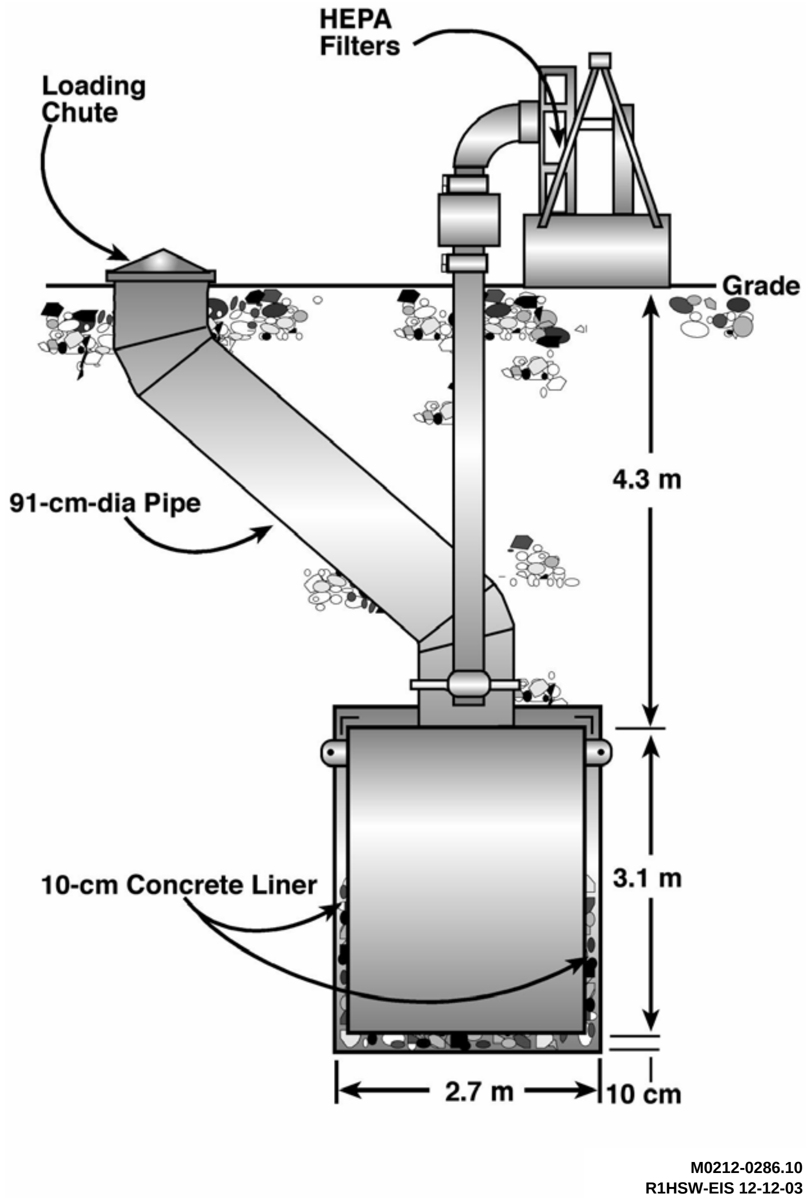

Figure 2.5. Schematic Drawing of RH TRU Caisson in the LLBGs

2.2.1.4 Interim Storage of ILAW in Grout Vaults

Grout vaults constructed in the 1980s would be used for interim storage of ILAW in the cullet form in the No Action Alternative. The existing vaults were designed to store low-activity tank waste in a grout-like form. Modifications to the vaults would be required before ILAW storage could take place. The modifications include excavation of surface materials, disassembly of vault covers, minor repairs to concrete surfaces and testing of leachate collection system, construction of superstructure over each vault to provide protection against wind and rain, and installation of additional leak detection monitoring. Once modifications are completed, ILAW canisters containing glass cullet form would be transported from WTP to the vaults via a tractor-trailer. A gantry crane would emplace the canisters. This process would continue until such time that new vaults could be constructed for disposal of the canisters. Then the canisters would be removed from the grout vaults and placed into the disposal vaults along with newly generated canisters.

2.2.2 Treatment and Processing Facilities

Treatment and processing facilities include those used to treat MLLW to applicable regulatory standards, as well as those where TRU waste is processed and certified for shipment to WIPP. DOE is currently using a combination of Hanford and offsite facilities to treat some CH MLLW and CH TRU waste. Commercial facilities have provided treatment capabilities for limited quantities of CH MLLW under two existing contracts. DOE does not currently have facilities for treatment of most CH MLLW, treatment of RH MLLW or TRU waste, or for non-standard containers of MLLW and TRU waste. The ETF provides treatment for leachate from the MLLW trenches. Cat 3 wastes are treated either by in-trench grouting or placement in HICs as discussed in Section 2.2.3.

Treatment and Processing Facilities

<u>Existing Facilities</u>

- WRAP
- T Plant Complex
- ETF
- Commercial Treatment Facilities
- In-Trench Grouting
- Other DOE sites

<u>Proposed New/Modified Facilities</u>

- Modified T Plant Complex
- New Waste Processing Facility
- Mobile TRU Processing Facility
- Pulse Driers
- Commercial Treatment Facilities

2.2.2.1 Waste Receiving and Processing Facility

The Waste Receiving and Processing Facility (WRAP) began operation in 1998 on the Hanford Site for management of TRU waste, MLLW, and LLW. The major function of WRAP is the inspection, repackaging, and certification of CH TRU waste to prepare it for transport and disposal at WIPP. The facility is also used to verify that incoming LLW meets HSSWAC, and to characterize MLLW for quality assurance purposes. A picture of WRAP is shown in Figure 2.6.

WRAP can accept CH drums and standard waste boxes. Handling of drums and boxes can be performed manually or by use of automated guided vehicles. WRAP provides the capability for non-destructive examination (NDE) and non-destructive assay (NDA) of incoming waste. The NDE is an X-ray process used to identify the physical contents of the waste containers in supporting waste characterization (see Figure 2.7). The NDA is a neutron or gamma energy assay system used to determine radionuclide content and distribution in waste packages.

2.2.1.4 Interim Storage of ILAW in Grout Vaults

Grout vaults constructed in the 1980s would be used for interim storage of ILAW in the cullet form in the No Action Alternative. The existing vaults were designed to store low-activity tank waste in a grout-like form. Modifications to the vaults would be required before ILAW storage could take place. The modifications include excavation of surface materials, disassembly of vault covers, minor repairs to concrete surfaces and testing of leachate collection system, construction of superstructure over each vault to provide protection against wind and rain, and installation of additional leak detection monitoring. Once modifications are completed, ILAW canisters containing glass cullet form would be transported from WTP to the vaults via a tractor-trailer. A gantry crane would emplace the canisters. This process would continue until such time that new vaults could be constructed for disposal of the canisters. Then the canisters would be removed from the grout vaults and placed into the disposal vaults along with newly generated canisters.

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Treatment and Processing Facilities

Existing Facilities
- WRAP
- T Plant Complex
- ETF
- Commercial Treatment Facilities
- In-Trench Grouting
- Other DOE sites

Proposed New/Modified Facilities
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- New Waste Processing Facility
- Mobile TRU Processing Facility
- Pulse Driers
- Commercial Treatment Facilities

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Figure 2.6. Waste Receiving and Processing Facility

Figure 2.7. X-Ray Image of Transuranic Waste Drum Contents

A layout for the 4806 m^2 (51,700 ft^2) facility is shown in Figure 2.8. The layout illustrates the major functions of shipping and receiving, examination, and repackaging within WRAP. Many operations at the facility, such as handling, opening, and processing waste packages, are conducted in gloveboxes or using automated equipment to minimize worker exposure to radioactive and hazardous materials. Certified CH TRU waste drums and standard waste boxes are loaded into TRUPACT-II shipping containers for transport from the facility to WIPP. Figure 2.9 shows the loading of a TRUPACT-II container in the WRAP.

WRAP also has limited treatment capabilities for TRU waste and MLLW by deactivation, solidification or absorption of liquids, neutralization of corrosives, amalgamation of mercury, microencapsulation, macroencapsulation, volume reduction by super compaction, stabilization of reactive waste, and repackaging waste as needed.

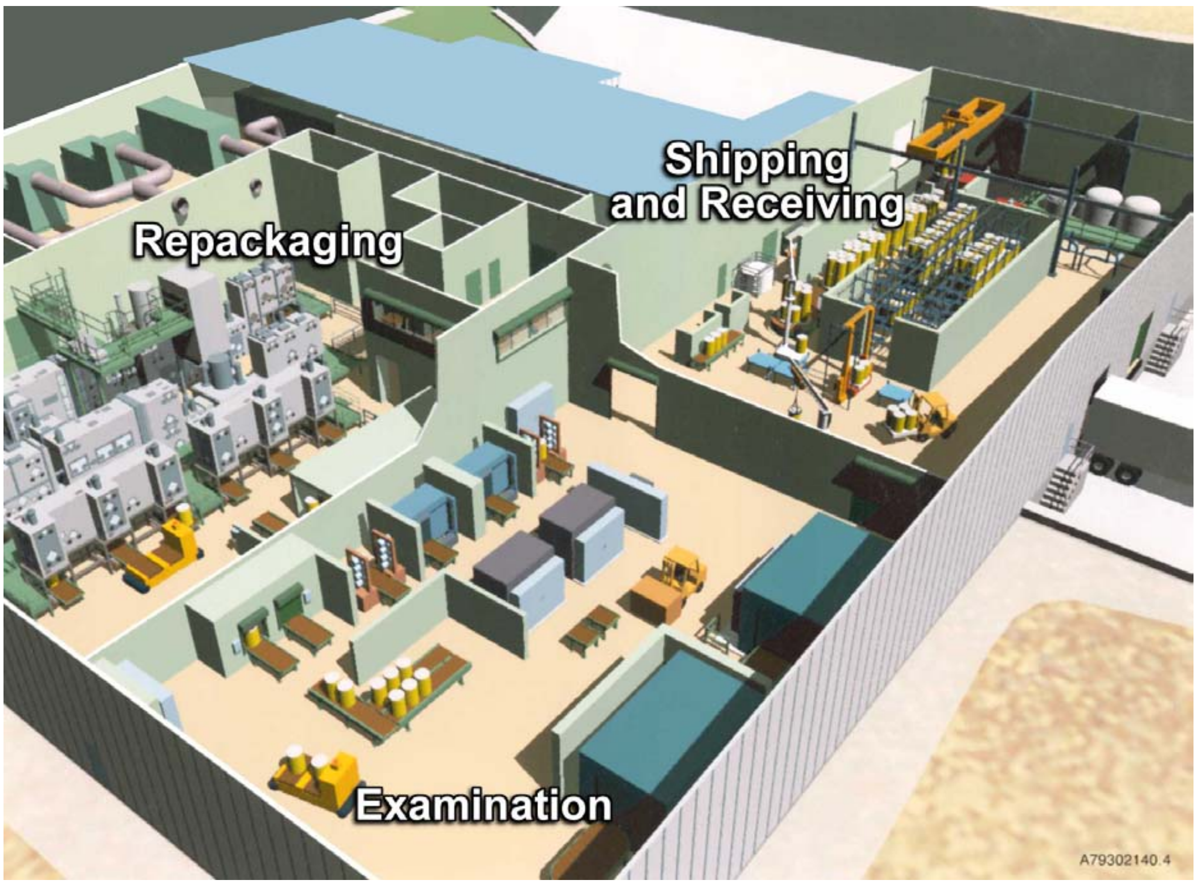

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Figure 2.8. Layout for the Waste Receiving and Processing Facility

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Figure 2.9. Transuranic Package Transporter-II Being Loaded in the Waste Receiving and Processing Facility

Proposed New/Modified Treatment Facility: Mobile TRU Processing Facility

Mobile TRU Processing Facilities or Accelerated Process Lines (APL) have been proposed for Hanford to accelerate the rate at which TRU waste can be certified and shipped to WIPP. The functions of the APLs are similar to functions in WRAP with capabilities to do NDA, NDE, headspace gas sampling, repackaging, and visual examination of the waste packages. The facilities will also have a loadout facility for TRUPACT-IIs. The facilities are expected to be developed in stages or modules so that the first module will process the standard 55-gal drums and a second module will process larger boxes. Two stage-one APLs are anticipated, each with a capacity to process about 2000 CH drums per year. It is anticipated that the headspace gas-sampling units will be inside one of the CWC buildings. Other units will be located outside but near the CWC buildings, on ground that has already been disturbed.

2.2.2.2 Commercial Treatment

Commercial treatment services have been used to treat some Hanford MLLW streams. These treatment capabilities consist of both non-thermal and thermal processes. Two contracts were placed with Allied Technology Group, Inc. (ATG) for thermal and non-thermal treatment of Hanford MLLW in a demonstration project beginning in 2000. Other commercial treatment contracts are being established by Hanford and through the broad spectrum contracts at Oak Ridge.

The non-thermal treatment contract provided for treatment of at least 1600 m^3 (56,500 ft^3) of MLLW and has been successfully completed and a new commercial contract has now been established for continued treatment of MLLW. The MLLW will largely consist of debris waste and will be treated principally by stabilization and macroencapsulation. Waste being macroencapsulated is shown in Figure 2.10. The local commercial treatment facility has some capability for physical extraction, neutralization, chemical oxidation, chemical reduction, microencapsulation, and deactivation. The local facility also has pretreatment capability for size reduction, drying, and sorting. The stabilization processes can be either cement or polymer based. Additional details on local commercial processes can be found in DOE 1998.

The thermal treatment contract was to begin in 2001 and provide processing of a minimum of 600 m^3 (21,200 ft^3) and a maximum of 3585 m^3 (126,600 ft^3) MLLW over a 5-year period. ATG planned to use a high-temperature plasma arc process to convert most organic contaminants to carbon dioxide and water (DOE 1999), however the unit experienced significant problems and has not been able to process the contracted volumes of waste and is no longer operating. At this point, the future of the thermal treatment unit remains uncertain. ATG has entered bankruptcy and the trustee in bankruptcy is seeking to sell the ATG Richland Operation.

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Figure 2.10. Macroencapsulation of Mixed Low-Level Waste Debris at a Local Commercial Treatment Facility

Proposed New/Modified Treatment Facility: Commercial Treatment Facilities

Additional contracts with commercial treatment facilities would provide treatment for CH MLLW and non-conforming LLW. Thermal treatment capabilities are still needed and may be available in the future either locally or at other commercial facilities.

2.2.2.3 Leachate Treatment

Lined disposal facilities are required to incorporate a leachate collection system (WAC 173-303). The collection system retains rain and snowmelt that may contact waste and leach hazardous constituents from the waste. The leachate from onsite mixed waste trenches and future lined disposal facilities is collected and either sent to the 200 East Area Liquid Effluent Retention Facility (LERF) prior to treatment in the ETF or sent directly to ETF. Leachate is currently transported from lined disposal trenches by tanker truck. The ETF treats liquid waste using pH adjustment, filtration, ultraviolet light and peroxide destruction of organic materials, reverse osmosis, and ion exchange. The leachate to be treated at ETF is required to meet ETF waste acceptance criteria. The volume of leachate is expected to depend on the exposed surface area of the trenches.

Proposed New/Modified Treatment Facility: ETF Replacement Capability

The ETF is scheduled to shut down at the end of 2025. After 2025 pulse driers would be used for leachate treatment. The pulse driers treat leachate by evaporation, leaving behind solids as secondary waste. These secondary wastes would be treated, as necessary, and disposed of in MLLW trenches as part of MLLW Action Alternatives. Depending on the amount of trench space available, these secondary wastes may be stored in CWC as part of the No Action Alternative.

2.2.2.4 T Plant Complex

The T Plant Complex consists of a number of buildings, as shown in Figure 2.11. The T Plant canyon and tunnel (221-T Building) are used for handling and processing of materials that require remote handling. Spent commercial reactor fuel and other RH wastes have been stored in the T Plant canyon. Dry decontamination, inspection, segregation, verification, and repacking of RH and large items are performed in the canyon. Current plans are to use the water-filled basin and refurbished process cells at T Plant to provide storage for the K Basin sludge (DOE 2001b). The sludge is expected to remain in the T Plant canyon until a treatment facility is available.

The T Plant canyon was built of reinforced concrete during 1943 and 1944 as a chemical reprocessing plant for defense program materials and was subsequently converted to decontamination and support functions in 1957. The building is 21 m (68 ft) wide, 259 m (850 ft) long, and 23 m (74 ft) high. The 37 cells within the building are designed to accommodate very high levels of radioactivity, and most cells have concrete shielding that is 2.1 m (7 ft) thick.

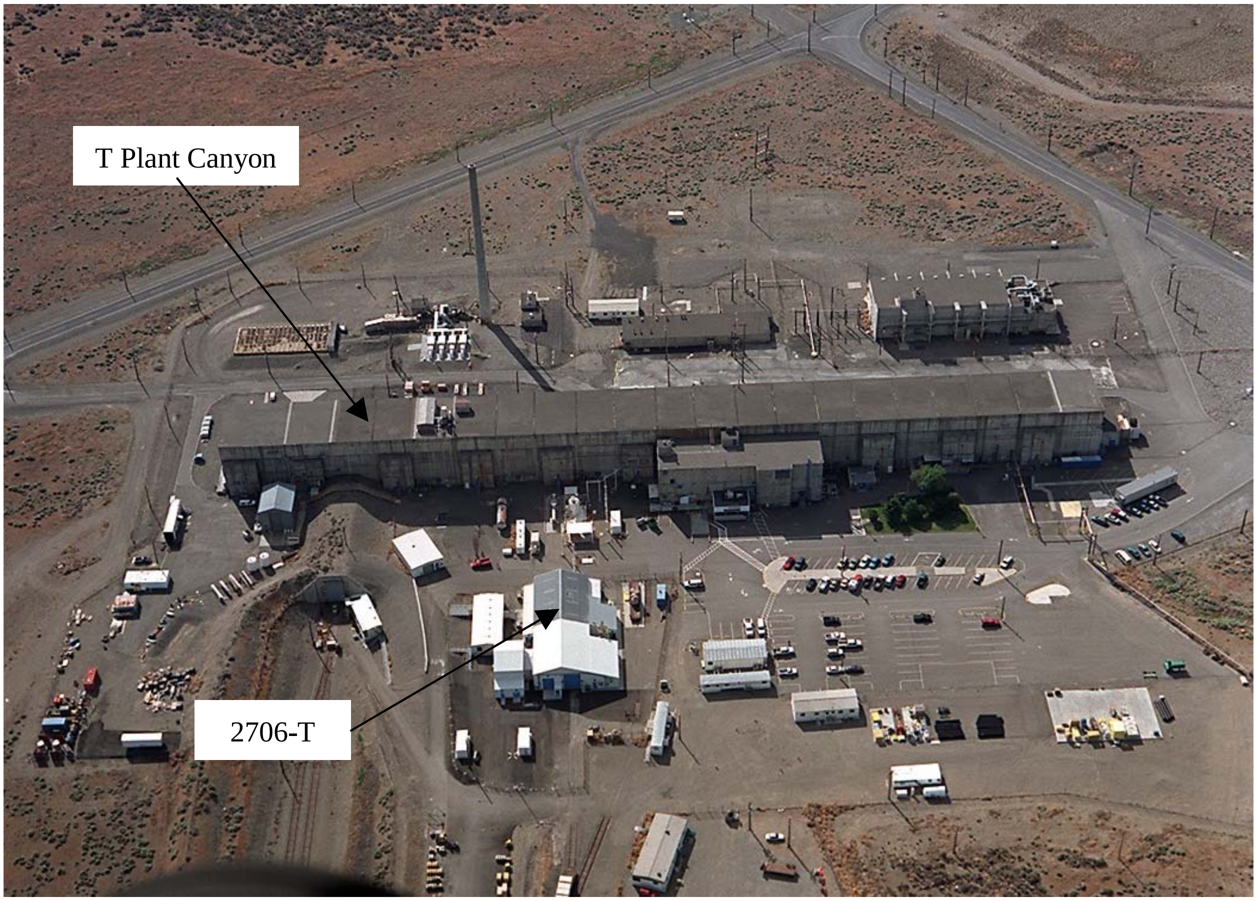

Figure 2.11. View of the T Plant Complex with 2706-T Facility and the T Plant Canyon Noted

Inspection, verification, opening, sampling, sorting, and limited treatment and repackaging of LLW, MLLW, and TRU waste are performed in the 2706-T Facility and other areas in the T Plant Complex. The 2706-T Facility, initially constructed during 1959 and 1960, was remodeled in 1998 to expand decontamination and treatment capabilities.

Proposed New/Modified Treatment Facility: Modified T Plant

In some MLLW alternatives and TRU waste alternatives, the T Plant Complex would be modified to establish the capabilities to treat/process waste for which no treatment capability currently exists. These waste streams include RH MLLW, MLLW in non-standard packages, RH TRU waste, CH TRU waste in non-standard containers, and PCB-commingled TRU waste. Specific capabilities provided by this modified T Plant would include stabilization, macroencapsulation, deactivation, sorting, sampling, repackaging NDE, and NDA.

MLLW would be treated to meet applicable regulatory requirements so that it can be disposed of in the MLLW trenches. TRU waste would be processed and shipped to WIPP.

Proposed New/Modified Treatment Facility: New Waste Processing Facility

As an alternative to modifying T Plant and using commercial contracts for MLLW and TRU waste treatment, a new facility would be constructed to process/treat the same waste streams and have all of the capabilities identified above for the modified T Plant Complex and for commercial treatment.

CH MLLW in standard containers, non-conforming LLW, elemental lead, and elemental mercury would also be treated in this new facility. Specific capabilities provided by the new facility to treat these waste streams could include stabilization, macroencapsulation, thermal desorption, mercury amalgamation, deactivation, sorting, sampling, repackaging, NDE, and NDA.

The new facility location is assumed to be in the 200 West Area near WRAP, consistent with previous DOE proposals for a modular complex to process MLLW and TRU waste. The new facility would be expected to be larger than WRAP (FH 2003).

MLLW would be treated to meet applicable regulatory requirements so that it can be disposed of in the MLLW trenches. TRU waste would be processed and shipped to WIPP.

2.2.3 Disposal Facilities

Facilities used for LLW and MLLW disposal at Hanford consist of the LLBGs and the Environmental Restoration Disposal Facility (ERDF). New or modified facilities would be developed for LLW, MLLW, ILAW, and WTP melters. Each of the existing and proposed new facilities considered in the alternatives is described in this section.

TRU wastes are disposed of in New Mexico at WIPP, which is the DOE repository for TRU wastes. Hanford began shipping TRU waste to WIPP in the summer of 2000 and would continue shipping TRU waste to WIPP for disposal.

LLW has been buried on the Hanford Site since the start of the defense materials production mission. Six LLBGs are located in the 200 West Area (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6) and two LLBGs are in the 200 East Area (218-E-10 and 218-E-12B). These eight disposal facilities are collectively referred to as the LLBGs. See Appendix D for additional information about each LLBG. The LLBGs have historically been used for temporary storage of some waste (these functions were previously described). Figure 2.12 shows a picture of a burial ground with both open and covered trenches.

Disposal Facilities

Existing Facilities
- LLBGs
  - LLW Trenches
  - MLLW Trenches
- ERDF

Proposed New/Modified Facilities
- Existing Design Unlined LLW Trenches
- Deeper, Wider Unlined LLW Trenches
- Single Expandable Unlined LLW Trench
- Deeper, Wider Lined LLW Trenches
- Existing Design MLLW Trenches
- Deeper, Wider Lined MLLW Trenches
- Single Expandable Lined Trench
- Melter Trench
- ILAW Multiple Trenches
- ILAW Disposal Vaults
- ILAW Expandable Trench
- Modular Lined Combined Use Disposal Trenches
- Closure Caps

Proposed New/Modified Treatment Facility: New Waste Processing Facility

As an alternative to modifying T Plant and using commercial contracts for MLLW and TRU waste treatment, a new facility would be constructed to process/treat the same waste streams and have all of the capabilities identified above for the modified T Plant Complex and for commercial treatment.

CH MLLW in standard containers, non-conforming LLW, elemental lead, and elemental mercury would also be treated in this new facility. Specific capabilities provided by the new facility to treat these waste streams could include stabilization, macroencapsulation, thermal desorption, mercury amalgamation, deactivation, sorting, sampling, repackaging, NDE, and NDA.

The new facility location is assumed to be in the 200 West Area near WRAP, consistent with previous DOE proposals for a modular complex to process MLLW and TRU waste. The new facility would be expected to be larger than WRAP (FH 2003).

MLLW would be treated to meet applicable regulatory requirements so that it can be disposed of in the MLLW trenches. TRU waste would be processed and shipped to WIPP.

2.2.3 Disposal Facilities

Facilities used for LLW and MLLW disposal at Hanford consist of the LLBGs and the Environmental Restoration Disposal Facility (ERDF). New or modified facilities would be developed for LLW, MLLW, ILAW, and WTP melters. Each of the existing and proposed new facilities considered in the alternatives is described in this section.

TRU wastes are disposed of in New Mexico at WIPP, which is the DOE repository for TRU wastes. Hanford began shipping TRU waste to WIPP in the summer of 2000 and would continue shipping TRU waste to WIPP for disposal.

Disposal Facilities

Existing Facilities

- LLBGs
  - – LLW Trenches
  - – MLLW Trenches
- ERDF

Proposed New/Modified Facilities

- Existing Design Unlined LLW Trenches
- Deeper, Wider Unlined LLW Trenches
- Single Expandable Unlined LLW Trench
- Deeper, Wider Lined LLW Trenches
- Existing Design MLLW Trenches
- Deeper, Wider Lined MLLW Trenches
- Single Expandable Lined Trench
- Melter Trench
- ILAW Multiple Trenches
- ILAW Disposal Vaults
- ILAW Expandable Trench
- Modular Lined Combined Use Disposal Trenches
- Closure Caps

LLW has been buried on the Hanford Site since the start of the defense materials production mission. Six LLBGs are located in the 200 West Area (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6) and two LLBGs are in the 200 East Area (218-E-10 and 218-E-12B). These eight disposal facilities are collectively referred to as the LLBGs. See Appendix D for additional information about each LLBG. The LLBGs have historically been used for temporary storage of some waste (these functions were previously described). Figure 2.12 shows a picture of a burial ground with both open and covered trenches.

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Figure 2.12. Aerial View of a Low Level Burial Ground

The total volume of LLW placed in the LLBGs between 1962 and 1999 was about 283,000 m^3 (10,000,000 ft^3). The waste occupies an area of 141 ha (348 ac). The LLBGs occupy a total area of 425 ha (1050 ac); thus, approximately two-thirds of the LLBGs would be available for future waste disposal.

Within the LLBGs, several techniques can be used to provide extra confinement for Cat 3 LLW and approved GTC3 LLW. These techniques include placement of higher-activity LLW deep within the trench, burial in HICs, and in-trench grouting. The higher-activity LLW is usually placed in the bottom of the trenches with Cat 1 wastes placed on top of the Cat 3 and GTC3 LLW. This is intended to reduce the risk of intrusion into the higher-hazard wastes.

HICs are large cement boxes or cylinders into which the Cat 3 LLW and approved GTC3 LLW are placed for burial. The HIC is first placed within the burial trench and the waste is loaded into the HIC. Figure 2.13 shows four HICs in the bottom of a burial trench. The HIC is then sealed with a lid and buried with other LLW placed around it. The HIC provides additional containment for higher-activity waste while the radioactivity decays. The concrete used to construct the HICs also changes the chemistry of the soil in the immediate vicinity of the waste, which reduces the mobility of certain radionuclides.

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Figure 2.13. High-Integrity Containers in a Low-Level Waste Disposal Trench

In-trench grouting involves placing the CH Cat 3 LLW and approved CH GTC3 LLW on a cement pad or on spacers, installing reinforcement steel and forms around the waste, and covering the waste with fresh concrete to encapsulate the waste within a concrete barrier. The process is limited to CH wastes because of the need for workers to be in close contact with the waste to place cement forms around them. Steel fibers are incorporated into the concrete to increase its strength. The resulting monoliths, such as the one shown in Figure 2.14, have a maximum size of 6.4 m (21 ft) long, 4 m (13 ft) high, and 2.7 m (9 ft) wide with a minimum wall thickness of 0.15 m (0.5 ft). After curing, the encased waste is covered with at least 2.4 m (8 ft) of soil. As with the HICs, in-trench grouting provides additional containment for the waste and retards migration of some radionuclides from the LLBGs. In-trench grouting is a more economical method for encapsulation of Cat 3 and GTC3 LLW than using the HIC.

The use of HICs versus in-trench grouting for CH waste is determined on a case-by-case basis. Generally, HICs are used for RH wastes while CH wastes are in-trench grouted. However, HICs can be used for either RH or CH waste.

The amount of waste that can be disposed of in a trench varies depending on the specific characteristics of the waste (e.g., CH vs. RH, Cat 1 vs. Cat 3) and how much cover soil is placed on the waste. Typically, about 30 percent to 50 percent of the total trench volume is filled with waste.

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Figure 2.14. Trench Grouted Wastes

2.2.3.1 LLW Disposal Trenches

The existing LLW trenches currently comprise a series of relatively long, unlined, narrow trenches for disposal of LLW. The dimensions of existing trenches in the LLBGs vary with location. Typically, trenches are about 12 m (40 ft) wide at the base; however, some are “V” shaped and some are wider with flat bottoms. The trenches are excavated to a depth of approximately 6 m (20 ft). The waste is placed within the trenches and the location of each waste package is recorded in waste management records. Periodically the waste may be covered with dirt for interim periods before adding additional wastes. After the trenches are filled with waste to the desired level, a 2.6-m (8-ft) layer of soil is placed over the waste so the surface is near the original grade. The trenches are inspected weekly to note any areas of subsidence and when necessary corrective actions are taken in a timely manner. Layouts of the trenches within each LLBG are shown in Appendix D.

Proposed New/Modified Disposal Facility: Existing Design Unlined LLW Trenches

Trenches of the current design would be used to expand LLBG disposal capacity. Dimensions are nominally 12 m (39 ft) wide at the base, 6.1 m (20 ft) deep, 20 m (66 ft) wide on top, and 350 m (1150 ft) long. However, the dimensions of each trench are modified to fit within the available space of each specific burial ground. The number of new trenches would depend on the amount and category of LLW received.

Proposed New/Modified Disposal Facility: Deeper, Wider Unlined LLW Trenches

Deeper, wider LLW trenches would be used to expand LLBG disposal capacity. The reference design for deeper, wider LLW trenches was assumed to be 67 m (220 ft) wide at the top, 7 m (23 ft) wide at the bottom, about 18 m (60 ft) deep, and 350 m (1150 ft) long. However, the dimensions of each trench are modified to fit within the available space of each specific burial ground. The number of new trenches would depend on the amount and category of LLW received.

Proposed New/Modified Disposal Facility: Single Expandable Unlined LLW Trench

A single expandable unlined LLW trench would be used to expand disposal capacity for LLW. The trench would be similar to those for ERDF (see Section 2.2.3.3), except they would not contain any liners for leachate collection. It would also be constructed in the 200 W Area so that they could be expanded as needed for future wastes. The design of such a facility is in the earliest stage of conceptual design. The potential benefit of such a facility is economy of scale for construction and land use. The size of the trench would depend on the amount and category of LLW received. The trench would be about 18 to 21 m (60 to 70 ft) deep and would require 3.8 to 8.9 ha (1.5 to 3.6 ac).

2.2.3.2 MLLW Trenches

The two existing MLLW trenches (218-W-5, trenches 31 and 34) are located within a LLBG but, for the HSW EIS, they are considered separately from the other LLW disposal trenches. The trenches are permitted for MLLW disposal (DOE-RL 1997). One trench (see Figure 2.15) is currently being used as a MLLW disposal unit. The floor dimensions of the trenches are about 30.5 m (100 ft) wide by 76.2 m (250 ft) long and 9.1-10.7 m (30-35 ft) deep. The floor slopes to allow collection of leachate (rain or snow melt that has permeated through the waste). The surface dimensions are approximately 91 m (300 ft) wide by 137 m (450 ft) long and encompass approximately 1.3 ha (3.2 ac) of land.

Applicable regulations (WAC 173-303) require that waste trenches contain liners to collect any leachate that contacts the waste during the operating period. All liquids collected in the leachate collection system would be treated before disposal as discussed in Section 2.2.2.3. The existing MLLW trenches would be capped in accordance with applicable regulations.

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Figure 2.15. Mixed Low-Level Waste Disposal Trench

Proposed New/Modified Disposal Facility: Existing Design MLLW Trenches

Additional trenches of the existing design would be needed. New MLLW trenches would be the same as those described above for the existing MLLW trenches. They would also be constructed in the 200 East Area to provide better access to ETF for leachate treatment. Regulations require that waste trenches contain liners to collect any leachate that contacts the waste during the operating period. All liquids collected in the leachate collection system would be treated before disposal. The trenches would be capped in accordance with applicable regulations.

Proposed New/Modified Disposal Facility: Deeper, Wider Lined MLLW Trenches

Deeper, wider trenches would be constructed to increase the efficiency and reduce the cost of future MLLW disposal at Hanford. They would also be constructed in the 200 East Area to provide better access to ETF for leachate treatment. The deeper, wider MLLW trench would be about 80 m (262 ft) wide as the base and 188 m (617 ft) wide at the top, with a depth of 18 m (60 ft). The length of the trench would be 170 m (558 ft) long for the Lower Bound volume and 340 m (1115 ft) long for the Upper Bound volume. Regulations require that waste trenches contain liners to collect any leachate that contacts the waste during the operating period. All liquids collected in the leachate collection system would be treated before disposal. The trenches would be capped in accordance with applicable regulations.

Proposed New/Modified Disposal Facility: Single Expandable Lined MLLW Trench

A single expandable lined trench would be used to expand disposal capacity for MLLW. It would also be constructed in the 200 East Area so that it could be expanded as needed for future wastes and have better access to ETF for leachate treatment. The design of such a trench is in the earliest stage of conceptualization. The potential benefit of such a trench is economy of scale for construction and land use. The size of the trench would depend on the future volume of MLLW to be disposed of. The trench would be about 18 to 21 m (60 to 70 ft) deep and would require 3.8 to 8.9 ha (1.5 to 3.6 ac).

Proposed New/Modified Disposal Facility: Lined Melter Trench

The vitrification of tank waste on the Hanford Site would result in the need to dispose of WTP melters. These items would be treated at the vitrification facility to ready them for disposal. The large melters would be taken to a lined trench designed for them. The dimensions for the melter trench would be about: 270 m (886 ft) long, 120 m (165 ft) wide, and 21 m (70 ft) deep. To place the melters into the trench a ramp with a 6 percent grade into the trench is planned. Leachate from the melter trench would be treated along with other MLLW trench leachate. The trench would be capped in accordance with applicable regulations.

2.2.3.3 ILAW Disposal Facilities

See the following text boxes for a description of the proposed ILAW disposal facilities.

Proposed New/Modified Disposal Facility: ILAW Disposal in an Expandable Trench

ILAW would be disposed in a single expandable trench located in the 200 East Area just southwest of the PUREX facility. A single trench 183 m wide by 365 m long by 10 m deep could accommodate the total mission quantity of ILAW (Aromi and Freeberg 2002). The bottom of the trench would contain a double leachate collection system similar to a RCRA Subtitle C landfill.

Initially two cells, each 62 m wide by 76 m long, would be installed. These cells could accommodate about 22,000 ILAW packages (Aromi and Freeberg 2002). Additional cells would be installed as necessary to accommodate the ILAW.

The canisters would be emplaced by a crane. The crane would be equipped with instrumentation and controls to allow the logging of each canisters position, serial number, and date using a GPS.

After several canisters are emplaced, the crane operator, using a material-handling bucket, will place fill between and over the canisters, thereby minimizing the overall radiation exposure to the crane operator.

Proposed New/Modified Disposal Facility: ILAW Disposal in Multiple Trenches

The current design for each monolithic ILAW canister disposal trench is for a bottom dimension of 20 m (66 ft) by 210 m (690 ft). The trenches would be 10 m (33 ft) in depth with a top dimension of 80 (300 ft) by 280 m (920 ft) with 3:1 side slopes. The bottom of the trench would contain a double leachate collection system similar to a RCRA Subtitle C landfill (Burbank 2002).

The monolithic ILAW canisters would be removed from the transport vehicles using a large crane with a 90-m (300-ft) boom and a 22-metric ton (25-ton) capacity at 85 m (280 ft). The crane would be equipped with instrumentation and controls to allow the logging of each canister's position, serial number, and date using a global positioning system (GPS). This information would be relayed to the support facility for real-time readout and tracking of all canisters placed.

After several canisters are emplaced, the crane operator, using a material handling bucket, would place fill between and over the canisters, thereby minimizing the overall radiation exposure to the crane operator. Final cover of each layer to provide 1 m (3 ft) compacted cover would be completed by standard heavy earthmoving equipment.

Three layers of canisters would be placed into each trench with the first layer containing approximately 1,900 canisters; the second layer containing approximately 4,500 canisters; and the third layer containing approximately 7,300 canisters. The total capacity of each trench would be approximately 13,700 canisters (Burbank 2002).

An interim barrier would be placed atop each trench as it is filled. The first layer is backfill, which would vary in thickness with a minimum depth of 1.3 m (4.3 ft) and would provide a slope of not greater than 2 percent from the center of the trench to the outer edges. To minimize leachate collection, a temporary weather barrier, 'rain cover' or surface liner would be placed on top of this slope as part of operations activities. As the final closure activities would not occur for several years following filling of a trench, an interim cover consisting of two layers of sand and gravel would be placed as part of the operations activities. This interim cover would be a minimum of 2 m (7 ft) in thickness to provide additional protection from water intrusion. The trenches would be capped in accordance with applicable regulations.

Proposed New/Modified Disposal Facility: ILAW Disposal Vaults

Under the No Action Alternative 66 new vaults would be constructed onsite for the disposal of the ILAW cullet. Each vault would be an estimated 37 m (120 ft) long by 10 m (33 ft) wide by 15 m (50 ft) deep with a capacity to hold 5,300 m^3 (7,000 yd^3) of ILAW (DOE 2001c). These vaults would contain a leachate collection system and an array of monitoring wells. The canisters would be emplaced by a gantry crane. The crane would be equipped with instrumentation and controls to allow the logging of each canisters position, serial number, and date using a GPS. An interim barrier would be placed atop each vault as they are filled. The interim barrier would consist of backfill of variable thickness but a minimum depth of 1.3 m (4.3 ft). The interim barrier would also contain a temporary surface liner and an interim cover of sand and gravel atop the backfill. The total thickness of the interim barrier would be at least 3.3 m (11 ft).

2.2.3.4 Environmental Restoration Disposal Facility

ERDF, which began operation in 1996, is located in the center of the Hanford Site between the 200 East and 200 West Areas. ERDF is a large-scale, evolving landfill, complete with ancillary facilities as shown in Figure 2.16. It is designed to receive and isolate low-level radioactive, hazardous and mixed wastes. ERDF is a RCRA- and TSCA-compliant landfill authorized under CERCLA. The facility complies with all substantive elements of applicable or relevant and appropriate requirements identified through the CERCLA process, including Washington State and EPA codes, standards, and regulations, as well as with DOE orders. Administrative requirements such as RCRA permitting are not required for disposal of CERCLA waste from Hanford cleanup actions.

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Figure 2.16. Environmental Restoration Disposal Facility (ERDF)

Four disposal cells currently make up ERDF. The first two cells are each 21 m (70 ft) deep, 152 m (500 ft) long, and 152 m (500 ft) wide at the bottom and were completed in 1996. Construction of two additional cells of the same size was completed in 2000. Two additional cells are currently under construction. An interim cover was placed over the filled portions of the first two cells. Design and construction of the final cover will not begin until cells #3 and #4 are filled. ERDF can be expanded further if necessary. It is authorized to be expanded up to eight cells. Capacity of the current four-cell configuration is 4.7 billion kg (5.2 million tons).

The cells are lined with a RCRA Subtitle C-type liner, and have a leachate collection system. The facility is monitored regularly and when closed will continue to be monitored to ensure that human health and the environment are protected.

ERDF is designed to provide disposal capacity, as needed, to accommodate projected Hanford waste volumes over the next 20 to 30 years. It is being included in this EIS as an alternative disposal site to the LLBGs.

Proposed New/Modified Disposal Facility: Modular Lined Combined Use Disposal Facility

A Modular Lined Combined Use Disposal Facility is similar in configuration and size to ERDF. The facility could involve three different configurations. The first and most comprehensive would include LLW, MLLW, melters, and ILAW (Aromi and Freeberg 2002). The second would include only LLW and MLLW, and the third would include only melters and ILAW. Several locations have been considered for the facility including near PUREX, so as to be close to the WTP, near the existing LLBGs in 200 East, and at ERDF. As with other disposal facilities, it would be capped in accordance with applicable regulations.

2.2.3.5 Liners for Waste Disposal Facilities

DOE currently has three double-lined facilities on the Hanford Site: ERDF, two RCRA-permitted mixed waste trenches, and three RCRA-permitted, liquid waste surface impoundments called the Liquid Effluent Retention Facility (not part of the HSW EIS scope). The RCRA-compliant waste disposal cells liner system consists of series of layers as shown in Figure 2.17. Additional liner technologies are discussed in Appendix D.

The geotextile layers provide a filtration/separation medium when placed adjacent to the sub-grade and between the geomembrane and the leachate collection system's layers. The geomembrane is to prevent the downward movement of contaminants. During liner installation, great care is taken to avoid mechanical tearing of the liner material and generally, a very comprehensive onsite liner system installation Quality Assurance Program is followed to ensure the integrity and longevity of the liner system.

Polyethylene geomembranes provide a highly impermeable barrier to gasses and liquids in order to mitigate or eliminate ground water contamination. The high-density polyethylene (HDPE) geomembranes are resistant to corrosion and most chemicals, resistant to biological degradation, and resistant to ultra-violet light degradation. They are also flexible, thereby permitting ground movement and contraction and swelling due to temperature fluctuations without cracking and unaffected by wet/dry cycle (unlike bentonite clays).

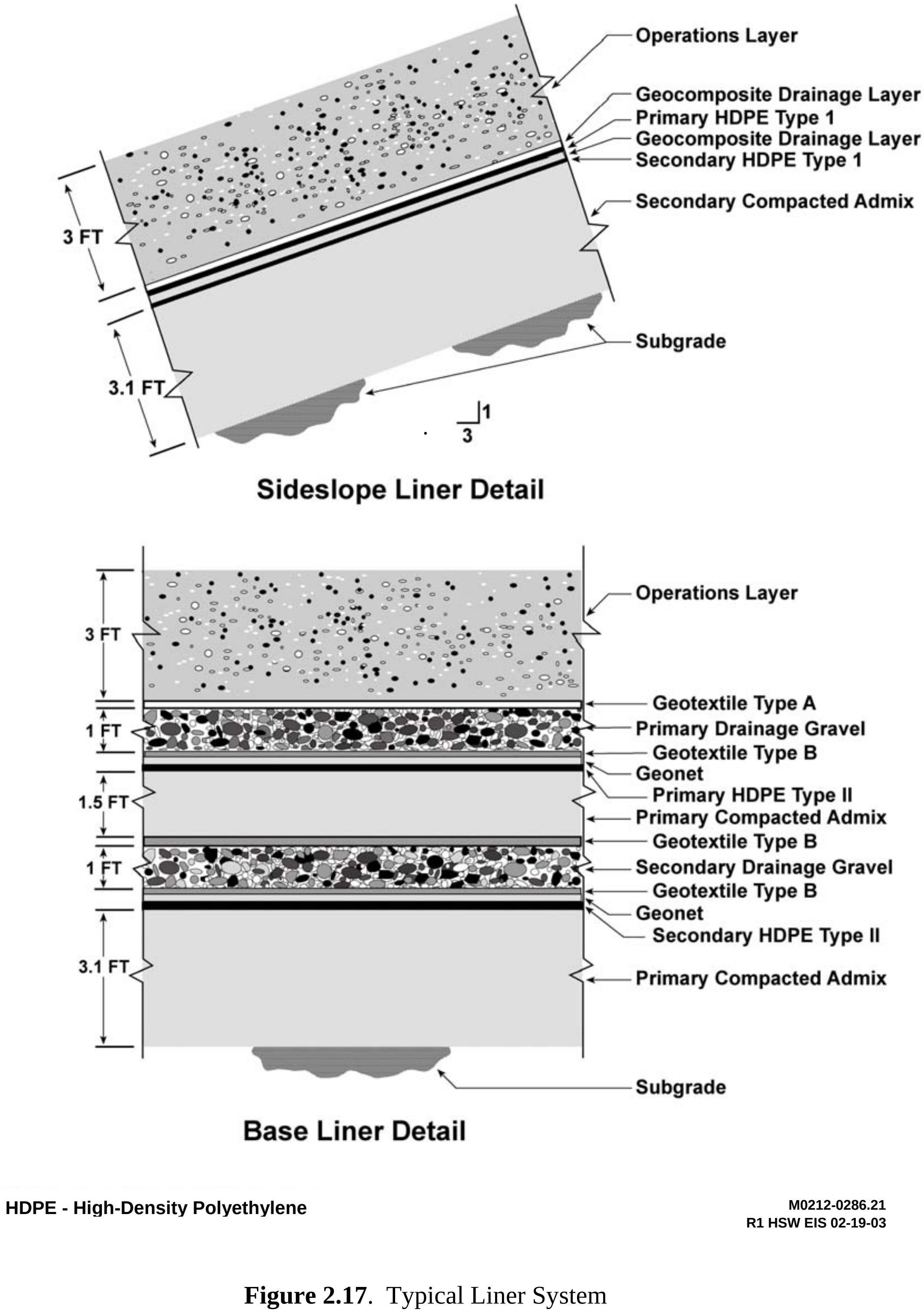

Figure 2.17. Typical Liner System

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HDPE is chemically resistant because it is essentially inert, and because of its high density and resultant low permeability, it resists penetration by chemicals. Chemicals that do react with HDPE are primarily oxidizing agents like nitric acid and hydrogen peroxide. Oxidation will only occur under two conditions: 1) the oxidizer must be in high concentrations, and 2) the material must receive a sufficient supply of energy to activate the reaction (Tisinger and Giroud 1993). If oxidation does occur, the HDPE material becomes soft and brittle and therefore becomes subject to stress cracking. Under anaerobic conditions or conditions devoid of energy, oxidation cannot occur. Because most waste facilities are typically anaerobic and the liner is buried and therefore not directly exposed to the sunlight, the process of oxidative degradation of HDPE liners is highly unlikely. Furthermore, most HDPE liners contain antioxidants that further mitigate the impacts of oxidation on liner degradation.

2.2.3.6 Closure Barriers

Closure barriers (also know as "caps") are planned for the disposal trenches in accordance with applicable regulations. Because the design and timing of the barriers is still being decided, the various design options are still being considered. For the EIS analysis the Modified RCRA Subtitle C barrier was selected. Other closure barrier designs are described in Appendix D.

The Modified RCRA Subtitle C barrier is designed to provide long-term containment and hydrologic protection for a performance period of 500 years with no maintenance being conducted after an assumed 100-year institutional control period. The performance period is based on radionuclide concentration and activity limits for Cat 3 LLW. The Modified RCRA Subtitle C Barrier, shown in Figure 2.18, is composed of eight layers of durable material with a combined minimum thickness of 1.7 m (5.5 ft) excluding the grading fill layer. This design incorporates *Resource Conservation and Recovery Act of* 1976 "minimum technology guidance" (MTG) (EPA 1989), with modifications for extended performance. One major change is the elimination of the clay layer, which may desiccate and crack over time in an arid environment. The geo-membrane component has also been eliminated because of its uncertain long-term durability. The design also incorporates provisions for bio-intrusion and human intrusion control.

A borrow pit to supply the local materials for the barriers would be developed at Areas B and C in accordance with the discussion in Appendix D.

Proposed New/Modified Disposal Facility: LLBG Closure Barrier or Cap

MLLW trenches are capped in accordance with applicable regulations. The LLBGs would be closed and capped beginning in 2046. While the final design for the closure cap or barrier has not yet been decided, the RCRA modified Subtitle C Barrier illustrated in Figure 2.18 has been used for the HSW EIS analysis. Alternative barrier designs are discussed in Appendix D. A discussion of the borrow pits in Areas B and C that are assumed to be used to derive some of the capping material is contained in Appendix D.

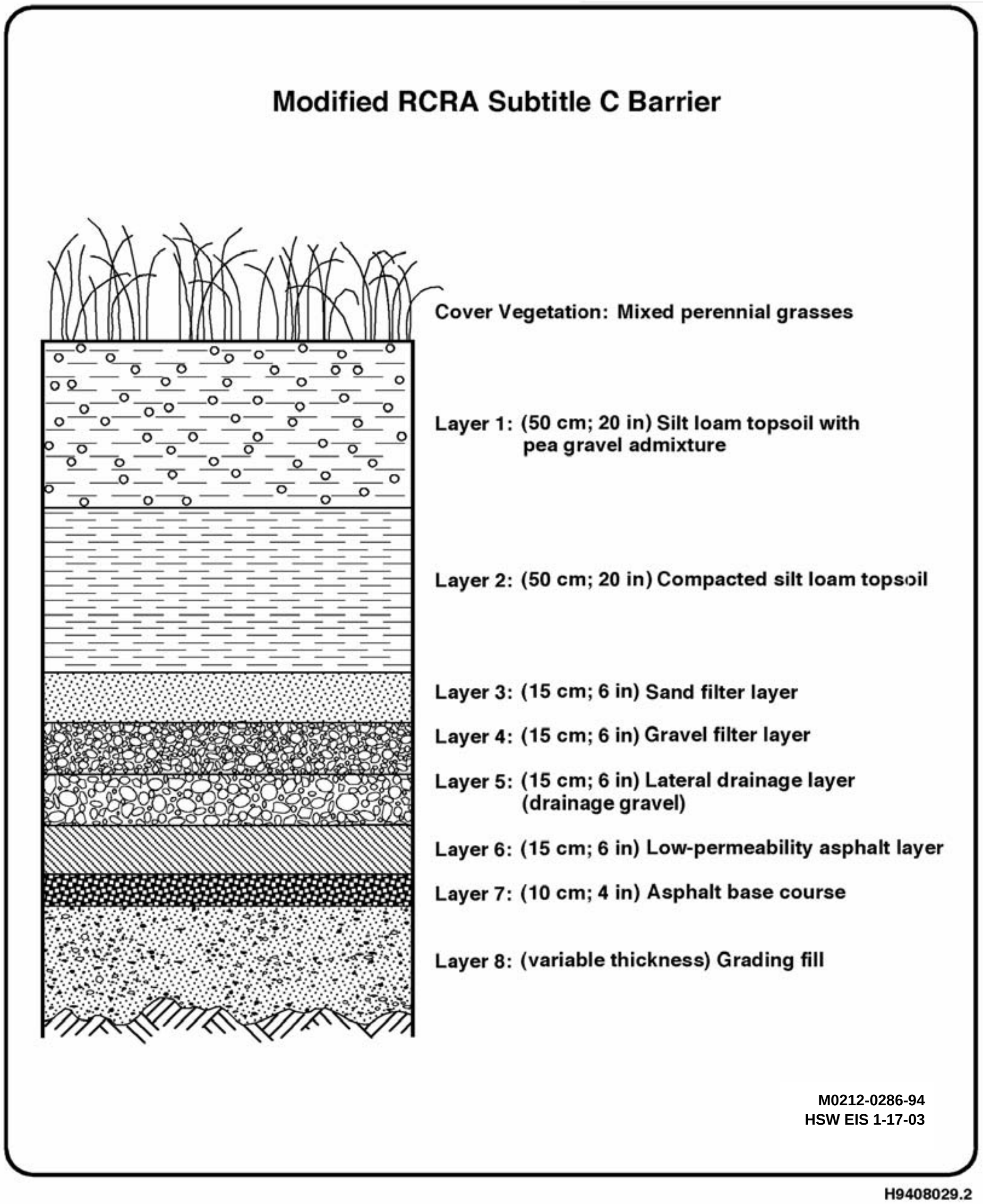

Figure 2.18. Modified RCRA Subtitle C Barrier for Mixed Low-Level Waste Trenches and the Low Level Burial Grounds

2.2.4 Transportation

Solid radioactive waste is currently transported on the Hanford Site by truck. The site has reactivated its rail system. DOE is considering shipping TRU waste to WIPP by rail, if rail shipments become practical. LLW and MLLW could be received by rail from offsite generators. Shipment of waste by rail may require constructing a spur or developing intermodal transfer capability from the existing rail lines, and if such construction and capability is proposed it will be evaluated under future NEPA reviews. Section 4.8.5 provides additional information on the Hanford transportation system features.

2.2.4.1 Transportation Overview

About 300 million hazardous material[a] shipments (DOT 1998) occur in the United States every year. About 3 million (1 percent) of these involve shipments of radioactive material.[b] Currently, less than one percent of these 3 million radioactive material shipments are DOE shipments (NEI 2003). The number of LLW and MLLW shipments is expected to rise over the next five years. The number of shipments expected to go to Hanford related to the proposed action is addressed in Section 5.8 as part of the environmental impacts analysis. The annual peak of all DOE radioactive material shipments is expected to be larger due to HLW, TRU waste, and spent nuclear fuel shipments and due to acceleration of cleanup activities. However, acceleration of cleanup activities would not change the total number of shipments. In addition, the annual number of DOE radioactive material shipments will continue to be small in comparison to the total number of hazardous material shipments nationwide.

Even though the number of DOE shipments will continue to be relatively small, DOE shipments will represent a large amount of the radioactivity being shipped. Of DOE's radioactive materials, LLW, MLLW, and TRU waste will account for about 90 percent by volume, but less than 6 percent by radioactivity. The bulk of the radioactivity is in HLW and SNF.

2.2.4.2 Transportation Regulations

Shipment of hazardous materials is regulated by the U.S. Department of Transportation (DOT). The DOT regulations for shipping hazardous materials can be found in the Hazardous Material Regulations (49 CFR 106-180), the Federal Motor Carrier Safety Regulations (49 CFR 390-397), and Packaging and Transportation of Radioactive Material (10 CFR 71). Other regulations and requirements for the shipment of radioactive materials can be found in DOE's Radioactive Material Transportation Practices (DOE 2002b).

These regulations address many specific subjects including:

- shipper and carrier responsibilities
- planning information

(a) For the purposes of this transportation discussion, hazardous materials include items that present chemical hazards, radioactive hazards, and physical hazards (e.g., compressed gases).

(b) Radioactive materials include radioactive waste.

- routing and route selection
- notifications
- shipping papers
- driver qualifications and training
- vehicles and required equipment
- equipment inspections
- labeling (information on containers)
- placarding (information on the shipping vehicle)
- emergency planning
- emergency notification
- emergency response
- security.

States have also established regulations consistent with DOT regulation. These regulations vary from state to state and typically address permitting, licensing, notification, determination of routes, financial liability, and inspection. Many states require transportation permits for radioactive materials. Some examples of state regulations can be found in:

- Oregon Administrative Rule 740-100, Vehicles: Driver: Equipment: Equipment Required and Condition of Vehicles (OAR 740-100)

- Oregon Administrative Rule 740-110, Transportation of Hazardous Materials (OAR 740-110)

- WAC 246-231, Packaging and Transportation of Radioactive Materials

- WAC 446-50, Transportation of Hazardous Materials.

Packaging – The type of package required depends, in part, on the total quantity of radioactivity, the form of the materials, and the concentration of radioactivity. DOE is responsible for determining the appropriate container for the material it is transporting. DOE ensures that each package containing hazardous materials meets DOT regulations for design, material, manufacturing methods, minimum thickness, tolerance, and testing.

Labeling and Placarding – Labels are required on each container to indicate the type of hazard contained in each container. Placards are used on vehicles transporting hazardous materials to indicate the type of hazard being transported. Labels and placards are used, in part, to help emergency responders in case of an accident.

Driver Qualifications – Drivers of all hazardous materials, including radioactive materials, must be trained in accordance with DOT regulations. Most radioactive waste shipments require specific driver training on emergency response appropriate for the materials being carried.

Routing – In general, the carrier selects the shipping routes for highway shipments of most hazardous materials in accordance with DOT regulations. Routes are selected to minimize risk with consideration to such factors as distance of shipment, accident rates, time in transit, population density, time of day, and day of the week. Most radioactive waste is transported along the interstate highway system.

Notification – DOE notifies affected states regarding shipments of spent nuclear fuel, HLW, and TRU waste. States are generally not notified about shipments of LLW and MLLW. DOE does not notify states about shipments of classified materials. When notifications are made to states, they are usually also made to affected tribal authorities.

Emergency Preparedness – Local, state, tribal, and federal governments and carriers all have responsibility for preparing for and responding to transportation emergencies.

Local or tribal personnel typically are the first responders and incident commanders for offsite transportation accidents. Although many local jurisdictions have special hazardous material response units, most seek state or federal technical assistance during radiological incidents.

State and tribal governments have primary responsibility for the health and welfare of their citizens and therefore have an interest in ensuring the safety of shipments of hazardous materials, including DOE-owned materials, within their boundaries. Some states maintain specialized emergency response units capable of responding to radioactive material incidents in support of local authorities.

The Federal Emergency Management Agency (FEMA) is responsible for the federal government's emergency response activities. These activities are coordinated through a Federal Radiological Emergency Response Plan developed by FEMA and 11 other federal agencies. FEMA also provides assistance and evaluates state and local preparedness for radiological emergencies.

DOT has established requirements for reporting transportation accidents involving radioactive materials and has a comprehensive training program on handling emergencies involving radioactive materials shipments.

Carriers are required to notify the National Response Center (operated by the U.S. Coast Guard) of all releases of hazardous substances that exceed reportable quantities or levels of concern. Certain transportation incidents involving hazardous materials must also be reported to the National Response Center immediately including those where

- a person is killed
- a person receives injuries that require hospitalization
- property damage exceeds $50,000
- radioactive materials are released
- major roads are closed.

The DOE manual (DOE 2002b) expands these criteria and requires notification to the states.

DOE operates a Radiological Assistance Program (RAP) with eight Regional Coordinating Offices staffed with experts available for immediate assistance in offsite radiological monitoring and assessment. DOE RAP teams assist state, local, and tribal officials in identifying the material and monitoring to determine if there is a release and with general support.

Consistent with the DOE manual (DOE 2002b), DOE has developed the Transportation Emergency Preparedness Program to assist federal, state, tribal, and local authorities to prepare for transportation accidents involving radioactive materials. That assistance includes planning for emergencies as well as training for emergencies. For example, through education programs offered to state and tribal organizations, over 17,000 emergency response personnel in twenty states have been trained to respond to accidents involving radioactive material (Westinghouse 2001).

Like private-sector shippers, DOE must provide emergency response information required on shipping papers, including a 24-hour emergency telephone number. Shippers have overall responsibility for providing adequate technical assistance for emergency response.

Carriers are required to provide emergency planning, emergency response assistance, liability coverage, and site cleanup and restoration. DOE's policy is to respond to requests for technical advice with appropriate information and resources.

Specific information regarding local emergency preparedness can be found through Local Emergency Planning Committees (LEPCs) or State Emergency Response Commissions (SERCs).

2.2.5 Pollution Prevention/Waste Minimization

Consistent with the requirements and guidance of several laws and executive orders, including the Pollution Prevention Act of 1990 (42 USC 13101), DOE performs pollution prevention and waste minimization activities in the work it does. Pollution prevention is defined as the use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and wastes into land, water, and air. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water, and other resources along with practices that protect natural resources through conservation or more efficient use. Within DOE, pollution prevention includes all aspects of source reduction as defined by the EPA, and incorporates waste minimization by expanding beyond the EPA definition of pollution prevention to include recycling.

Pollution prevention is achieved through:

- equipment or technology selection or modification, process or procedure modification, reformulation or redesign of products, substitution of raw material, waste segregation, and improvements in housekeeping, maintenance, training or inventory control

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Like private-sector shippers, DOE must provide emergency response information required on shipping papers, including a 24-hour emergency telephone number. Shippers have overall responsibility for providing adequate technical assistance for emergency response.

Carriers are required to provide emergency planning, emergency response assistance, liability coverage, and site cleanup and restoration. DOE's policy is to respond to requests for technical advice with appropriate information and resources.

Specific information regarding local emergency preparedness can be found through Local Emergency Planning Committees (LEPCs) or State Emergency Response Commissions (SERCs).

2.2.5 Pollution Prevention/Waste Minimization

Consistent with the requirements and guidance of several laws and executive orders, including the Pollution Prevention Act of 1990 (42 USC 13101), DOE performs pollution prevention and waste minimization activities in the work it does. Pollution prevention is defined as the use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and wastes into land, water, and air. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water, and other resources along with practices that protect natural resources through conservation or more efficient use. Within DOE, pollution prevention includes all aspects of source reduction as defined by the EPA, and incorporates waste minimization by expanding beyond the EPA definition of pollution prevention to include recycling.

Pollution prevention is achieved through:

- equipment or technology selection or modification, process or procedure modification, reformulation or redesign of products, substitution of raw material, waste segregation, and improvements in housekeeping, maintenance, training or inventory control

- increased efficiency in the use of raw materials, energy, water, or other resources

- recycling to reduce the amount of waste and pollutants destined for release, treatment, storage, and disposal.

Pollution prevention is applied to all DOE pollution-generating activities including:

- manufacturing and production operations
- facility operations, maintenance, and transportation
- laboratory research
- research, development, and demonstration,
- weapons dismantlement
- stabilization, deactivation, and decommissioning
- legacy waste and contaminated site cleanup.

2.2.6 Decontamination and Decommissioning of Hanford Facilities

Decontamination is the removal, by chemical or physical methods, of radioactive or hazardous materials from internal and external surfaces of components, systems and structures in a nuclear facility. It is usually the first step toward decommissioning. Decommissioning of a nuclear facility can be defined as the measures taken at the end of the facility's lifetime to assure protection of public health and safety and the environment. Such measures can involve protective storage, entombment, or removal. For protective storage, the facility is left intact after removal of most of the radioactive materials and the appropriate security controls are established to assure public health and safety. Entombment consists of removing radioactive liquids and wastes and then sealing all remaining radioactivity within the facility and then establishing appropriate security controls to assure public health and safety. For the removal option, all radioactive materials are removed from the site and the facility is refitted for other use or completely dismantled.

2.2.7 Long-Term Stewardship

The Hanford Site is being cleaned up to meet certain land-use requirements. These requirements are based, in part, on limitations of what level of cleanup can be practically achieved. Limitations that prevent unrestricted use of all land and groundwater at the Hanford site include:

- technical and economic limitations – technically or economically practicable technology does not exist to perform cleanup activities. For example, no technology, known or anticipated, can remove 100% of the contents of Hanford's high-level waste tanks.

- worker safety and health issues – impacts to workers from cleaning up may be greater than the impacts to the general public for not cleaning up. For example, the impacts to workers from digging up and treating waste from old burial grounds might be greater than the impacts to the general public from capping the waste in place.

- increased efficiency in the use of raw materials, energy, water, or other resources

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- environmental issues – cleanup may result in greater impacts to the environment than already exist. For example, the risk of accidental releases to the environment during retrieval of waste from old burial grounds might be larger than the risk to the environment from capping the waste in place.

These limitations result in some hazards remaining after cleanup activities are complete. Since some hazards will remain, continued efforts are needed to monitor the hazards and deal with any problems that occur. These post-cleanup activities are referred to as long-term stewardship.

Specific long-term stewardship activities are dependent on rules and regulations under which the specific cleanup and post-cleanup activities are performed and the specific hazards that remain. Long-term stewardship activities are intended to continue isolating hazards from people and the environment. Specific long-term stewardship activities can include:

- monitoring to verify the integrity of caps placed over disposal sites
- maintaining caps to ensure their continued integrity
- monitoring groundwater and the vadose zone to determine whether systems to contain hazards are performing as expected
- monitoring for surface contamination
- monitoring animals, plants, and the ecosystem
- performing groundwater pump-and-treatment operations
- installing and maintaining fences and other barriers
- posting warning signs
- establishing easements and deed restrictions
- establishing zoning and land use restrictions
- maintaining records on clean up activities, remaining hazards, and locations of the hazards
- providing funding and infrastructure (e.g., utilities, roads, communication systems)

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3.0 Description and Comparison of Alternatives

This section describes the alternatives for storage, treatment, and disposal that are analyzed in this revised draft of the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) as well as alternatives eliminated from detailed analysis. As required by the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) of 1969 (40 CFR 1500-1508), a No Action Alternative is also included.

The waste streams and facilities that are considered in this EIS were identified and described in Sections 2.1 and 2.2. Section 3.1 describes the alternatives and the development and selection of alternative groups that are analyzed in detail. Section 3.2 identifies alternatives that were not analyzed in detail. The three waste volumes, Hanford Only, Lower Bound and Upper Bound are presented as alternative waste volume scenarios in Section 3.3. A comparison of the environmental impacts associated with each of the alternative groups is contained in Section 3.4. The major uncertainties in the EIS analysis are identified in Section 3.5. A summary of the estimated costs for the alternative groups is included in Section 3.6. The U.S. Department of Energy (DOE) preferred alternative is discussed in Section 3.7. Detailed descriptions of alternatives, assumptions, waste volumes, and waste stream flowsheets are provided in Appendixes B and C. The Section 2 and the Technical Information Document (TID) prepared by Fluor Hanford, Inc. (FH 2003) to support this EIS should be reviewed when additional information on a facility or waste stream is desired.

3.1 Alternatives Considered in Detail and Their Development

The CEQ regulations direct all federal agencies to use the NEPA process to identify and assess the reasonable alternatives to proposed actions that would avoid or minimize adverse effects of the proposed action on the quality of the human environment. Related CEQ guidance in 46 FR 18026 (Forty Most Asked Questions) states that "When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS." In considering the alternatives for this EIS it was quickly recognized that there is a very large number of combinations of the various waste streams, potential waste volumes and individual options for storage, treatment, and disposal. Therefore, the alternatives developed for this EIS were selected to represent the full spectrum of reasonable alternatives.

The individual alternatives for the proposed actions are shown in Figure 3.1. The alternatives are first subdivided into three types of action (storage, treatment, and disposal), then further subdivided into specific alternatives for each of the waste types (LLW, MLLW, TRU waste, ILAW, and melters) as appropriate. It should be noted that no storage or treatment alternatives are shown for ILAW and melters because those activities have been, or are being, evaluated in separate NEPA reviews (DOE and Ecology 1996; 68 FR 1052). Also, no disposal alternatives are shown for TRU waste because DOE previously decided to dispose of TRU waste at the Waste Isolation Pilot Plant (WIPP, DOE 1997a). WIPP alternatives and activities are also not within the scope of this EIS. Disposal alternatives for each of the waste

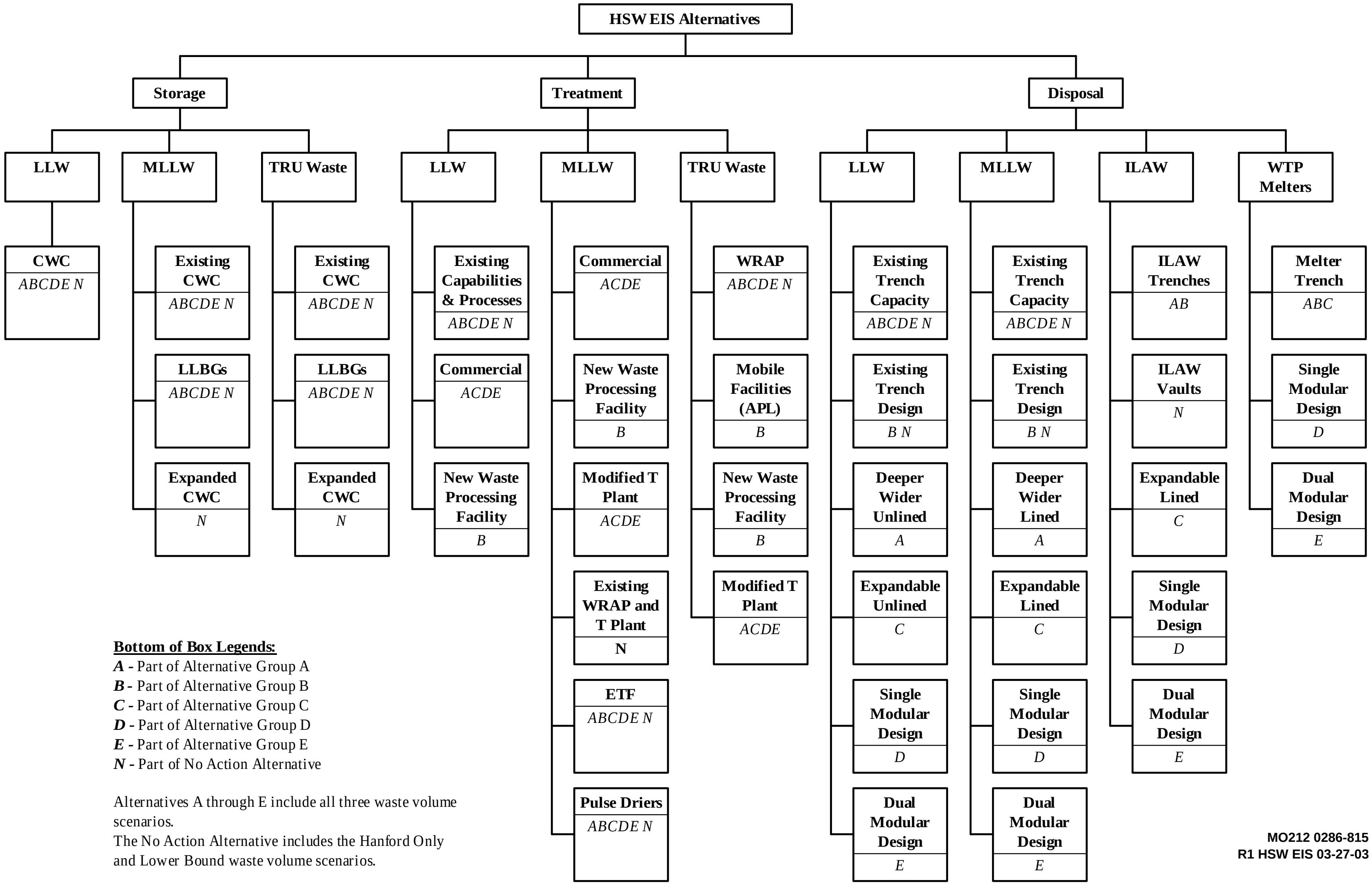

Figure 3.1. Options for HSW EIS Alternatives

types consider both independent disposal facilities for a single waste type as well as modular combined-use disposal facilities that would contain either two or four of the waste types.

It should be noted that Figure 3.1 has been simplified by considering actions where possible at the four waste type levels, rather than the 21 waste stream levels (see Figure 2.1 in Section 2). In the descriptions of the alternatives, specific actions for individual waste streams are also discussed. With the primary alternatives in Figure 3.1, alternative groups can be defined from the potential combinations of storage, treatment, and disposal alternatives for each of the waste types. However, these groupings for purposes of analysis are not intended to be restrictive in the final selection and implementation of the EIS alternatives. DOE may ultimately develop its final decisions based on a different combination of specific actions for individual waste streams.

For the analysis of potential actions, DOE has defined six representative alternatives groups from among the many possible combinations. It is necessary in the development of an alternative to specify options for each of the waste types and to include a full set of treatment, storage, and disposal activities. For the purposes of this EIS, each selected set of activities is called an alternative group, since it consists of a group of alternatives for various waste types and activities. The use of groups in the analysis is necessary because some facilities can process more than one waste type, and some impacts are only meaningful when assessed using a complete set of alternatives. The alternative groups have been identified as A, B, C, D, E, and No Action (N). Key characteristics of each of the groups are shown in the adjacent text box. Each of the alternative groups is discussed in greater detail in subsequent sections. The individual alternative actions that are used in each of the alternative groups can be noted by the corresponding letter in italics at the bottom of each box. Note that some individual alternatives are used in all alternative groups, whereas in other cases an alternative is only used in one alternative group. For Alternative Groups D and E, different potential disposal facility locations within the Hanford Central Plateau are under consideration and have been evaluated in Section 5. The specifics for the locations are discussed in their respective sections (3.1.5 and 3.1.6). The locations of the major facilities are shown in Figure 3.2.

Alternative Groups

A – Additional treatment in the modified T Plant and disposal in deeper and wider trenches.
B – Additional treatment in a new waste processing facility and disposal in existing trench designs.
C – Additional treatment in the modified T Plant and disposal in a single expandable trench for each waste type.
D – Additional treatment in the modified T Plant and disposal in a single expandable trench containing LLW, MLLW, and WTP wastes.
E – Additional treatment in the modified T Plant and disposal in two expandable trenches, one with LLW and MLLW, and the second with ILAW and WTP melters.

Within the EIS, DOE analyzes as many as three alternative waste volume scenarios. The “Hanford Only” waste volume represents waste forecast to be received from Hanford Site generators. The “Lower Bound” waste volume is the current best estimate of the amount DOE could receive from offsite (based on past receipts) combined with the best projection of what might be generated at Hanford. The “Upper Bound” waste volume provides the highest projected offsite waste volume that could be received, along with the best projection of what might be generated at Hanford.

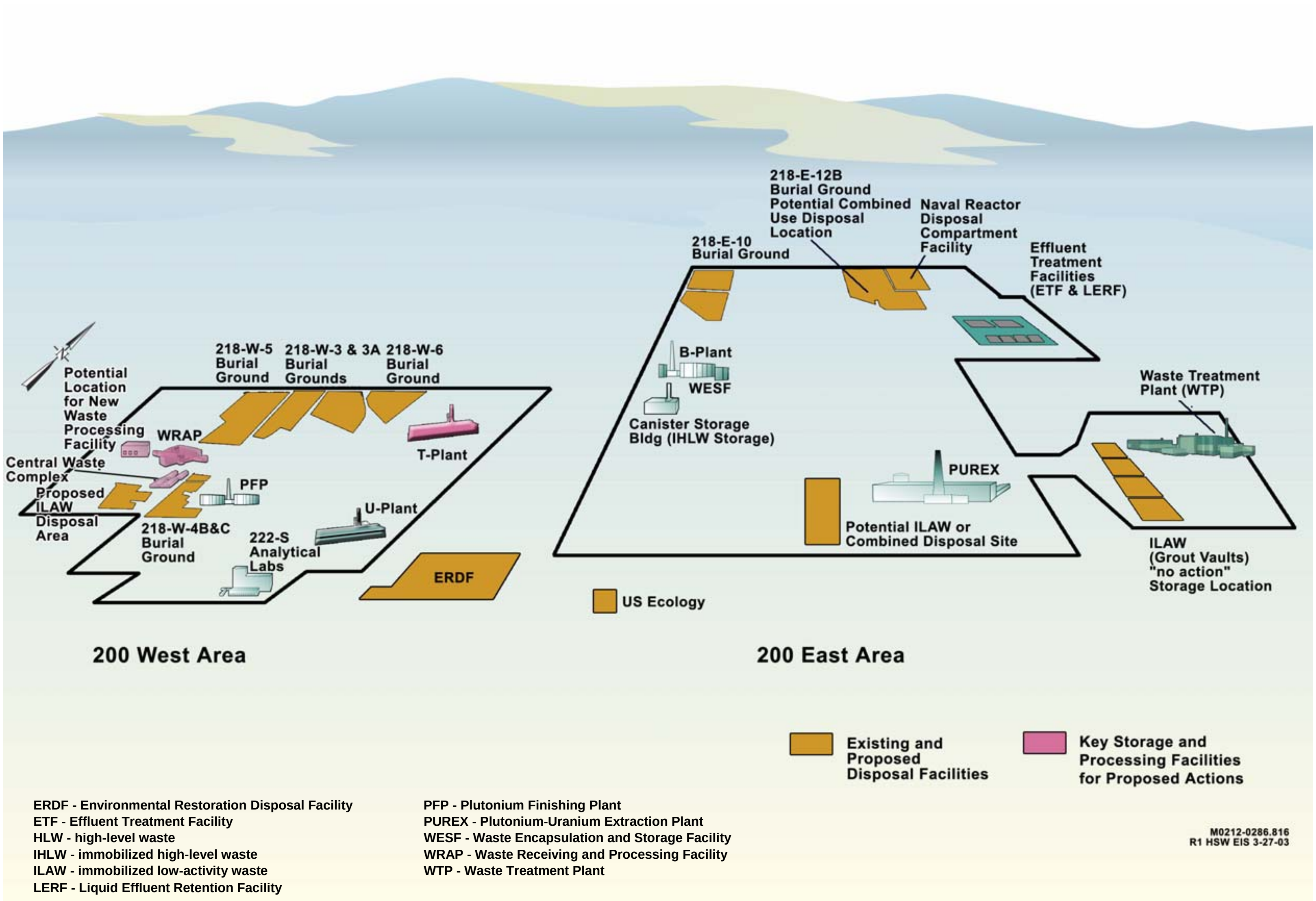

Figure 3.2. Locations of Existing and Potential Processing and Disposal Facilities on the Hanford Site

The Hanford Only waste volume excludes future offsite waste volumes entirely so the incremental impacts of receiving offsite waste could be determined. The three volumes by waste type are illustrated in Figure 3.3.

3.1.1 No Action Alternative

The No Action Alternative provides a baseline for comparison of the impacts from the proposed action and alternatives and is consistent with decisions reached under previous NEPA reviews. No Action thus reflects the current status quo and continued operation of existing facilities without conducting additional activities necessary to meet regulatory obligations. The No Action Alternative would only partially meet DOE's obligations under the Hanford TPA and applicable regulatory requirements. As such it represents an analytical construct to meet NEPA requirements rather than an expression of DOE's intended future actions.

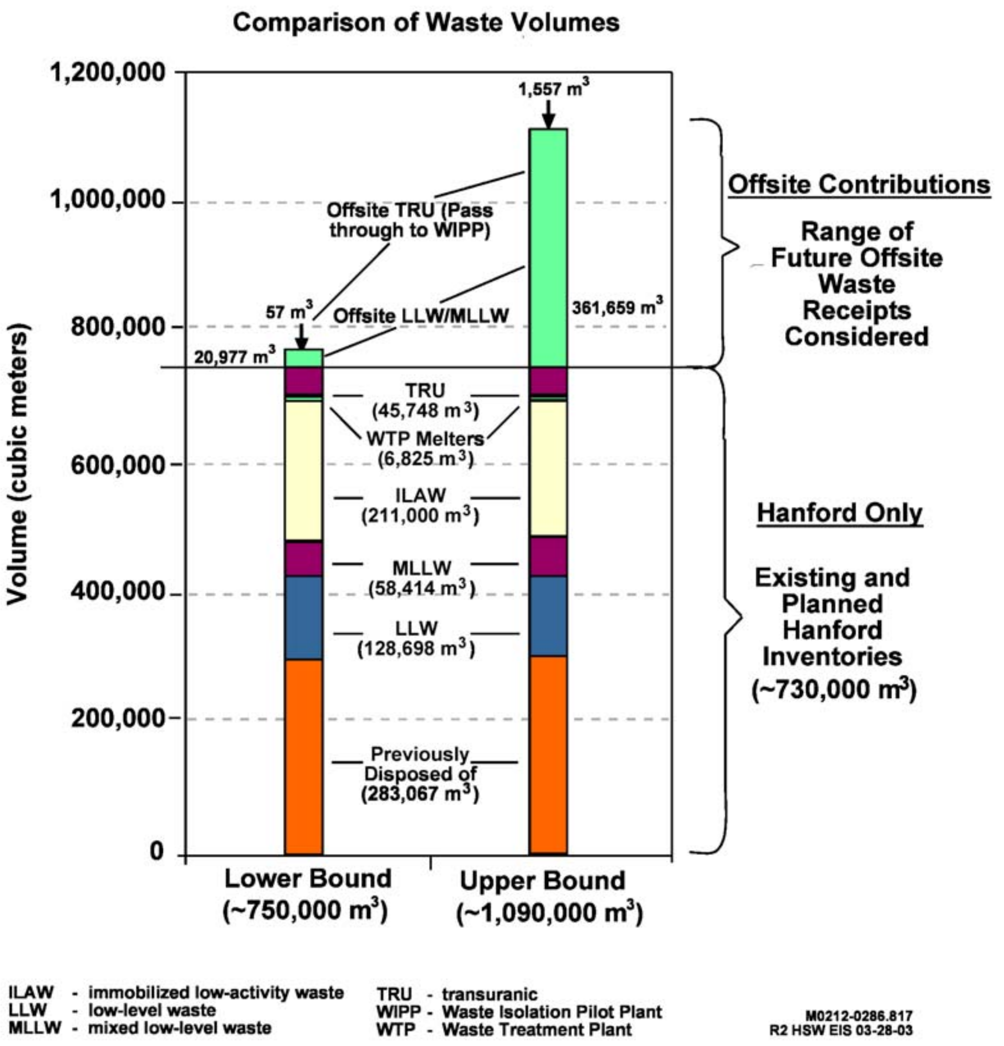

Figure 3.3. Range of Waste Volumes Considered in the HSW EIS

Because most activities considered in the HSW EIS are ongoing operations, or have been the subject of previous decisions made under other NEPA reviews, the No Action Alternative consists of implementing the previous NEPA decisions or of continuing current solid waste management practices, consistent with CEQ guidance. The No Action Alternative for LLW, MLLW, and TRU waste was described in the previous draft HSW EIS (DOE 2002a). The No Action Alternative for disposal of ILAW consists of the preferred alternative selected previously in the Record of Decision (ROD) for the Tank Waste Remediation System (TWRS) EIS (62 FR 8693). The No Action Alternative was evaluated using the Hanford Only waste volume and the Lower Bound waste volume. The ILAW volume reflects a different waste form (cullet in canisters) than that assumed for Alternative Groups A through E (monolithic vitrified waste in canisters).

3.1.1.1 Storage

In the No Action Alternative, additional CWC storage would be needed for waste that could not be treated or disposed of. Hanford's non-conforming LLW would continue to be stored in the CWC. Most MLLW would be stored at CWC due to limited treatment and disposal capacity. Likewise, melters from the WTP would be stored at CWC, as no disposal facility would be available for them. All TRU waste that cannot be processed at WRAP would be stored at CWC or T Plant Complex. The wastes requiring storage would include non-standard containers, RH TRU waste, and PCB-commingled TRU waste. K Basin sludge would remain in storage at the T Plant Complex. Additional storage space would be constructed at CWC as needed for LLW, MLLW, melters, and TRU waste.

The existing grout vaults would be modified for storage of ILAW until disposal vaults were constructed in accordance with the TWRS EIS ROD.

3.1.1.2 Treatment

No treatment capability would be available for non-conforming LLW, and for most MLLW. Treatment of solid MLLW would be limited to the existing commercial treatment contracts and the limited existing capacity of WRAP, the T Plant Complex, and other onsite facilities. Leachate from the MLLW trenches would be collected and sent by truck to the 200 East Area Effluent Treatment Facility (ETF) for treatment. After ETF closes, leachate would be treated using a pulse drier. Solids from that treatment would be sent to the MLLW trenches for disposal or to CWC for storage after the trenches are closed. Previously treated MLLW, potentially including MLLW received from offsite generators, would be directly disposed of in the two existing regulatory-compliant (lined) MLLW trenches as long as space is available.

Processing and certification of TRU waste would continue at WRAP and the T Plant Complex to prepare existing stored and newly generated CH TRU waste packaged in standard containers for shipment to WIPP. The EIS analysis assumed that DOE would continue to operate WRAP until 2032 to perform this function. After closure of WRAP, individual generators would be responsible for certifying and shipping their own waste.

Consistent with the TWRS EIS ROD, ILAW would be processed into cullet (granular glass particles similar to coarse sand), and placed into containers for onsite storage in modified grout vaults that were constructed in the 1980s.

3.1.1.3 Disposal

LLW would be prepared for disposal to meet the *Hanford Site Solid Waste Acceptance Criteria* (HSSWAC, FH 2002). Cat 1 wastes would be placed directly into the LLBGs. Cat 3 and GTC3 wastes would either be disposed of in high-integrity containers (HICs) or in-trench grouted. DOE would continue the practice of building LLW disposal trenches in the LLBGs using the current trench design (unlined) as additional disposal capacity is needed. DOE would backfill the trenches with soil as their capacity is reached, but the trenches would not be capped.

Disposal of MLLW would occur only in the two existing MLLW trenches. The MLLW trenches would be capped in accordance with regulations after they are filled. An additional 66 new vaults would be constructed for ILAW disposal in the 200 East Area within 3.1 km (1.9 mi) of the existing vaults southwest of PUREX. The new vaults would contain a leachate collection system and would have an array of monitoring wells. All ILAW would be transferred to the new vaults, which would be equipped with a crane to place the containers into specific locations that would be recorded into a registry that includes container serial number, date, and position. An interim barrier containing a surface liner and an interim cover of sand and gravel totaling about 3.3 m (11 ft) thick would be placed over the containers. A regulatory-compliant barrier would be applied at closure.

3.1.2 Alternative Group A

Alternative Group A includes actions for management of LLW, MLLW, and TRU waste as described in Alternative 1 of the first draft HSW EIS (DOE 2002a). An alternative for disposal of ILAW has been added to this group. The storage, treatment, and disposal alternatives included in Group A are described in the following sections.

3.1.2.1 Storage

Most LLW would not be stored, but would be sent directly to the LLBGs. However, some waste would be received and placed into temporary storage in CWC until it could go to WRAP for inspection. After passing inspection it would be sent on to the LLBGs. Non-conforming LLW that cannot go to disposal would be stored in CWC until it could be sent to a treatment facility. No long-term storage of LLW is expected in Alternative Group A.

Historically, MLLW has been stored in CWC and would continue to be stored there until treatment is available. In Alternative Group A, all MLLW would be treated, so no long-term storage would be needed.

TRU waste is currently stored in CWC and in the LLBGs. In Alternative Group A, all of the waste would be sent to onsite processing facilities and then to WIPP, thus eliminating any long-term onsite storage requirement.

WTP waste including the ILAW and melters would be sent directly to their respective disposal facilities. Storage of these wastes is not evaluated in this EIS.

3.1.2.2 Treatment

LLW needs to meet the HSSWAC before it can be disposed at Hanford. Most LLW does not require treatment to meet the HSSWAC. Treatment of LLW for volume reduction is not generally economically beneficial and is therefore not proposed as part of the HSW EIS alternatives. Cat 1 wastes would be placed directly into the LLBG following verification. Cat 3 and GTC3 wastes would continue to be either emplaced in HICs or in-trench grouted. For purposes of analysis, it was assumed nonconforming LLW that could not be treated onsite would be treated in a commercial treatment facility and returned to Hanford for disposal.

At Hanford, most MLLW arrives treated and ready for disposal without further treatment. Other waste streams require treatment in accordance with regulatory requirements to allow the wastes to meet the HSSWAC for onsite disposal. Six MLLW streams are evaluated in this HSW EIS, each of which involves specific treatment standards. DOE would continue to use limited existing treatment capabilities at the T Plant Complex and WRAP; however, most MLLW generated at Hanford would require development of new treatment capacity.

Treatment standards for CH Inorganic Solids and Debris specify treatment by macroencapsulation as demonstrated by an existing commercial contract. DOE would continue to use commercial facilities to treat most of Hanford's CH MLLW, with minimal onsite treatment in the modified T Plant Complex. CH Organic Solids and Debris require thermal treatment if such capability is available. Availability of thermal treatment technologies has been limited; however, in this Alternative Group it is assumed that the commercial facilities would become available to treat these wastes. Most Elemental Lead, which would likely be treated by macroencapsulation, and Elemental Mercury wastes, possibly treated by thermal desorption, would be sent to commercial treatment facilities. The Mixed Waste Trench Leachate would be treated in ETF, and pulse driers would be used after ETF closes. Treatment would be the same as in the No Action Alternative; however, the volume would be much higher with additional disposal trenches.

The RH and non-standard Packages of MLLW and TRU waste require new treatment and processing capabilities. In Alternative Group A, operations such as size-reduction and repackaging technologies and RH macroencapsulation capacity would be incorporated into the Modified T Plant to process these waste streams.

In Alternative Group A, the CH TRU wastes from trenches, wastes currently stored in CWC, and newly generated TRU wastes in standard packages would be processed in WRAP. DOE would continue to operate WRAP until 2032 to perform this function. After closure of WRAP, individual Hanford generators would be responsible for certifying and shipping their own waste. The RH and non-standard wastes from trenches and caissons, wastes currently stored in CWC, newly generated wastes, polychlorinated biphenyl (PCB) wastes, and K Basin sludge, would be processed in a modified T Plant using a variety of technologies to package and certify the wastes for WIPP.

3.1.2.3 Disposal

Alternative Group A would utilize the existing LLW trenches in the LLBG until they have been filled, and then additional disposal trenches would be constructed in the 200 West Area using a deeper, wider trench design to increase the efficiency of the disposal operations and to maintain the current focus of LLW disposal operations in the 200 West Area in accordance with the previous performance assessments for LLW disposal. Unlined deeper wider trenches would be used after about 2005.

MLLW disposal alternatives would use the existing MLLW trenches until they have been filled and then develop deeper, wider lined trenches in the 200 East Area. Leachate from the 200 East Area disposal facilities would then be sent by truck to the ETF for treatment, and pulse driers would be used thereafter.

TRU waste would be shipped to WIPP.

The ILAW canisters would be placed into a dedicated disposal facility near PUREX in multiple lined trenches.

The large WTP melters would be taken to a dedicated lined trench near PUREX for disposal.

All of the MLLW trenches would be capped when the trenches are filled. Other LLW trenches, ILAW, and melter trenches would be closed at the end of their mission and the disposal facilities would be capped in accordance with applicable regulatory requirements with the modified RCRA Subtitle C barrier.

3.1.3 Alternative Group B

Alternative Group B includes activities that maximize onsite treatment of MLLW and non-conforming LLW, and which involve construction of new facilities to treat LLW, MLLW, and TRU waste. Disposal of LLW and MLLW would take place in less efficient trench configurations of existing design. Disposal of WTP melters and ILAW would use the same trench configurations as in Alternative Group A, but would occur in different locations. This combination of alternatives is expected to result in the maximum short- and long-term environmental impacts because it includes more onsite activities and new construction. Alternatives included in Alternative Group B are described as follows.

3.1.3.1 Storage

The storage alternatives for LLW, MLLW, and TRU waste are the same in Alternative Group B as in Alternative Group A.

3.1.3.2 Treatment

LLW treatment alternatives are the same as in Group A, except for the non-conforming wastes. Those wastes would be sent to an onsite New Waste Processing Facility rather than to a commercial treatment facility.

MLLW treatment would first complete the existing commercial contracts and then utilize the New Waste Processing Facility rather than using additional offsite commercial facility contracts and the modified T Plant as in Alternative Group A.

TRU waste would be prepared for shipment to WIPP. The New Waste Processing Facility would be used for RH and non-standard wastes, and other wastes that would go to the modified T Plant as in Alternative Group A. WRAP would continue operations as the main processing facility for CH TRU wastes, and TRU waste processing capacity would be increased by the use of mobile treatment capabilities.

3.1.3.3 Disposal

As in Alternative A, the existing LLW trenches and existing MLLW trenches would first be utilized. Then additional facilities based on the current design for LLW trenches would be built in the 200 West Area. Additional MLLW trenches of the current design would be built in the 200 East Area. Leachate from the 200 East Area disposal facilities would then be sent by truck to the ETF for treatment, and pulse driers would be used thereafter.

The WTP melters would be disposed of in a single expandable lined trench to be built in the 200 East Area LLBGs, and the ILAW would be disposed of in multiple lined trenches to be built in the 200 West Area.

All of the mixed waste trenches would be capped with a modified RCRA Subtitle C barrier in accordance with applicable regulatory requirements. The rest of the LLBGs would be capped at closure.

As in Alternative Group A, CH TRU waste in standard containers would be processed at WRAP. The New Waste Processing Facility would be used to process and certify RH and non-standard containers of TRU waste. All of the processed and certified TRU waste would be shipped to WIPP.

3.1.4 Alternative Group C

Alternative Group C activities for storage, treatment, and processing of LLW, MLLW, and TRU waste are the same as those considered in Alternative Group A. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure as in Alternative Group A.

Additional disposal alternatives in Alternative Group C include: LLW disposal in the LLBGs in a single expandable unlined trench in the 200 West Area; MLLW disposal in the LLBGs in a single expandable lined trench in the 200 East Area; ILAW disposal in a single expandable lined trench near PUREX, and melter disposal in a single expandable lined trench also near PUREX. All of the trenches would be capped with a modified RCRA Subtitle C barrier at closure in accordance with applicable regulatory requirements.

3.1.5 Alternative Group D

Alternatives for treatment and processing of LLW, MLLW, and TRU waste are the same as those considered in Alternative Group A. Alternative Group D considers a single lined modular combined-use facility for onsite disposal of all LLW, MLLW, ILAW, and WTP melters. This Alternative Group contains three subalternatives that correspond to different locations for the combined-use disposal facility. The subalternatives are denoted by subscripts. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure as in Alternative Group A. The three subalternative locations for the single combined-use disposal facility are:

- Alternative Group D_1 – 200 East Area near the PUREX plant
- Alternative Group D_2 – 200 East Area LLBGs
- Alternative Group D_3 – at ERDF.

During final design a combined-use disposal facility could be configured in numerous ways. Different waste types could be disposed of in separate cells within a combined-use disposal facility, or different waste types could be disposed of in the same cell (commingled). Little interaction between the different waste types is anticipated because MLLW, ILAW, and the melters would be treated to meet applicable regulatory requirements. In addition, all waste types would need to meet the waste acceptance criteria for that disposal facility. The separate cells could be permitted under RCRA where appropriate, or the entire facility could be operated under a single regulatory program.

3.1.6 Alternative Group E

Alternatives for treatment and processing of LLW, MLLW, and TRU waste are the same as those considered in Alternative Group A. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure caps as in Alternative Group A. Alternative Group E considers two onsite lined combined-use facilities, one facility for combined disposal of LLW and MLLW, and a separate facility for combined disposal of ILAW and WTP melters. Alternative Group E contains three subalternatives that correspond to different combinations of locations for the two disposal facilities. The subalternatives are denoted by subscripts. This group also includes use of existing LLW and MLLW disposal capacity before construction of new disposal facilities and appropriate closure as in Alternative Group A. The subalternative locations for the two dual use disposal facilities are:

- Alternative Group E_1 – combined disposal of LLW and MLLW in a modular lined facility in the 200 East Area LLBGs; combined disposal of WTP melters and ILAW in a modular lined facility at ERDF;

- Alternative Group E_2 – combined disposal of LLW and MLLW in a modular lined facility near PUREX; combined disposal of WTP melters and ILAW in a modular lined facility at ERDF; and

- Alternative Group E_3 – combined disposal of LLW and MLLW in a modular lined facility at ERDF; combined disposal of WTP melters and ILAW in a modular lined facility near PUREX.

During final design a combined-use disposal facility could be configured in numerous ways. Different waste types could be disposed of in separate cells within a combined-use disposal facility, or different waste types could be disposed of in the same cell (commingled). Little interaction between the different waste types is anticipated because MLLW, ILAW, and the melters would be treated to meet applicable regulatory requirements. In addition, all waste types would need to meet the waste acceptance criteria for that disposal facility. The separate cells could be permitted under RCRA where appropriate, or the entire facility could be operated under a single regulatory program.

3.1.7 Summary Tables of Alternative Groups

To facilitate comparison and references for each of the alternative groups, Tables 3.1 and 3.2 summarize the various actions proposed as part of each group. Table 3.1 provides the treatment alternatives and Table 3.2 provides the disposal alternatives. Table 3.1 identifies the various treatment alternatives on a waste stream level and shows which individual alternatives (indicated by bullet) are included in each alternative group. The ILAW and melter waste types are not included in Table 3.1 since the treatment of ILAW and melters is part of the WTP scope. In Table 3.2 the individual disposal facility alternatives are shown for each alternative group.

3.2 Alternatives Considered but Not Evaluated in Detail

This section describes alternatives that were considered as possible methods for the management of one or more of the waste types, but were not evaluated in detail, because DOE has determined that they are not currently reasonable alternatives. The alternatives are organized by the key activity of storage, treatment, and disposal. This section also provides a qualitative discussion of the Stop Work scenario.

3.2.1 Storage Options

3.2.1.1 Storage of Waste at the Generators' Sites

Storage of waste at either the Hanford or offsite generators' sites could potentially reduce the storage requirements at CWC. However, the action alternatives do not require additional storage beyond the current CWC capacity. Storage at multiple sites would not allow DOE to take advantage of the economies of scale possible by consolidation of the wastes at CWC and would make security more difficult. Continued storage at generator's sites could be inconsistent with LDR requirements and site treatment plans. Most onsite and offsite generators do not have permitted available onsite storage and would need to increase storage capacity and might adversely impact cleanup and closure activities.

3.2.1.2 Shipment of Hanford GTC3 Wastes to Other Sites for Longer-Term Storage

No GTC3 LLW is forecast to be generated at Hanford, but 1 m^3 is assumed for analysis to address future contingencies. The amount of storage required for this waste is so small in comparison with other wastes, that storage of this waste at Hanford is not expected to impact the required capacity at CWC in any of the alternatives. Shipment of GTC3 wastes from Hanford to other DOE sites would not be

Table 3.1. Treatment Alternatives Summary

Treatment Alternatives	Alternative Groups for Analysis					
	A	B	C	D	E	No Action
LLW – Cat 1						
None required; optional by generator	-	-	-	-	-	-
LLW – Cat 3, GTC3						
HICs or Trench Grouted	s	s	s	s	s	s
LLW – Non-Conforming						
Offsite Facility, establish new contract(s)	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated LLW)						•
MLLW – RH & Non-Standard Containers						
Modified T Plant	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – CH Standard, Organic Solids & Debris						
Offsite Facility, complete existing commercial contract	s	s	s	s	s	s
Offsite Facility, establish new contract(s)	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – CH Standard, Elemental Lead, Elemental Mercury						
Offsite Facility	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – Disposal Trench Leachate						
Effluent Treatment Facility (ETF)	s	s	s	s	s	s
Pulse dryers after ETF closure	s	s	s	s	s	s
TRUW – CH Standard (retrievably stored in LLBGs & CWC, newly generated)						
WRAP	•	•	•	•	•	•
Mobile Units in 200 W Area		•				
TRUW – CH Non-Standard (LLBGs, CWC, newly generated), RH (LLBGs, caissons, CWC, newly generated), K Basin sludge, PCB Commingled						
Modified T Plant	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
Mobile Units in 200 W Area		•				
None (storage of unprocessed TRU Waste)						•

- = Activity not included in analysis
s = Activity included in analysis; same for all alternatives
• = Alternative actions evaluated in analysis group.

Table 3.2. Disposal Alternatives Summary

Disposal Alternatives for New Construction[(a)]	Alternative Groups for Analysis									
				D			E			
	A	B	C	1	2	3	1	2	3	No Action
LLW – Cat 1, Cat 3, GTC3, Non-Conforming										
200 W LLBG – Existing design unlined trenches		•								
200 W LLBG – Deeper, wider unlined trenches	•									
200 W LLBG – Single unlined trench			•							
Near PUREX – Modular combined-use lined facility				•				•		
200 E LLBG – Modular combined-use lined facility					•		•			
ERDF – Modular combined use lined facility						•			•	
200 W LLBG – Existing design unlined trenches, backfill only, no barrier (Cat 1, Cat 3, GTC3 LLW)										•
None (storage of non-conforming LLW)										•
Previously Buried Waste										
Install modified RCRA Subtitle C barrier	•	•	•	•	•	•	•	•	•	
Backfill only, no RCRA barrier										•
MLLW – treated, ready for disposal, RH & CH MLLW, Elemental Lead & Elemental Mercury, solids from MLLW leachate treatment										
200 E LLBG – Existing design lined trenches		•								
200 E LLBG – Deeper, wider lined trenches	•									
200 E LLBG – Single expandable lined trench			•							
Near PUREX – Modular combined-use lined facility				•				•		
200 E LLBG – Modular combined-use lined facility					•		•			
ERDF – Modular combined-use lined facility						•			•	
None (storage of untreated MLLW and treated MLLW in excess of existing disposal capacity)										•
TRUW – CH Standard										
Ship to Waste Isolation Pilot Plant	s	s	s	s			s			s
TRUW – CH Non-Standard, RH, K Basin sludge, PCB										
Ship to Waste Isolation Pilot Plant	•	•	•	•			•			
None (storage of unprocessed TRUW)										•

(a) In all cases, existing trench space for LLW and MLLW in the 200 W Area, LLBGs would be filled before constructing new disposal capacity. All disposal facilities would be covered with a modified RCRA Subtitle C barrier as filled or at closure, except as noted.

S = Activity included in analysis; same in all alternative groups.

• = Alternative actions evaluated in analysis group.

Table 3.2. (contd)

Disposal Alternatives for New Construction[(a)]	Alternative Groups for Analysis									
	A	B	C	D			E			No Action
				1	2	3	1	2	3	
WTP Melters										
Near PUREX – Single lined trench	•		•							
200 E LLBG – Single lined trench		•								
Near PUREX – Modular combined-use lined facility				•					•	
200 E LLBG – Modular combined-use lined facility					•					
ERDF – Modular combined-use lined facility						•	•	•		
None (storage)										•
ILAW										
Near PUREX – Multiple lined trenches	•									
200 W Area – Multiple lined trenches		•								
Near PUREX – Single lined trench			•							
Near PUREX – Modular combined-use lined facility				•					•	
200 E LLBG – Modular combined-use lined facility					•					
ERDF – Modular combined-use lined facility						•	•	•		
Near PUREX – Lined vault disposal facility										•

(a) In all cases, existing trench space for LLW and MLLW in the 200 W Area, LLBGs would be filled before constructing new disposal capacity. All disposal facilities would be covered with a modified RCRA Subtitle C barrier as filled or at closure, except as noted.

• = Alternative actions evaluated in analysis group.

consistent with the WM PEIS ROD (65 FR 10061) for LLW and MLLW. The effort required to send waste to another site would be greater than the effort to store onsite. Thus, the most reasonable storage alternative for GTC3 LLW is storage in CWC.

3.2.2 Treatment Options

3.2.2.1 Use of Offsite DOE Facilities for Treatment of All Hanford Waste

The consolidation of waste management functions at designated DOE sites was a major focus of the WM PEIS (DOE 1997b). Attempts were made to identify treatment capacity at other DOE sites for Hanford wastes, but treatment capacity is limited at other DOE sites. Therefore, this is not a reasonable alternative for all Hanford waste. If DOE were able to ship wastes to other DOE sites for treatment, potential impacts would be similar to those for commercial treatment. Hanford may ship small-volume waste streams to other DOE sites in the future if specialized facilities become available. However, impacts of those shipments would be similar to those included for offsite treatment of MLLW.

During final design a combined-use disposal facility could be configured in numerous ways. Different waste types could be disposed of in separate cells within a combined-use disposal facility, or different waste types could be disposed of in the same cell (commingled). Little interaction between the different waste types is anticipated because MLLW, ILAW, and the melters would be treated to meet applicable regulatory requirements. In addition, all waste types would need to meet the waste acceptance criteria for that disposal facility. The separate cells could be permitted under RCRA where appropriate, or the entire facility could be operated under a single regulatory program.

3.1.7 Summary Tables of Alternative Groups

To facilitate comparison and references for each of the alternative groups, Tables 3.1 and 3.2 summarize the various actions proposed as part of each group. Table 3.1 provides the treatment alternatives and Table 3.2 provides the disposal alternatives. Table 3.1 identifies the various treatment alternatives on a waste stream level and shows which individual alternatives (indicated by bullet) are included in each alternative group. The ILAW and melter waste types are not included in Table 3.1 since the treatment of ILAW and melters is part of the WTP scope. In Table 3.2 the individual disposal facility alternatives are shown for each alternative group.

3.2 Alternatives Considered but Not Evaluated in Detail

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3.2.1 Storage Options

3.2.1.1 Storage of Waste at the Generators' Sites

Storage of waste at either the Hanford or offsite generators' sites could potentially reduce the storage requirements at CWC. However, the action alternatives do not require additional storage beyond the current CWC capacity. Storage at multiple sites would not allow DOE to take advantage of the economies of scale possible by consolidation of the wastes at CWC and would make security more difficult. Continued storage at generator's sites could be inconsistent with LDR requirements and site treatment plans. Most onsite and offsite generators do not have permitted available onsite storage and would need to increase storage capacity and might adversely impact cleanup and closure activities.

3.2.1.2 Shipment of Hanford GTC3 Wastes to Other Sites for Longer-Term Storage

No GTC3 LLW is forecast to be generated at Hanford, but 1 m^3 is assumed for analysis to address future contingencies. The amount of storage required for this waste is so small in comparison with other wastes, that storage of this waste at Hanford is not expected to impact the required capacity at CWC in any of the alternatives. Shipment of GTC3 wastes from Hanford to other DOE sites would not be

Table 3.1. Treatment Alternatives Summary

Treatment Alternatives	Alternative Groups for Analysis					
	A	**B**	**C**	**D**	**E**	**No Action**
LLW – Cat 1						
None required; optional by generator	-	-	-	-	-	-
LLW – Cat 3, GTC3						
HICs or Trench Grouted	s	s	s	s	s	s
LLW – Non-Conforming						
Offsite Facility, establish new contract(s)	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated LLW)						•
MLLW – RH & Non-Standard Containers						
Modified T Plant	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – CH Standard, Organic Solids & Debris						
Offsite Facility, complete existing commercial contract	s	s	s	s	s	s
Offsite Facility, establish new contract(s)	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – CH Standard, Elemental Lead, Elemental Mercury						
Offsite Facility	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
None (storage of untreated MLLW)						•
MLLW – Disposal Trench Leachate						
Effluent Treatment Facility (ETF)	s	s	s	s	s	s
Pulse dryers after ETF closure	s	s	s	s	s	s
TRUW – CH Standard (retrievably stored in LLBGs & CWC, newly generated)						
WRAP	•	•	•	•	•	•
Mobile Units in 200 W Area		•				
TRUW – CH Non-Standard (LLBGs, CWC, newly generated), RH (LLBGs, caissons, CWC, newly generated), K Basin sludge, PCB Commingled						
Modified T Plant	•		•	•	•	
New Waste Processing Facility in 200 W Area		•				
Mobile Units in 200 W Area		•				
None (storage of unprocessed TRU Waste)						•

- = Activity not included in analysis
s = Activity included in analysis; same for all alternatives
• = Alternative actions evaluated in analysis group.

Table 3.2. Disposal Alternatives Summary

Disposal Alternatives for New Construction[(a)]	Alternative Groups for Analysis									
				D			E			
	A	B	C	1	2	3	1	2	3	No Action
LLW – Cat 1, Cat 3, GTC3, Non-Conforming										
200 W LLBG – Existing design unlined trenches		•								
200 W LLBG – Deeper, wider unlined trenches	•									
200 W LLBG – Single unlined trench			•							
Near PUREX – Modular combined-use lined facility				•				•		
200 E LLBG – Modular combined-use lined facility					•		•			
ERDF – Modular combined use lined facility						•			•	
200 W LLBG – Existing design unlined trenches, backfill only, no barrier (Cat 1, Cat 3, GTC3 LLW)										•
None (storage of non-conforming LLW)										•
Previously Buried Waste										
Install modified RCRA Subtitle C barrier	•	•	•	•	•	•	•	•	•	
Backfill only, no RCRA barrier										•
MLLW – treated, ready for disposal, RH & CH MLLW, Elemental Lead & Elemental Mercury, solids from MLLW leachate treatment										
200 E LLBG – Existing design lined trenches		•								
200 E LLBG – Deeper, wider lined trenches	•									
200 E LLBG – Single expandable lined trench			•							
Near PUREX – Modular combined-use lined facility				•				•		
200 E LLBG – Modular combined-use lined facility					•		•			
ERDF – Modular combined-use lined facility						•			•	
None (storage of untreated MLLW and treated MLLW in excess of existing disposal capacity)										•
TRUW – CH Standard										
Ship to Waste Isolation Pilot Plant	s	s	s	s			s			s
TRUW – CH Non-Standard, RH, K Basin sludge, PCB										
Ship to Waste Isolation Pilot Plant	•	•	•	•			•			
None (storage of unprocessed TRUW)										•

(a) In all cases, existing trench space for LLW and MLLW in the 200 W Area, LLBGs would be filled before constructing new disposal capacity. All disposal facilities would be covered with a modified RCRA Subtitle C barrier as filled or at closure, except as noted.

S = Activity included in analysis; same in all alternative groups.

• = Alternative actions evaluated in analysis group.

Table 3.2. (contd)

Disposal Alternatives for New Construction[a]	Alternative Groups for Analysis									
	A	B	C	D			E			No Action
				1	2	3	1	2	3	
WTP Melters										
Near PUREX – Single lined trench	•		•							
200 E LLBG – Single lined trench		•								
Near PUREX – Modular combined-use lined facility				•					•	
200 E LLBG – Modular combined-use lined facility					•					
ERDF – Modular combined-use lined facility						•	•	•		
None (storage)										•
ILAW										
Near PUREX – Multiple lined trenches	•									
200 W Area – Multiple lined trenches		•								
Near PUREX – Single lined trench			•							
Near PUREX – Modular combined-use lined facility				•					•	
200 E LLBG – Modular combined-use lined facility					•					
ERDF – Modular combined-use lined facility						•	•	•		
Near PUREX – Lined vault disposal facility										•

(a) In all cases, existing trench space for LLW and MLLW in the 200 W Area, LLBGs would be filled before constructing new disposal capacity. All disposal facilities would be covered with a modified RCRA Subtitle C barrier as filled or at closure, except as noted.

• = Alternative actions evaluated in analysis group.

consistent with the WM PEIS ROD (65 FR 10061) for LLW and MLLW. The effort required to send waste to another site would be greater than the effort to store onsite. Thus, the most reasonable storage alternative for GTC3 LLW is storage in CWC.

3.2.2 Treatment Options

3.2.2.1 Use of Offsite DOE Facilities for Treatment of All Hanford Waste

The consolidation of waste management functions at designated DOE sites was a major focus of the WM PEIS (DOE 1997b). Attempts were made to identify treatment capacity at other DOE sites for Hanford wastes, but treatment capacity is limited at other DOE sites. Therefore, this is not a reasonable alternative for all Hanford waste. If DOE were able to ship wastes to other DOE sites for treatment, potential impacts would be similar to those for commercial treatment. Hanford may ship small-volume waste streams to other DOE sites in the future if specialized facilities become available. However, impacts of those shipments would be similar to those included for offsite treatment of MLLW.

3.2.2.2 Use of the Effluent Treatment Facility for Non-Conforming LLW

Much of the non-conforming LLW stream is organic-based liquid. The treatment of these liquids in the ETF was considered. However, organic-based liquids wastes are not compatible with the aqueous-based ETF treatment system.

3.2.3 Disposal Options

3.2.3.1 Use of Canyon Facilities for Disposal of Specific Wastes

An ongoing CERCLA study is considering the use of the major canyon facilities for disposal of some waste types that are included in the HSW EIS (Hanford Advisory Board 1997; Richland Environmental Restoration Project 2001). As currently envisioned, higher-hazard waste such as Cat 3 LLW would be placed inside the canyons and lower-activity wastes (Cat 1 LLW, for example) would be placed above and outside the canyon. Waste in the cells might be grouted in place, which would provide additional protection from intrusion as well as mitigating contaminant transport. The entire facility would then be capped with an engineered barrier. Performance monitoring of the barrier would be conducted and adjustments made as necessary. The canyons, with their thick cement walls, would provide containment of the wastes inside and retard their dispersal over the long term. The wastes outside the canyons should be as well contained as wastes placed in the LLBGs. This concept is not sufficiently well developed for detailed analysis at this time. It is being studied as part of the CERCLA process, and if pursued, would be subject to future environmental review before implementation.

3.2.3.2 Leave Retrievably Stored Transuranic Waste in the Low Level Burial Grounds

In this alternative, retrievably stored TRU waste in trenches and caissons would remain buried and would not be retrieved. Further actions could be taken to minimize environmental impacts, including the placement of a barrier over the waste to reduce the potential for further waste migration. This alternative would be attractive from an operational standpoint because it would reduce worker exposure to radio-active materials from retrieval, treatment, and transportation activities, particularly the high radiation doses from RH TRU wastes in the caissons. Modeling of this alternative indicates that it would not result in substantial radionuclide discharges to the accessible environment, or have other major environmental impacts; however, it would not be consistent with previous NEPA decisions to retrieve the waste or with the national policy to ship TRU waste to WIPP.

3.2.3.3 Use of U.S. Ecology Disposal Facility

The U.S. Ecology commercial LLW disposal site is located on land leased to the State of Washington near the 200 Areas within the Hanford Site boundary and could receive some of the LLW expected to be buried in Hanford Solid Waste disposal facilities. A draft State of Washington Environmental Policy Act (SEPA) EIS for the U.S. Ecology facility has been issued (WDOH and Ecology 2000). However, this alternative was not considered reasonable as a replacement for DOE disposal capabilities because some wastes managed by DOE could not be accepted by commercial facilities, and the Hanford infrastructure would still be necessary to manage those wastes. Disposal of DOE waste in commercial facilities would also reduce the limited capacity available for commercial waste disposal. This alternative would offer no clear environmental benefit. LLW would be disposed of on the Central Plateau in unlined trenches, and costs for disposal would be higher.

3.2.3.4 Disposal of All Hanford LLW or MLLW at Other Sites

DOE previously decided that Hanford LLW and MLLW would be disposed of at Hanford (65 FR 10061). Adequate commercial disposal capacity is not available. In view of the large volumes of waste at Hanford, the cost and number of shipments involved with shipping these wastes offsite, and the limited availability of offsite disposal capacity for certain waste types, DOE does not regard shipping the bulk of Hanford waste to other sites for disposal as a reasonable alternative.

3.2.4 Stop Work Scenario

In response to stakeholder comments DOE has included a Hanford Only scenario for waste volumes and included a qualitative discussion of a Stop Work scenario for purposes of comparison with the No Action Alternative as described in the previous section. In the Stop Work scenario, all waste management operations including storage, treatment, and disposal would be terminated. No more waste would be processed or treated and no waste would be disposed of. This scenario would not be in conformance to DOE agreements in the TPA, applicable regulations, or previous NEPA decisions. DOE does not consider this to be a reasonable scenario. Specific actions to be taken for each waste type are noted below and then onsite and offsite impacts are briefly identified. A variation of the Stop Work scenario in which Hanford would cease disposing of LLW and MLLW onsite, but would otherwise maintain normal waste management operations, is discussed further in Appendix O.

Under the Stop Work scenario receipt of LLW would be terminated. Hanford wastes would be stored by the generator, and no offsite wastes would be received. When generators run out of storage space their activities would have to stop also, or other disposal capacity would need to be identified and utilized. No further action would be taken to dispose of waste or to cap the burial grounds. Thus, wastes in the uncapped burial grounds would be exposed to increased water percolation and release to the groundwater.

Under the Stop Work scenario no further MLLW would be received from onsite or offsite generators. Waste would be left in storage, and no treatment of existing or future-generated wastes would occur. No disposal of additional wastes would take place and there would be no closure of the existing MLLW disposal trenches.

Under the Stop Work scenario no further TRU waste would be received from onsite or offsite activities. Generators, such as the Plutonium Finishing Plant, would be required to store waste and ultimately cease operations. There would be no retrieval of suspect TRU waste from the burial grounds. There would be no processing or certification of wastes in WRAP or other facilities, and the wastes would be stored. Waste shipments to the WIPP would cease.

In this scenario for the WTP, DOE would not have the ability to dispose of the ILAW at the Hanford Site. Because of limited storage space for ILAW, tank waste retrieval and operations at the WTP would be jeopardized.

Waste generators (onsite or offsite) would not be able to dispose of waste at Hanford and would have to make other arrangements. The majority of the wastes would require storage at the generator sites. However, storage at multiple sites would not allow DOE to take advantage of the economies of scale possible by consolidating waste management activities. Lastly, most generators are not permitted to store MLLW longer than 90 days. Most onsite and offsite generators do not have onsite storage available, and the need to increase storage capacity could impact cleanup and closure activities and increase environmental impacts at Hanford and other DOE sites.

3.3 Volumes of Waste Considered in Each Alternative

The environmental impacts of the alternatives considered in this EIS will depend in part on the volumes of each waste type managed at the Hanford Site. In order to assess the impacts of different amounts of waste, alternative waste volume scenarios have been analyzed: Hanford Only, Lower Bound, and Upper Bound.

- The **Hanford Only** waste volume consists of 1) the forecast volumes of LLW, MLLW, and TRU waste from Hanford Site generators, 2) the forecast ILAW and melter volumes from treatment of Hanford tank waste, and 3) existing onsite inventories of waste that are already in storage. The analysis also includes waste that has previously been disposed of.

- The **Lower Bound** waste volume consists of 1) the Hanford Only volume, and 2) additional volumes of LLW and MLLW that are currently forecast for shipment to Hanford from offsite facilities. The Lower Bound volume for TRU waste is not substantially greater than the Hanford Only volume, and is not analyzed separately in all cases.

- The **Upper Bound** waste volume consists of 1) the Lower Bound volume, and 2) estimates of additional LLW, MLLW, and TRU waste volumes that may be received from offsite generators as a result of the WM PEIS decisions.

A comparison of the waste volumes used for the HSW EIS analyses is shown in Figure 3.3.

The summary volumes used for each waste type are presented in the following sections. Annual volumes corresponding to the total volumes shown in the tables in this section are listed in Section B.4 of Appendix B (Volume II). These volumes represent the "as-received" volume of waste. As the wastes are treated and prepared for disposal their volumes may change. The changes in volume can be noted in the processing assumptions in Section B.4 of Appendix B (Volume II) and in the flowsheets in Section B.6. A more detailed description of the development of the waste volumes for each type of waste is included in Appendix C (Volume II). The number of significant figures shown in the volume tables can exceed the

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3.3.1 LLW Volumes

The alternatives for management of LLW have been analyzed using all three sets of volumes. Table 3.3 shows the volumes of each LLW stream included in each data set. The total LLW in the Hanford Only waste volume is 411,000 m^3. The Lower Bound and Upper Bound waste volumes represent increases of approximately 21,000 m^3 and 220,000 m^3, respectively, compared with the Hanford Only waste volume. The only additional LLW expected to be managed in the Lower Bound and Upper Bound cases are LLW Cat 1 and Cat 3.

Table 3.3. Estimated Volumes of LLW Waste Streams

Waste Streams	Hanford Only (cubic meters)[(a)]	Lower Bound (cubic meters)[(a)]	Upper Bound (cubic meters)[(a)]
Cat 1	88,792	107,883	287,130
Cat 3	39,607	41,334	60,933
GTC3	<1	<1	<1
Non-conforming	299	299	299
Previously disposed waste in LLBG	283,067	283,067	283,067
Total[(b)]	411,765	432,584	631,429

(a) To convert to cubic feet, multiply by 35.3.
(b) Totals may not equal the sum of the waste stream volumes due to rounding.

3.3.2 MLLW Volumes

As with LLW, the alternatives for management of MLLW have been analyzed using all three sets of waste volumes. The MLLW stream volumes included in each data set are shown in Table 3.4. Slightly over 58,400 m^3 is expected to be managed in the Hanford Only case. Only a small amount of additional waste, approximately 100 m^3, is expected to be managed in the Lower Bound case. The additional volume of waste that would be managed under the Upper Bound case is approximately 140,000 m^3. It is assumed in this EIS that the additional MLLW received in the Upper Bound case would be treated prior to receipt at Hanford and that the waste would be disposed of directly. Therefore, this additional MLLW is included in the Treated and Ready for Disposal waste stream.

3.3.3 TRU Waste Volumes

The three sets of volumes developed for TRU waste are presented in Table 3.5. The Hanford Only waste volume is approximately 45,700 m^3. The Lower Bound waste volume is only slightly larger (by approximately 57 m^3). In the Upper Bound case, an additional 1,500 m^3 of TRU waste would be received

Table 3.4. Estimated Volumes of MLLW Waste Streams

Waste Streams[a]	Hanford Only (cubic meters)[b]	Lower Bound (cubic meters)[b]	Upper Bound (cubic meters)[b]
Treated and Ready for Disposal	28,054	28,082	168,419
RH and Non-Standard Packages	2904	2904	2904
CH Inorganic Solids and Debris	20,108	20,111	20,111
CH Organic Solids and Debris	6727	6790	6790
Elemental Lead	600	608	608
Elemental Mercury	21	21	21
Total[c]	58,414	58,515	198,852

(a) Leachate from MLLW trenches has not been included in this table because the volumes are dependent upon the selected alternative. The total volume of leachate from the MLLW trenches by alternative can be found in the flowcharts in Appendix B.
(b) To convert to cubic feet, multiply by 35.3.
(c) Totals may not equal the sum of the waste stream volumes due to rounding.

Table 3.5. Estimated Volumes of TRU Waste Streams

Waste Streams	Hanford Only (cubic meters)[a]	Lower Bound (cubic meters)[a]	Upper Bound (cubic meters)[a]
Waste from trenches	14,552	14,552	14,552
Waste from caissons	23	23	23
Commingled PCB waste	80	95	95
Newly generated and existing CH standard containers	27,719	27,727	28,897
Newly generated and existing CH non-standard containers	1077	1077	1357
Newly generated and existing RH	2157	2191	2241
K Basin sludge	139	139	139
Total TRU waste[b]	45,748	45,805	47,305

(a) Convert to cubic feet, multiply by 35.3.
(b) Totals may not equal the sum of the waste stream volumes due to rounding.

for temporary storage and eventual shipment to WIPP. Because the differences between the three sets of volumes are small, environmental impacts have been evaluated for the Hanford Only and Upper Bound cases only.

3.3.4 Waste Treatment Plant Waste Volumes

Waste volumes expected from the Waste Treatment Plant are shown in Table 3.6. Because these wastes would be generated at Hanford, the Lower Bound and Upper Bound cases are not applicable. The

Table 3.6. Estimated Volumes of WTP Waste Streams Through 2046

Waste Streams	No Action (cubic meters)[(a)]	Action Alternatives (cubic meters)[(a)]
ILAW	350,000	211,000
WTP Melters	6,825	6,825
Total WTP waste	356,825	217,825

(a) To convert to cubic feet, multiply by 35.3.

volume of ILAW generated by the WTP, however, may vary depending on the waste form produced. For the No Action Alternative, ILAW would be produced in a cullet form and packaged in containers for retrievable disposal in vaults as outlined in the TWRS EIS for the preferred alternative (Phased Implementation). The EIS analysis assumed 140,000 containers would be required, or an equivalent volume of approximately 350,000 m^3. For the action alternatives, ILAW was assumed to be in a monolithic form, packaged in 2.6-m^3 containers for disposal in trenches. Approximately 81,000 containers would be required, or an equivalent volume of approximately 211,000 m^3 (Burbank 2002).

3.4 Comparison of Environmental Impacts Among the Alternatives

For purposes of comparison of impacts among the alternatives in this section, impacts associated with alternative treatment, storage, and disposal actions for each waste type have been combined to provide a consolidated analysis of HSW management operations. These consolidated analyses are referred to as alternative groups, which were described in Section 3.1. The No Action Alternative analysis consists of the No Action activities for each waste type. This approach facilitates comparative presentation of impacts for all Solid Waste Program operations evaluated in this EIS and is necessary where analyses are performed for facilities that are used to manage more than one type of waste. In the alternative group analyses, each of the waste types and activities necessary to manage those wastes are considered. In addition, within the analyses for each alternative group, three alternative waste volume scenarios were considered as described in Section 3.2, namely the Hanford Only, Lower Bound, and Upper Bound waste volumes.

Summary comparisons of impacts among the alternative groups during the operational period and during the long term (10,000 years) after disposal facility closure are presented in Tables 3.7 and 3.8, respectively. The environmental consequences presented in this section represent the incremental impacts from implementing the alternatives for solid waste management described in Section 3.1. The cumulative impacts described in Section 3.4.12 present the proposed action and alternatives in the context of other past, present, and reasonably foreseeable activities to which the waste management operations discussed in this EIS might contribute.

Potential environmental impacts resulting from implementing any of the alternatives are compared in somewhat more detail in the sections that follow. Further details and the supporting analyses for the material presented in this section are provided in Section 5 and its appendixes.

Table 3.6. Estimated Volumes of WTP Waste Streams Through 2046

Waste Streams	No Action (cubic meters)[a]	Action Alternatives (cubic meters)[a]
ILAW	350,000	211,000
WTP Melters	6,825	6,825
Total WTP waste	356,825	217,825
(a) To convert to cubic feet, multiply by 35.3.		

volume of ILAW generated by the WTP, however, may vary depending on the waste form produced. For the No Action Alternative, ILAW would be produced in a cullet form and packaged in containers for retrievable disposal in vaults as outlined in the TWRS EIS for the preferred alternative (Phased Implementation). The EIS analysis assumed 140,000 containers would be required, or an equivalent volume of approximately 350,000 m^3. For the action alternatives, ILAW was assumed to be in a monolithic form, packaged in 2.6-m^3 containers for disposal in trenches. Approximately 81,000 containers would be required, or an equivalent volume of approximately 211,000 m^3 (Burbank 2002).

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Table 3.7. Summary Comparison of Impacts Among the Alternatives During Operational Period (Present to 2046)

Hanford Only to Upper Bound Waste Volume - Alternative Groups A-E[(a)] Hanford Only and Lower Bound Waste Volume for No Action Alternative[(b)]															
	Facility Operations – Direct Radiation and Emissions to Atmosphere						Transportation [(d)]								
	Normal Operations				Fatalities from Operational Accident Having Largest Consequences: Beyond-Design- Basis Earthquake at CWC[(c)]		Routine	# Accidents/# Fatalities from Trauma							
Alternative	Chances of Latent Cancer Fatality: Lifetime Exposure of Maximally Exposed Individual: Public	Chances of Latent Cancer Fatality: Lifetime Exposure of Maximally Exposed Individual: Non-Involved Workers	Latent Cancer Fatalities (LCFs) Among Population within 80 km Lifetime Exposure	Latent Cancer Fatalities (LCFs) from Collective Radiation Exposure of Workers	Public	Non-Involved Workers[(e)]	Onsite & for Offsite Treatment: Includes Transport Crew, Public, and Non-Involved Workers, Fatalities[(f)]	Onsite & for Offsite Treat-ment	Incoming LLW, MLLW & TRU Waste Within Oreg. State Only	Incoming LLW, MLLW & TRU Waste Within Wash. State Only	TRU Waste to WIPP	Shrub-Steppe Habitat Disturbed, ha	Geologic Resources Committed (sand, gravel, silt/loam, and basalt), millions of m^3	Diesel Fuel Committed Thousands of m^3	Cost in Billions of 2002 Dollars
Group A	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	32	2.4 -2.5	133 - 134	3.7 - 4.0
Group B	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	0	1/0	2-4/0	1/0	18/3	0	2.6 - 2.8	137 - 141	3.8 - 4.2
Group C	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	14	2.2 - 2.3	66 - 67	3.5 - 3.9
Group D_1	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	19 - 25	2.2 - 2.3	66 - 67	3.2 - 3.5
Group D_2	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	0	2.2 - 2.3	66 - 67	3.2 - 3.5
Group D_3	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	0	2.2 - 2.3	66 - 67	3.2 - 3.5
Group E_1	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	0	2.2 - 2.3	66 - 67	3.4 - 3.8
Group E_2	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	5 - 11	2.2 - 2.3	66 - 67	3.4 - 3.8
Group E_3	<1/million	<1/million	0 (<0.001)	0 (<0.50)	30	1	1	20/1	2-4/0	1/0	18/3	14	2.2 - 2.3	66 - 67	3.4 - 3.8
No Action	<1/million	<1/million	0 (<0.001)	1 (0.52)	30	1	0	1/0	0	0	9/1	10	1.4	187	3.5 - 3.5

(a) Where a single value is given, the value applies to both Hanford Only and Upper Bound waste volumes.
(b) Where a single value is given, the value applies to both Hanford Only and Lower Bound waste volumes.
(c) Unlike the Alternative Groups where the risk of this accident would be over about 43 years, the risk would continue as long as waste is stored in CWC.
(d) Excludes transport in general of wastes from offsite generators, the impacts for which the PEIS should be consulted.
(e) For the "involved" worker(s) that might be in a CWC building during such an event the consequences could range from none to several fatalities from collapse of the building.
(f) Includes inferred fatalities from radiation exposure and vehicular emissions.

Table 3.8. Summary Comparison of Long-Term (10,000 years) Impacts Among the Alternatives

Hanford Only to Upper Bound Waste Volume - Alternative Groups A-E[(a)]											
Hanford Only and Lower Bound Waste Volume for No Action Alternative[(b)]											
		Exposure to Radionuclides Via Groundwater Pathway									
Alternative	**Additional Land Permanently Committed to Disposal, ha**	**Maximum Annual Drinking Water Dose, mrem**		**Chances in a <u>Million</u> of Fatality (LCF) to Lifetime Onsite Resident Gardener**		**Chances of Fatality (LCF) for Lifetime Onsite Resident Gardener <u>with Sauna/Sweat Lodge</u>**		**Fatalities (LCFs) in Populations over 10,000 years[(d)]**		**Maximum Waste Site Intruder Risk of Fatality at 100 Years After Closure[(e)]**	
		200 Areas	Near River	200 Areas[(f)]	Near River	200 Areas[(g)]	Near River	Tri-Cities	Portland	Drilling	Excavation
Group A	38 - 47	0.46 - 2.2	0.05 - 0.09	65 - 120	7	1 in 400 - 1 in 10	1 in 4000 - 1 in 300	0	0	4 in 100	Precluded
Group B	56 - 80	0.46 - 2.4	0.12 - 0.21	64 - 130	13 - 15	1 in 100 - 1 in 10	1 in 200 - 1 in 100	0	0	4 in 100	Precluded
Group C	20 - 29	0.46 - 2.2	0.05 - 0.09	65 - 120	7	1 in 400 - 1 in 10	1 in 4000 - 1 in 300	0	0	4 in 100	Precluded
Group D$_1$	19 - 25	0.26 - 2.2	0.06 - 0.09	37 - 120	8 - 9	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group D$_2$	19 - 25	0.34 - 2.3	0.08 - 0.09	45 - 120	11	1 in 200 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group D$_3$	19 - 25	0.46 - 2.3	0.06 - 0.09	63 - 120	8	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group E$_1$	19 - 25	0.34 - 2.3	0.08 - 0.09	45 - 120	11	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
Group E$_2$	19 - 25	0.21 - 0.26	0.05 - 0.10	28 - 29	6 -7	1 in 400 - 1 in 10	1 in 2000 - 1 in 200	0	0	4 in 100	Precluded
Group E$_3$	19 - 25	0.27 - 2.3	0.06 - 0.09	39 - 120	8	1 in 400 - 1 in 10	1 in 2000 - 1 in 300	0	0	4 in 100	Precluded
No Action	86 - 95[(c)]	0.51-0.99	0.04	43	6	1 in 50	1 in 800	0	0	4 in 100	Likely a Fatality[(g)]

(a) Where a single value is given the value applies to both Hanford Only and Upper Bound waste volumes.
(b) Where a single value is given the value applies to both Hanford Only and Lower Bound waste volumes.
(c) Includes land for storage of waste in CWC.
(d) Zero inferred latent cancer fatalities. Constant populations; Tri-Cities -113,000; Portland 510,000.
(e) Risk value given assumes that the event takes place.
(f) Location within the 200 Areas having the highest results.
(g) Very high dose would possibly lead to fatality.

3.4.1 Land Use

Land permanently committed to HSW disposal includes about 130 ha (320 ac) already occupied by waste previously disposed of in LLBGs. Disposal of the Hanford Only waste volume would increase land permanently committed for disposal from a low of 19 ha (47 ac) for Alternative Groups C through E, to a high of 56 ha (140 ac) for Alternative Group B (Land Use values are rounded and may not add or convert exactly). Similarly the increases for the Lower Bound waste volume would range from 20 ha (49 ac) to 59 ha (150 ac) for the same alternative groups. The increases for the Upper Bound waste volume would range from 25 ha (62 ac) to 80 ha (200 ac) for the same alternative groups. In the No Action Alternative the increase in land permanently committed to disposal would be 28 ha (69 ac), which**,** however**,** does not take into account an increase in land usage of 66 ha (160 ac) for facilities committed to storage of LLW, MLLW, and TRU waste. The areas of land to be committed are shown for comparison among the alternatives in Table 3.9.

Table 3.9. Comparison of Land Area Permanently Committed in the Various Alternatives as of 2046, ha[(a)]

Alternative	Hanford Only Waste Volume			Lower Bound Waste Volume			Upper Bound Waste Volume		
	LLW & MLLW Increase	ILAW Increase	Total Land Committed[(b)]	LLW & MLLW Increase	ILAW Increase	Total Land Committed[(b)]	LLW & MLLW Increase	ILAW Increase	Total Land Committed[(b)]
Alternative Group A	12	26	**168**	13	26	**170**	21	26	**178**
Alternative Group B	30	26	**187**	33	26	**189**	54	26	**210**
Alternative Group C	12	8	**151**	13	8	**152**	21	8	**160**
Alternative Groups D & E	11	8	**150**	12	8	**150**	17	8	**155**
No Action Alternative	17	10	**274**[(c)]	19	10	**275**[(c)]	Not applicable		

(a) One hectare (ha) = about 2.5 acre (ac). Values may not add exactly due to rounding.
(b) Includes 130 ha already committed for HSW previously disposed of in the LLBGs.
(c) Includes 116 ha for storage of waste in CWC buildings.

3.4.2 Air Quality

Air quality impacts are based on estimated concentrations of criteria pollutants: particulate matter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen dioxide (NO_2) at points of public occupancy. Table 3.10 presents the largest potential impacts calculated for each alternative group in comparison to Air Quality Standards. Air quality impacts for obtaining capping materials are presented separately following the table. Impacts from releases of radioactive material and chemicals to the atmosphere are addressed in Section 3.4.11 and 5.11, Human Health and Safety.

Table 3.10. Comparison Among the Alternative Groups of Estimated Criteria-Pollutant Impact Maximums for Solid Waste Operations in the 200 Areas, Percent of Air Quality Standards[(a)]

Alternative	Hanford Only and Lower Bound Waste Volumes				Upper Bound Waste Volume			
	24-Hour PM_{10}	**1-Hour SO_2**	**8-Hour CO**	**Annual NO_2**	**24-Hour PM_{10}**	**1-Hour SO_2**	**8-Hour CO**	**Annual NO_2**
Alternative Group A, %	46	8.1	4.7	0.84	49	9.8	5.9	0.8
Alternative Group B, %	47	13	8	1.0	60	18	11	1.1
Alternative Group C, %	40	7.9	4.6	0.79	41	8.0	4.7	0.78
Alternative Group D, %	41	8.4	5.0	0.91	41	8.4	5.0	0.98
Alternative Group E, %	40	9.3	5.3	0.84	41	9.5	5.3	0.97
No Action Alternative, %	38	8.6	4.6	0.93	Not applicable			
(a) (24-Hour PM_{10} = 150 $\mu g/m^3$, 1-Hour SO_2 = 1,000 $\mu g/m^3$, 8-Hour CO = 10,000 $\mu g/m^3$, Annual NO_2 = 100 $\mu g/m^3$)								

Maximum air quality impacts from operating the Area C borrow pit would amount to 14 percent of the 24-Hour Standard for PM_{10}, 26 percent of the 1-Hour Standard for SO_2, 36 percent for the 8-Hour Standard for CO, and 0.16 percent of the Annual Standard for NO_2, but would be common to all alternatives.

For the most part the impacts on air quality are essentially the same for all alternatives. An exception is Alternative Group B where the impacts for some pollutants are below standard values, but noticeably higher than for the other alternatives due to the increased excavation required for construction of disposal trenches.

3.4.3 Water Quality

As a result of wastewater management activities during past Hanford Site operations, groundwater beneath the 200 Areas has been contaminated with radionuclides and non-radioactive chemicals. The contaminants emanating from the 200 Areas are moving toward the Columbia River. None of these contaminants are thought to have originated from existing LLBGs or other waste management facilities being considered in the HSW EIS. Uncertainties regarding levels of chemicals previously disposed of in LLBGs are discussed in Section 3.5.

One benchmark measure of water quality for purposes of comparison among the alternatives is taken as the percentage of Maximum Contaminant Levels (MCLs)[(a)] in groundwater. The percentage of MCLs

(a) Maximum Contaminant Levels (MCLs), defined in 40 CFR 141, apply to drinking water supplies. Although groundwater beneath the Hanford Site is not a drinking water supply the MCLs provide a useful benchmark against which to compare contaminant levels.

is calculated for hypothetical wells intercepting maximum cumulative concentrations of radionuclides in predicted plumes along several lines of analysis downgradient from the HSW disposal facilities. These lines of analysis were positioned at a distance to capture contributions from all HSW disposal facilities within 200 West Area, at the ERDF, and 200 East Area including possible contributions from the 200 West Area and ERDF sources. The specific lines of analysis considered in this assessment are as follows:

- a line of analysis 1 km downgradient from waste disposed of in the 200 West Area LLBGs or the ILAW waste disposal facility near CWC (referred to as the 200 West Line Of Analysis [LOA] in Section 5.3 and Appendix G).

- a line of analysis about 1 km downgradient to the northwest from the 200 East LLBGs (referred to as the 200 East NW LOA in Section 5.3 and Appendix G). This LOA was used to evaluate concentrations in groundwater migrating northwest of the 200 East Area.

- a line of analysis about 1 km downgradient to the southeast from a new disposal facility near the PUREX Plant (referred to as the 200 East SE LOA in Section 5.3 and Appendix G). This LOA was used to evaluate concentrations in groundwater migrating southwest of the 200 East Area.

- a line of analysis about 1 km downgradient from the ERDF location (referred to as the ERDF LOA in Section 5.3 and Appendix G).

- a line of analysis along the Columbia River (referred to as the Columbia River LOA in Section 5.3 and Appendix G).

The highest percentages of MCLs together with the time of occurrence are given in Table 3.11 for the period ending in about 10,200 AD. In that time period technetium-99 and iodine-129 are the principal contaminants of interest. After about 10,200 AD uranium begins to dominate as the principal contaminant in groundwater. The highest percentages of the MCL for uranium are given in Table 3.12.

Another benchmark measure of water quality for purposes of comparison among the alternatives is taken as the dose to an individual from drinking 2 liters per day of groundwater from the hypothetical wells described above. These doses are based on inventories by activity presented in Appendix B, groundwater transport analysis as described in Section 5.3 and Appendix G, and dose conversion factors based on Federal Guidance Reports 11 and 12, details of which are presented in Appendix F. The latter are Plots of maximum annual drinking water dose as a function of time are provided in Figures 3.4 to 3.8.[a]

(a) The period of analysis is 10,000 years after 2046 and the plots would end at 12,046, however the plots are constrained by the software to the next whole millennium.

Table 3.11. Highest Percentage of Maximum Concentration Levels (MCLs) to the Year 10,200 AD[(a,b)]

Hanford Only Waste Volume																				
Alternative	**200 W Well Location**				**ERDF Well Location**				**200E NW Well Location**				**200 E SE Well Location**				**River Well Location**			
	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	**I-129**	**Tc-99**	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD
Group A	57	1	**58**	2270					84	1	**85**	3400	2	3	**5**	12050	14	4	**18**	3680
Group B	57	1	**58**	2250					84	1	**85**	3400	Not applicable				15	3	**18**	3490
Group C	57	1	**58**	2270	Not applicable				84	1	**85**	3400	2	3	**5**	12050	14	4	**18**	3680
Group D_1	57	1	**58**	2250					56	2	**58**	2100	63	0.1	**63**	2420	7	4	**11**	3560
Group D_2	57	1	**58**	2250					86	15	**100**	3400					14	4	**18**	3660
Group D_3	57	1	**58**	2250	93	24	**117**	3790	56	2	**58**	2090	Not applicable				12	3	**15**	4060
Group E_1	57	1	**58**	2250	22	27	**49**	12050	86	15	**100**	3400					14	4	**18**	3650
Group E_2	57	1	**58**	2250	22	27	**49**	12050	56	2	**58**	2100	63	0.1	**63**	2420	8	3	**11**	3580
Group E_3	57	1	**58**	2250	92	23	**115**	3790	56	2	**58**	2080	2	3	**5**	12050	11	3	**15**	3710
No Action	80	2	**82**	2080	Not applicable				56	2	**58**	2080	Not applicable				4	2	**6**	4020
Upper Bound Waste Volume																				
Alternative	**200 W Well Location**				**ERDF Well Location**				**200E NW Well Location**				**200 E SE Well Location**				**River Well Location**			
	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD	I-129	Tc-99	**Total**	Yr AD
Group A	57	1	**58**	2270					93	10	**103**	3390	2	3	**5**	12050	14	4	**18**	3650
Group B	57	1	**58**	2250					123	13	**136**	3290	Not applicable				17	4	**21**	3480
Group C	57	1	**58**	2270	Not applicable				93	10	**103**	3390	2	3	**5**	12050	14	4	**18**	3650
Group D_1	57	1	**58**	2250					56	2	**58**	2090	72	16	**88**	3380	10	5	**14**	3540
Group D_2	57	1	**58**	2250					95	16	**111**	3380					15	5	**19**	3630
Group D_3	57	1	**58**	2250	95	25	**120**	3800	56	2	**58**	2090	Not applicable				12	4	**16**	4050
Group E_1	57	1	**58**	2250	22	27	**49**	12050	95	16	**111**	2690					14	4	**18**	3670
Group E_2	57	1	**58**	2250	22	27	**49**	12050	56	2	**58**	2090	72	16	**88**	3340	8	3	**11**	3580
Group E_3	57	1	**58**	2250	93	23	**116**	3800	56	2	**58**	2090	2	3	**5**	12050	12	4	**15**	3730
No Action	Not applicable																			

(a) MCL for Tc-99 is 900 pCi/L and for I-129 is 1 pCi/L.
(b) Some of the numbers do not add exactly due to rounding.

Table 3.12. Highest Percentage of Maximum Concentration Levels (MCLs) from 10,200 to 12,050 AD - All Due to Uranium[(a)]

<table>
<tr><th></th><th colspan="5">Hanford Only Waste Volume</th><th colspan="5">Upper Bound Waste Volume</th></tr>
<tr><th rowspan="2">Alternative</th><th>200 W Well</th><th>ERDF Well</th><th>200E NW Well</th><th>200 E SE Well</th><th>River Well</th><th>200 W Well</th><th>ERDF Well</th><th>200E NW Well</th><th>200 E SE Well</th><th>River Well</th></tr>
<tr><th>%</th><th>%</th><th>%</th><th>%</th><th>%</th><th>%</th><th>%</th><th>%</th><th>%</th><th>%</th></tr>
<tr><td>Group A</td><td><0.1</td><td rowspan="5">NA</td><td>0.1</td><td>1</td><td><0.1</td><td><0.1</td><td rowspan="5">NA</td><td>55</td><td>1</td><td>2</td></tr>
<tr><td>Group B</td><td>3</td><td>3</td><td>NA</td><td>3</td><td>4</td><td>58</td><td>NA</td><td>5</td></tr>
<tr><td>Group C</td><td><0.1</td><td>0.1</td><td>1</td><td><0.1</td><td><0.1</td><td>55</td><td>1</td><td><0.1</td></tr>
<tr><td>Group D_1</td><td><0.1</td><td>0.1</td><td>0.1</td><td>1</td><td>0.1</td><td>55</td><td>1</td><td>3</td></tr>
<tr><td>Group D_2</td><td><0.1</td><td>2.0</td><td rowspan="3">NA</td><td><0.1</td><td>0.1</td><td>56</td><td rowspan="3">NA</td><td>2</td></tr>
<tr><td>Group D_3</td><td><0.1</td><td>4</td><td>0.1</td><td><0.1</td><td>0.1</td><td>4</td><td>55</td><td>2</td></tr>
<tr><td>Group E_1</td><td><0.1</td><td>4</td><td>0.3</td><td><0.1</td><td>0.1</td><td>4</td><td>55</td><td>2</td></tr>
<tr><td>Group E_2</td><td><0.1</td><td>4</td><td>0.1</td><td>0.1</td><td>0.1</td><td>0.1</td><td>4</td><td>55</td><td><0.1</td><td>2</td></tr>
<tr><td>Group E_3</td><td><0.1</td><td><0.1</td><td>0.1</td><td>1</td><td><0.1</td><td><0.1</td><td>0</td><td>55</td><td>1</td><td>2</td></tr>
<tr><td>No Action</td><td><0.1</td><td>NA</td><td>13</td><td>NA</td><td>0.3</td><td colspan="5">Not applicable</td></tr>
<tr><td colspan="11">(a) MCL for uranium is 30 micrograms per liter.</td></tr>
</table>

Maximum doses from drinking water containing combined radionuclide concentrations predicted at all lines of analysis in groundwater for any of the alternatives and waste volumes fall below 1 mrem/yr for the first 1,000 years after disposal, and below the 4 mrem/yr drinking water standard,[(a)] that is used as a benchmark for performance, for the entire 10,000-year period of analysis. The combined dose from drinking maximum radionuclide concentrations predicted adjacent to the Columbia River is less than 0.1 mrem/yr for about 9,000 years and does not exceed 1 mrem/yr for the 10,000-year period of analysis. Results from modeling indicate potential increases in the dose near the end of the 10,000-year period because of the arrival of uranium in groundwater.

LLW disposed of prior to September 1987 may contain hazardous chemical constituents, but no specific requirements existed to account for or report the content of hazardous chemical constituents in this category of LLW. As a consequence, analysis of these constituents and estimated impacts based on the limited amount of information on estimated inventories and waste disposal locations would be subject to substantial uncertainty at this time. (Additional discussion on uncertainties is presented in Section 3.5.) Regardless the fate of these chemical-bearing wastes would be capped under all of the alternative groups. A distinction as to their fate would, however, be made for the No Action Alternative where the LLBGs would not be capped.

(a) Drinking water standards promulgated by the EPA as Primary Drinking Water Standards (40 CFR 141) under the Safe Drinking Water Act are applicable to treated water at the tap, and therefore are not directly applicable to groundwater quality. However, the 4 mrem/yr standard provides a benchmark against which to compare the values shown in the figures.

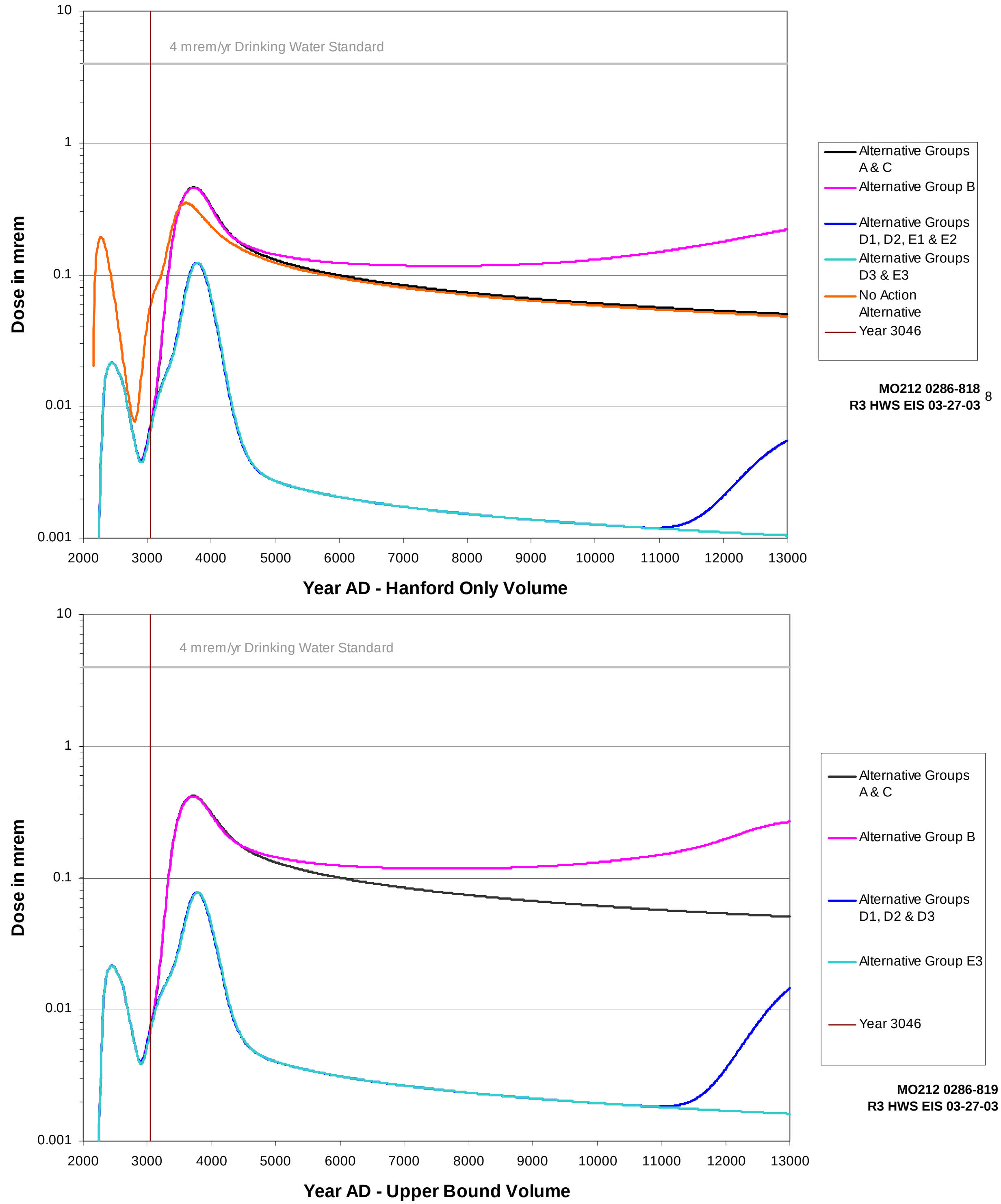


Figure 3.4. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Downgradient from the 200 West Area Disposal Facilities as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

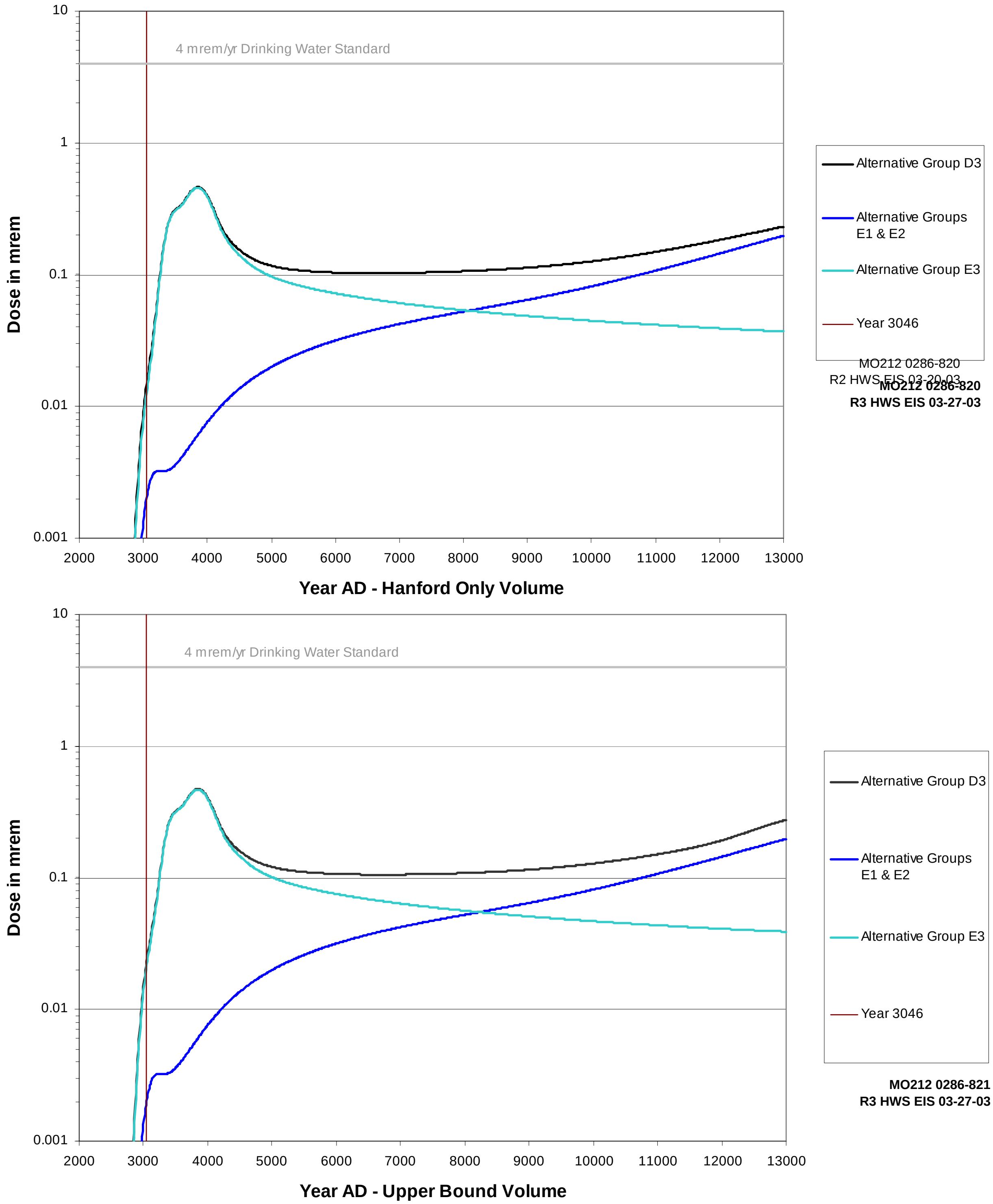


Figure 3.5. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Downgradient from ERDF as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

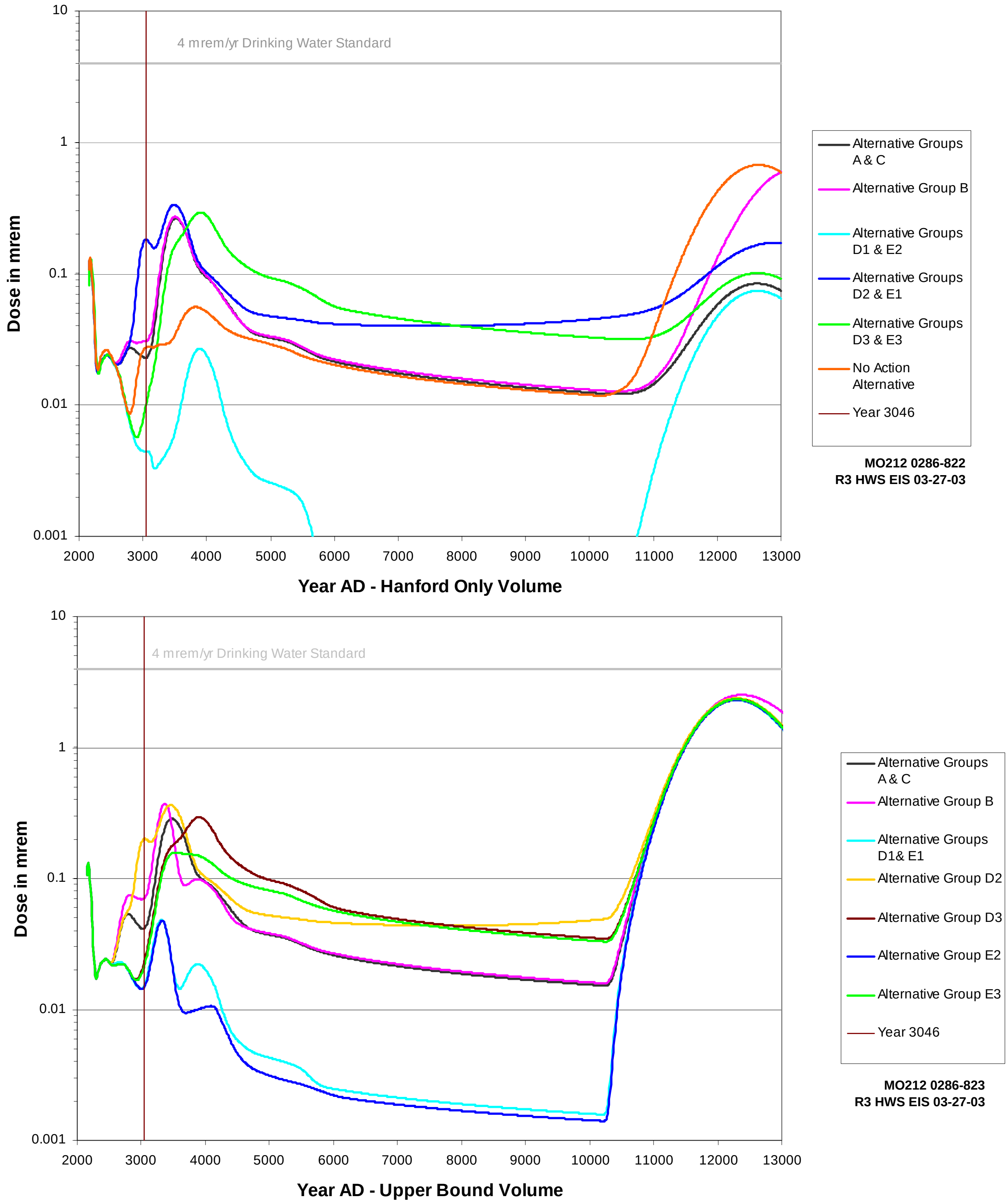


Figure 3.6. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Northwest Downgradient from the 200 East Area as Disposal Facilities as Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

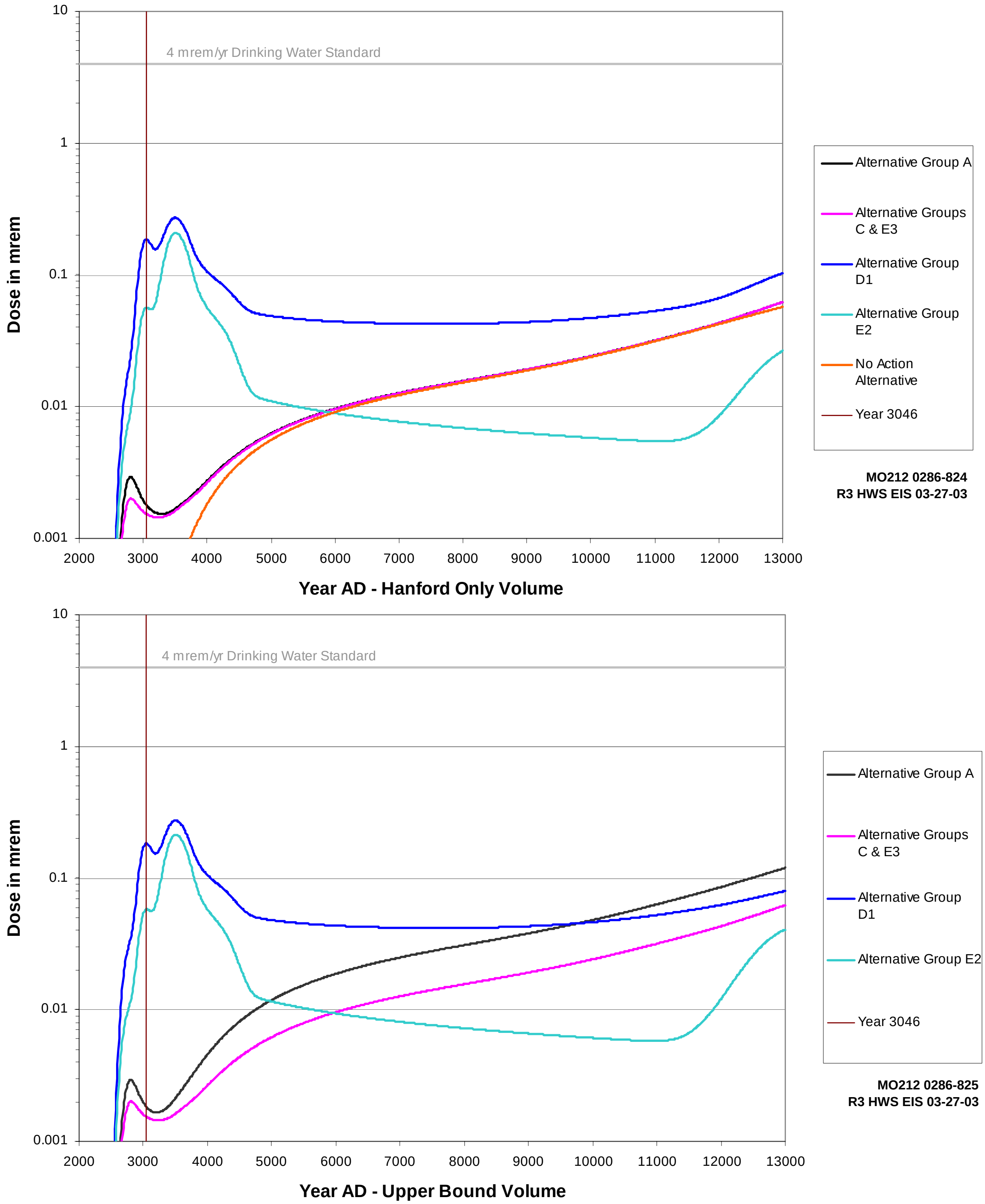


Figure 3.7. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater at 1 km Downgradient Southeast from the 200 East Area Disposal Facilities as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

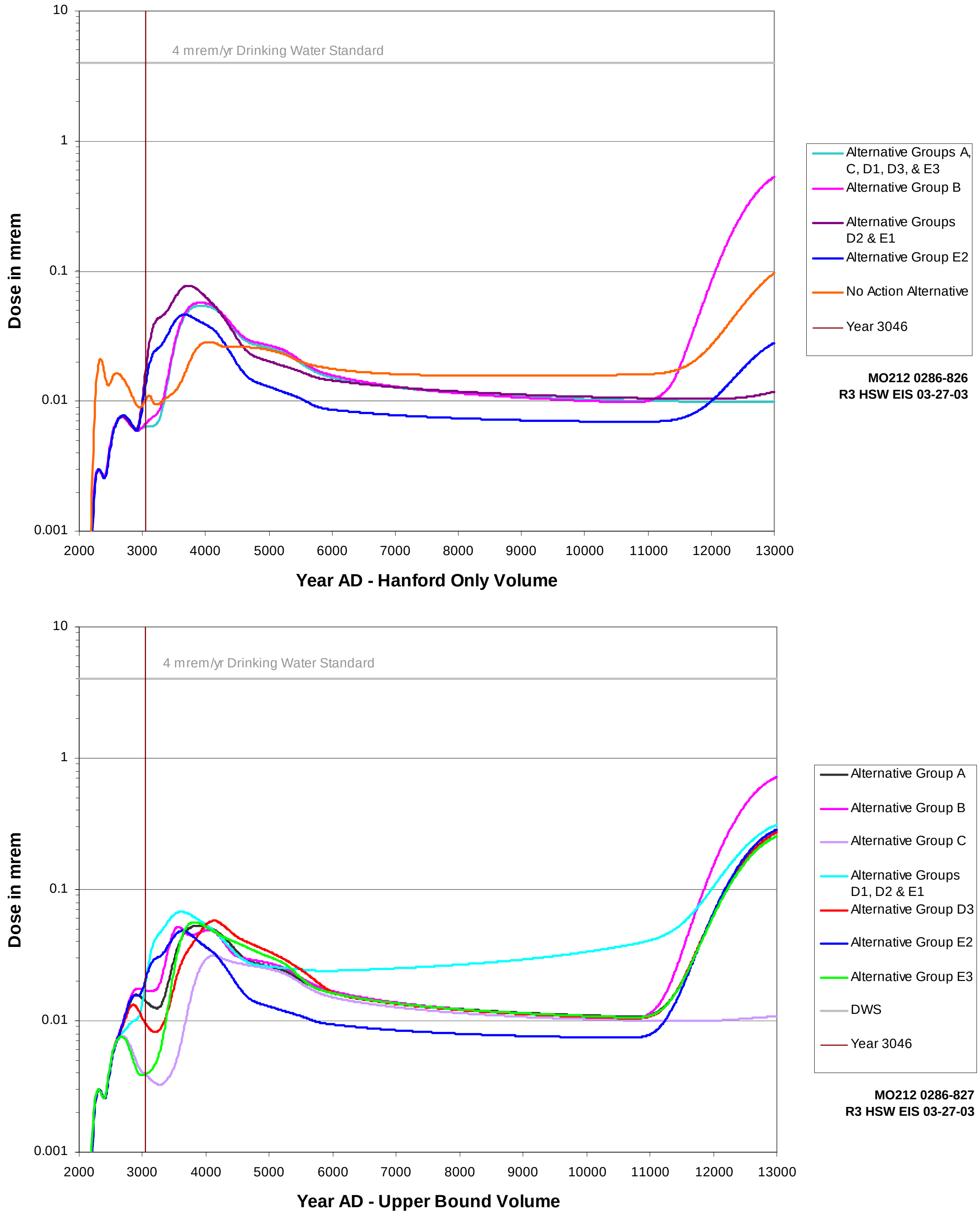


Figure 3.8. Annual Dose from Drinking Water Containing Maximum Concentrations of Radionuclides in Groundwater Near the Columbia River as a Function of Calendar Year, Hanford Only and Upper Bound Waste Volumes

Estimated inventories of hazardous chemical constituents associated with LLW and MLLW disposed of after 1988 being considered under each alternative group would be expected to be found at trace levels. MLLW, which would be expected to contain the majority of hazardous chemical constituents, would undergo predisposal solidification to stabilized waste forms and containment and thermal treatment to remove organic chemical components of the MLLW. This waste treatment would be done to meet current waste acceptance criteria and land disposal restrictions before being disposed of in permitted MLLW facilities. Consequently, groundwater quality impacts from these constituents would not be expected to be substantial.

Based on the analysis presented in Section 5.3 and Appendix G, Alternative Groups D and E tend to be the most protective.

3.4.4 Geologic Resources

Although large quantities of gravel, silt/loam, and basalt would be needed for capping waste disposal facilities upon closure, these resources are readily available in the Area C borrow pit. A comparison among the alternatives of quantities that would be needed is shown in Table 3.13.

Table 3.13. Comparison of Commitments of Geologic Resources, Millions of $m^{3(a)}$

Alternative	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume
Alternative Group A	2.4	2.4	2.5
Alternative Group B	2.5	2.6	2.8
Alternative Group C	2.2	2.2	2.3
Alternative Group D	2.2	2.2	2.3
Alternative Group E	2.2	2.2	2.3
No Action Alternative	1.4	1.4	Not Applicable
(a) 1 m^3 = about 1.3 yd^3.			

3.4.5 Ecological Resources

Impacts on ecological resources, other than disturbance of shrub-steppe habitat, were determined to be low and sufficiently similar among the alternative groups and the No Action Alternative that they would not be expected to be an important discriminator in the alternative selection process. Disturbance of shrub-steppe habitat would be related to alternative groups making use of the near PUREX disposal facility, which is in an area that was not burned over in the 24 Command Fire of June 2000. There, the area of disturbance ranged from zero in the case of Alternative Groups B, D_2, D_3, and E_1 to 32 ha (79 ac) for Alternative Group A. Other alternative groups and the No Action Alternative were intermediate with 5–25 ha (12-62 ac) of disturbance depending on waste volume disposed of (see Table 3.4). Conclusions regarding potential impacts on terrestrial biota at the disposal facility near PUREX were based on spring/summer surveys conducted from 1998 to 2002. Conclusions regarding potential impacts on aquatic and riparian biota near and in the Columbia River were based on an ecological risk assessment of potential future releases from waste sites through groundwater to the river. Details of the analysis are presented in Section 5.5 with additional information in Appendix I.

3.4.6 Socioeconomics and Environmental Justice

Implementation of any of the HSW EIS alternative groups or the No Action Alternative would have small and barely differentiable impacts on local socioeconomic infrastructure, including housing, schools, medical support, traffic, etc. Details of the analysis are presented in Section 5.6. No particular distinction was made among any of the alternatives for impacts on environmental justice (see Section 5.13).

3.4.7 Cultural, Aesthetic, and Scenic Resources

The principal potential for impacts on cultural resources in implementing any of the alternative groups or the No Action Alternative would be associated with disturbance of the surface and near surface portions of the Area C borrow pit. Although archeological sites might be found in Area C, a recent field reconnaissance failed to reveal any archeological sites or artifacts on the surface. Because construction would be halted in the event that an artifact of possible cultural significance is found and will remain so until a professional evaluation is made, it is unlikely that impact to cultural resources would be an important discriminator among the alternatives. Details of the analysis are presented in Sections 5.7 and Appendix K.

No particular distinction was made among any of the alternative groups for impacts on aesthetic and scenic resources; the most noticeable change would be the potential impact on the viewshed from nearby prominences as a result of obtaining capping materials from Area C (see Section 5.12).

3.4.8 Transportation

The measure of impacts from transportation for comparison among the alternatives was taken as the number of fatalities resulting from transport of wastes and construction materials for the Hanford Only waste volume. Those impacts include offsite transport of MLLW for treatment in all Alternative Groups except B. These values are presented in Table 3.14. Details of the transportation analysis are presented in Section 5.8 and Appendix H.

Transport of wastes from offsite is the same for all alternative groups. The potential impacts of offsite transportation were previously evaluated in the WM PEIS and the WIPP SEIS-2 and are incorporated by reference (DOE 1997b and DOE 1997a, respectively). Impacts within the states of Oregon and Washington that might occur from shipping waste to and from the Hanford Site were analyzed and are summarized in Table 3.15.

Table 3.14. Summary Comparison of Radiological and Non-Radiological Transportation Impacts – Hanford Only Waste Volumes

Alternative	Radiological			Non-radiological		
	Incident-free		Accidents			
	Crew - Fatalities	Public - Fatalities	Accidents Fatalities	Number of Accidents	Accident Fatalities	Emissions Fatalities
Alternative Groups A, C, D, and E(a)	**0** (0.45)	**0** (0.15)	**0** (0.027)	**20**	**1** (0.52)	**0** (0.38)
Alternative Group B(b)	**0** (0.068)	**0** (0.055)	**0** (0.027)	**1** (0.78)	**0** (0.049)	**0** (0.28)
No Action Alternative(c)	**0** (0.075)	**0** (0.047)	**0** (0.024)	**1** (1.2)	**0** (0.055)	**1** (0.27)

Note: Public includes non-involved workers. Numbers in parentheses are the calculated values. Accidents and fatalities occur as whole numbers and calculated values are rounded to whole numbers.

(a) The impacts in these Alternative Groups are for the Hanford Only waste volume case. The differences between this case and the Upper and Lower Bound waste volume case of additional offsite-generated waste are shown in Table 3.15., for Oregon and Washington only. Impacts of nation-wide transport of wastes were discussed previously in the PEIS.

(b) Offsite shipments are minimal in Alternative Group B for all waste volume cases.

(c) There are no offsite shipments associated with the No Action Alternative.

Table 3.15. Impacts in Oregon and Washington from Offsite Shipments of Solid Wastes to and from Hanford

Shipping Segment	Radiological Impacts			Non-radiological Impacts		
	Incident Free Worker Fatalities	Incident Free Public Fatalities	Accident Fatalities	Number of Accidents	Accident Fatalities	Emissions Fatalities
Lower Bound Waste Volume						
Oregon	0.054	0.042	0.0017	2.2	0.0031	0.025
Washington	0.013	0.0093	0.00040	0.52	0.0080	0.0025
Total	**0** (0.067)	**0** (0.051)	**0** (0.0021)	**3** (2.7)	**0** (0.039)	**0** (0.031)
Upper Bound Waste Volume						
Oregon	0.17	0.11	0.10	3.6	0.063	0.047
Washington	0.039	0.024	0.026	0.85	0.015	0.011
Total	**0** (0.21)	**0** (0.13)	**0** (0.13)	**5** (4.5)	**0** (0.078)	**0** (0.058)

As shown in the Table 3.15 transport of waste from offsite generators might result in two accidents in Oregon and 1 in Washington for the Lower Bound waste volume and 4 accidents in Oregon and one in Washington for the Upper Bound waste volume. No fatalities were forecast in either case.

Transport of TRU waste to WIPP for Alternative Groups A through E might result in 18 accidents and 3 fatalities, and for the No Action Alternative, 9 accidents and 1 fatality, although not predicted to occur in the states of Oregon or Washington.

One to four accidents were calculated to occur during transport of construction and capping materials for Alternative Groups A – E, and four accidents were estimated for the No Action Alternative. No fatalities were forecast in any case.

3.4.9 Noise

Since all alternatives would involve essentially the same activities, noise levels produced by those activities at any given point in time would be essentially the same. Noise was not considered to be an important impact element, because of distance to public receptors. Wildlife that might be disturbed by noise near the Area C borrow pit would likely move to more acceptable locations. Details of the analysis of noise are presented in Section 5.9 and Appendix J. Based on the level of activity associated with waste management operations and their location within the Hanford Site, noise levels are predicted to be well within allowable limits at locations occupied by members of the public.

3.4.10 Resource Commitments

Resources committed to implementing the various alternative groups and the No Action Alternative would include land, the vadose zone beneath the disposal facilities, groundwater beneath the disposal sites and on to where it empties into the Columbia River, various amounts of fossil fuel, electricity, steel, concrete, gravel, sand, gravel, silt/loam, basalt, water and other materials. Land Use and geologic resources have been described previously (Tables 3.9 and 3.13). Comparison of fossil fuel commitments among the alternatives is provided in Table 3.16. Alternative Groups A and B, and the No Action Alternative have generally higher demand for fossil fuels than the other alternatives because of additional construction and operation required. Details of the analysis of resource commitments are presented in Section 5.10.

3.4.11 Human Health and Safety

Comparison of human health and safety among the alternatives is expressed in terms of worker dose, dose to the public from atmospheric releases, accidents during the operational period, and long-term impacts via the groundwater pathway in the post-closure period. Details of the analyses are provided in Section 5.11 and Appendix F. Intruder scenarios and consequences are essentially the same for all alternative groups. The exception would be for the basement excavation scenario in the No Action Alternative where only the Trenches 31 and 34 containing MLLW are capped. The depth of capping material would be expected to preclude the occurrence of that scenario for those wastes.

Table 3.16. Comparison of Fossil Fuel Commitments Among the Alternatives[(a)]

Alternative	Diesel, m^{3}[(b)]			Gasoline, m^3			Propane, tonnes		
	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume
Alternative Group A	132,900	132,900	133,700	260	260	270	12,700	12,700	19,300
Alternative Group B	136,600	136,700	140.600	340	340	430	23,500	23,500	38,300
Alternative Group C	65,900	65,900	66,700	260	260	270	12,700	12,700	19,300
Alternative Group D	65,900	65,900	66,700	260	260	270	18,800	20,300	27,800
Alternative Group E	65,900	65,900	66,700	260	260	270	18,800	20,300	27,800
No Action Alternative	188,600	188,700	Not Applicable	48	50	Not Applicable	3,560	3,560	Not Applicable

(a) 1 tonne = about 1.1 ton.
(b) Includes 120,100 m^3 for ILAW in Alternative Groups A and B, 53,100 m^3 for ILAW in Alternative Groups C, D, and E, and 183,400 m^3 for ILAW in the No Action Alternative.

3.4.11.1 Operational Period – Normal Operations

Radiological impacts to workers from air emissions and routine occupational radiation exposure through 2046 are compared among the alternatives in Table 3.17. No latent cancer fatalities (LCFs) would be expected from doses associated with any of the action alternatives; however, one LCF might be inferred from the No Action Alternative.

Radiological impacts on the public from the release of radioactive material to the atmosphere during routine operations through 2046 are compared among the alternatives in Table 3.18. (For more details, see Section 5.11.) No latent cancer fatalities would be expected from the doses presented.

3.4.11.2 Operational Period – Accidents

The consequences of industrial accidents on workers through 2046 are compared among the alternatives in Table 3.19.

Impacts on public health and safety from processing chemicals through 2046 are compared among the alternatives in Table 3.20.

For chemicals, there is no difference in impacts between the Hanford Only and the Lower Bound Volume cases because the difference in MLLW processing is small (0.4 percent volume difference).

Table 3.17. Comparison of Worker Health Impacts

Alternative	Non-Involved Worker, mrem[(a)]			Occupational Exposure, person-rem[(b)]		
	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume
Alternative Group A	0.48	0.58	0.89	765	766	774
Alternative Group B	0.51	0.60	0.92	772	773	786
Alternative Group C	0.48	0.48	0.89	765	765	773
Alternative Groups D and E	0.48	0.58	0.89	767	767	778
No Action Alternative	0.48	0.58	Not Applicable	873	873	Not Applicable

(a) Lifetime dose to the hypothetical maximally exposed individual (MEI) based on the industrial worker scenario
(b) Work force external exposure from proximity to wastes

Table 3.18. Comparison of Public Health Impacts from Emissions of Radioactive Material to the Atmosphere During Routine Operations

Alternative	Population Dose, person-rem[(a)]			MEI Lifetime Dose, mrem[(b)]		
	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume	Hanford Only Waste Volume	Lower Bound Waste Volume	Upper Bound Waste Volume
Alternative Groups A, C, D, and E	0.11	0.13	0.27	0.0016	0.0018	0.0038
Alternative Group B	0.15	0.17	0.22	0.0021	0.0023	0.0032
No Action Alternative	0.078	0.094	Not Applicable	0.0011	0.0013	Not Applicable

(a) Collective population dose within 80 km (50 mi) based on the offsite resident gardener scenario as applied to average individuals in the population (see Appendix F).
(b) Lifetime dose to the hypothetical MEI based on the offsite resident gardener scenario.

Table 3.19. Comparison of Consequences of Industrial Accidents on Workers Among the Alternatives

Alternative	Total Recordable Cases		Lost work-day Cases		Lost Work Days	
	Hanford Only and Lower Bound Volume Cases	Upper Bound Volume Case	Hanford Only and Lower Bound Volume Cases	Upper Bound Volume Case	Hanford Only and Lower Bound Volume Cases	Upper Bound Volume Case
Alternative Groups A, C, D, and E	620	640	260	260	8900	9200
Alternative Group B	640	660	260	270	9000	9300
No Action Alternative	770	NA	320	Not Applicable	10,900	Not Applicable

Table 3.20. Comparison of Health Impacts on the Public from Routine Atmospheric Releases of Chemicals

Alternative	Hazard Quotient[(a)]		Cancer Incidence[(b)]	
	Hanford Only and Lower Bound Waste Volumes	Upper Bound Waste Volume	Hanford Only and Lower Bound: Waste Volumes	Upper Bound Waste Volume
Alternative Groups A, C, D, and E	1.1E-5	5.0E-5	1.2E-10	4.2E-10
Alternative Group B	3.8E-4	4.2E-4	7.0E-9	7.3E-9
No Action Alternative	5.3E-6	Not Applicable	8.9E-11	Not Applicable

(a) Peak annual hazard quotient values to the hypothetical MEI based on the offsite resident gardener scenario.
(b) Lifetime risk of cancer incidence to the hypothetical MEI based on the offsite resident gardener scenario.

No particular distinction was made among any of the alternatives for operational accidents involving either radiological or chemical materials. Details are provided in Section 5.11.

3.4.11.3 Post-Closure Period

Scenarios for intrusion into waste sites, soon after the time when active institutional control cannot be relied upon to prevent such action, include drilling through the waste in constructing a well and excavation of a basement for a dwelling house. The importance of these scenarios lies in the presence of short-lived radionuclides that may occur in quantity. In the case of drilling, the existence of a cap over the waste is assumed to constitute no deterrence. Inasmuch as the highest concentrations of radionuclides that are used in this analysis are common to all alternatives there would be no distinction among the alternatives based on this type of intrusion (the highest concentrations of radionuclides were determined to occur in waste previously disposed of in LLBGs). In the case of excavation for a basement, the depth to the top of the disposed waste is deep enough in all alternatives for which the waste sites are capped that the scenario is not considered credible. In the No Action Alternative where it is assumed that only the MLLW sites are capped, the depth to the top of the waste would be much less and waste could be encountered in the excavation. In any event these intruder scenarios, save for the No Action Alternative, do not provide a basis for discriminating among the alternatives. Details of these intruder analyses are presented in Section 5.11.2.2 and Appendix F.

Insights regarding the relative potential for impacts on the public over the long term may be obtained by examining the annual dose a hypothetical gardener might receive, if the individual were to intrude on the Hanford Site, drill a well (on the order of 80 to 90 m deep [about 250 ft]) into a contaminated aquifer, spread the drilling mud about the garden plot and use the well water for both domestic and irrigation purposes. Hypothetical wells near the disposal facilities are located 1 km (0.6 mi) from the aggregated waste sites in order to capture the front of the combined plume from the individual trenches. In addition, a well is modeled near the Columbia River where an individual might drill a shallow well rather than use debris-containing water directly from the river. Plots of the annual doses to the hypothetical resident gardener are provided in Figures 3.9 to 3.13. (The vertical line represents 1,000 years after closure of the disposal facilities.) Since the plots for the Hanford Only and Lower Bound waste volumes are essentially the same, plots are provided only for the Hanford Only and Upper Bound waste volumes. As may be seen in the figures, there are differences in the annual doses over time as a function of alternative, however the maximum values are all small compared to DOE's 25 mrem all pathways limit and, except for the period beginning about 9,000 years after disposal, the doses are below the drinking water standard of 4 mrem/yr.

To account for the possibility that the hypothetical gardener had a sauna, or hot tub; or in the case of a Native American, a sweat lodge, the annual dose to such an individual at any time during the 10,000-year analysis period was also determined. Plots of the annual doses to the resident gardener are compared among the alternatives in Figures 3.14 to 3.18. (Note that the vertical scale of Figure 3.16 is 10 times that for the remaining figures in the set.) The much higher doses associated with the sauna/sweat lodge scenario are attributable to inhalation of radionuclides released as a result of elevated water temperatures used in saunas or sweat lodges. For all alternatives the annual dose is at or less than 4 mrem for the first 1,000 years. Late in the 10,000-year period there is considerable difference among the alternatives with the risk of a latent cancer fatality ranging up to about 1 in 10 (about 2.5 rem/yr – 70 yr occupancy) for well locations on the 200 Areas plateau to about 3 in 100 (about 0.8 rem/yr) for a well adjacent to the Columbia River. This rise is due primarily to the late arrival of uranium in quantity in groundwater at some sites.

For perspective, it may be noted that a hypothetical gardener with sauna or sweat lodge, and using water drawn from the Columbia River at Priest Rapids upstream of the Hanford Site, could receive an annual dose of about 90 mrem from upstream sources of uranium (based on 5-year average measurements of the concentration of uranium in Columbia River water at Priest Rapids (Poston et al. 2002). Over a 70-yr period at such an annual dose a probability of latent cancer fatality of 0.004 would be inferred.

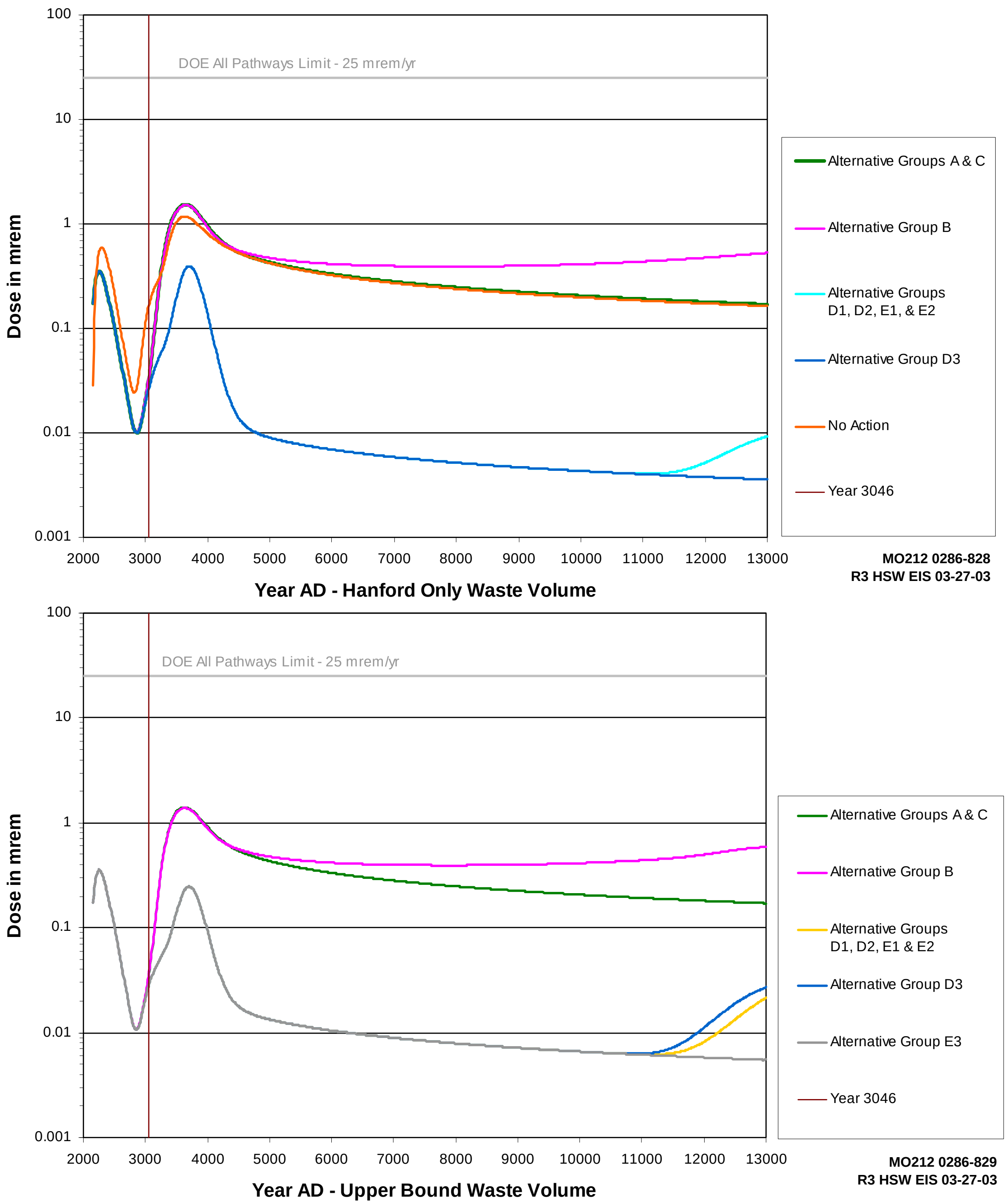


Figure 3.9. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from 200 West Area

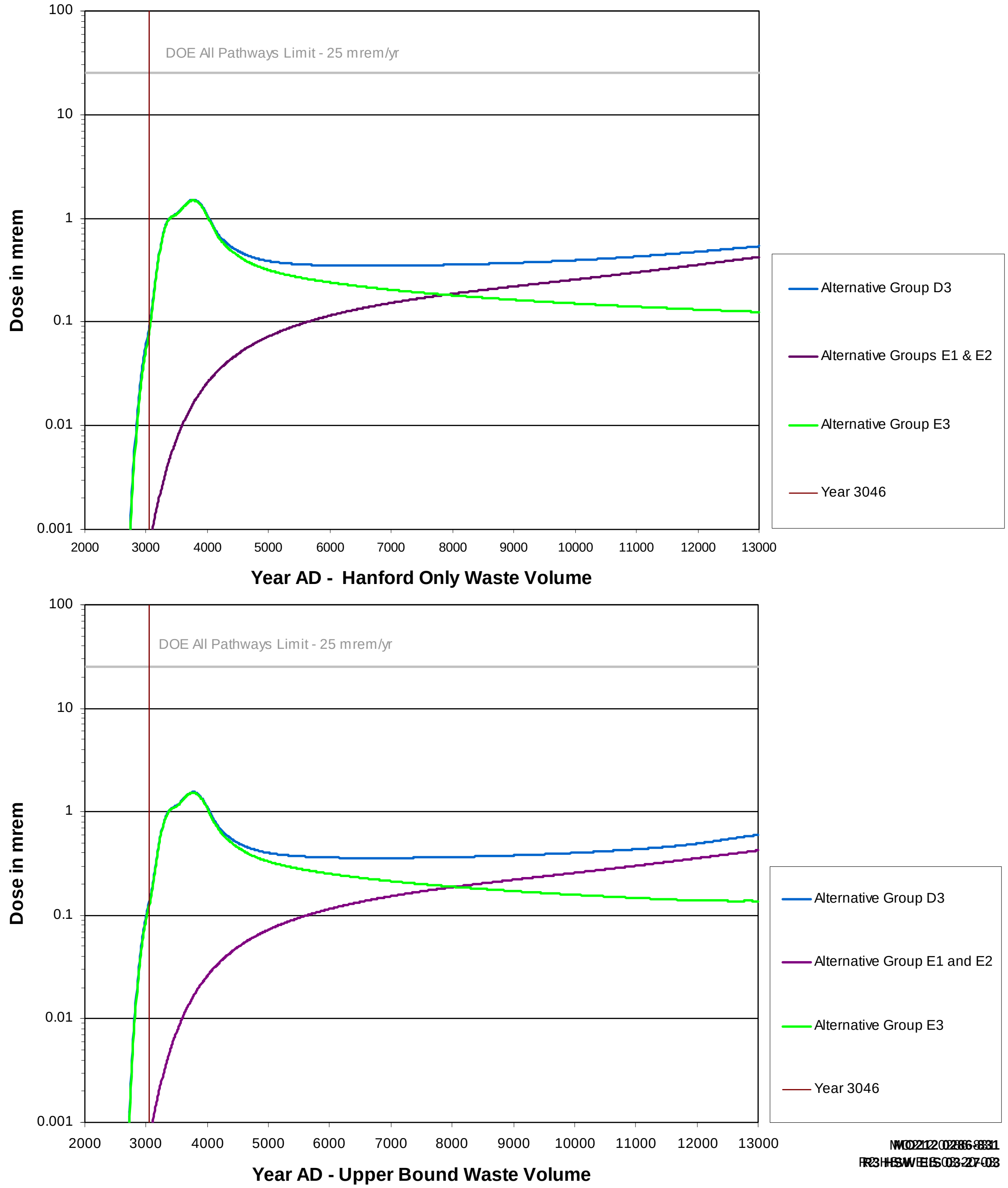


Figure 3.10. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from ERDF

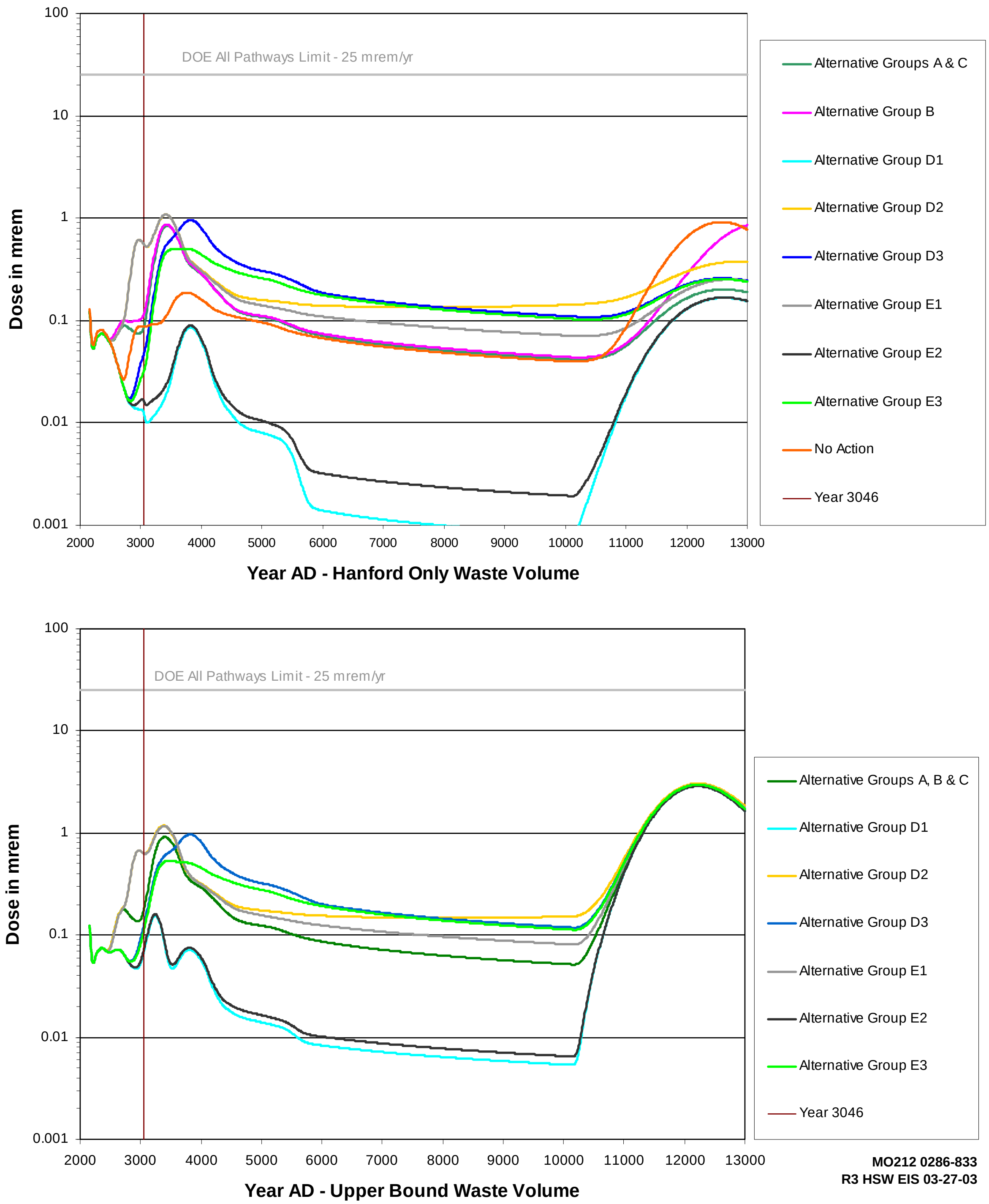


Figure 3.11. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Northwest from 200 East Area

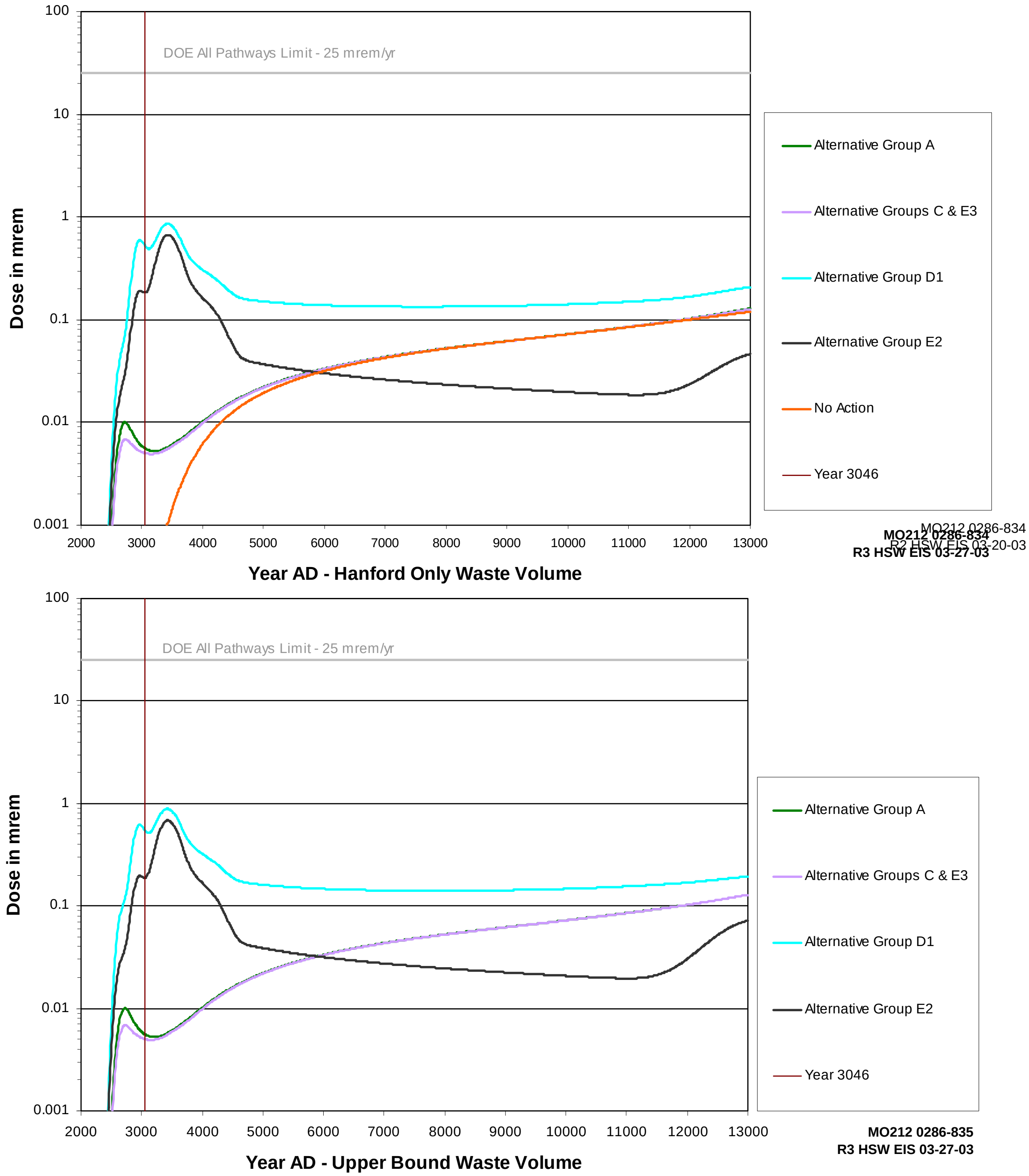


Figure 3.12. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Southeast of 200 East Area

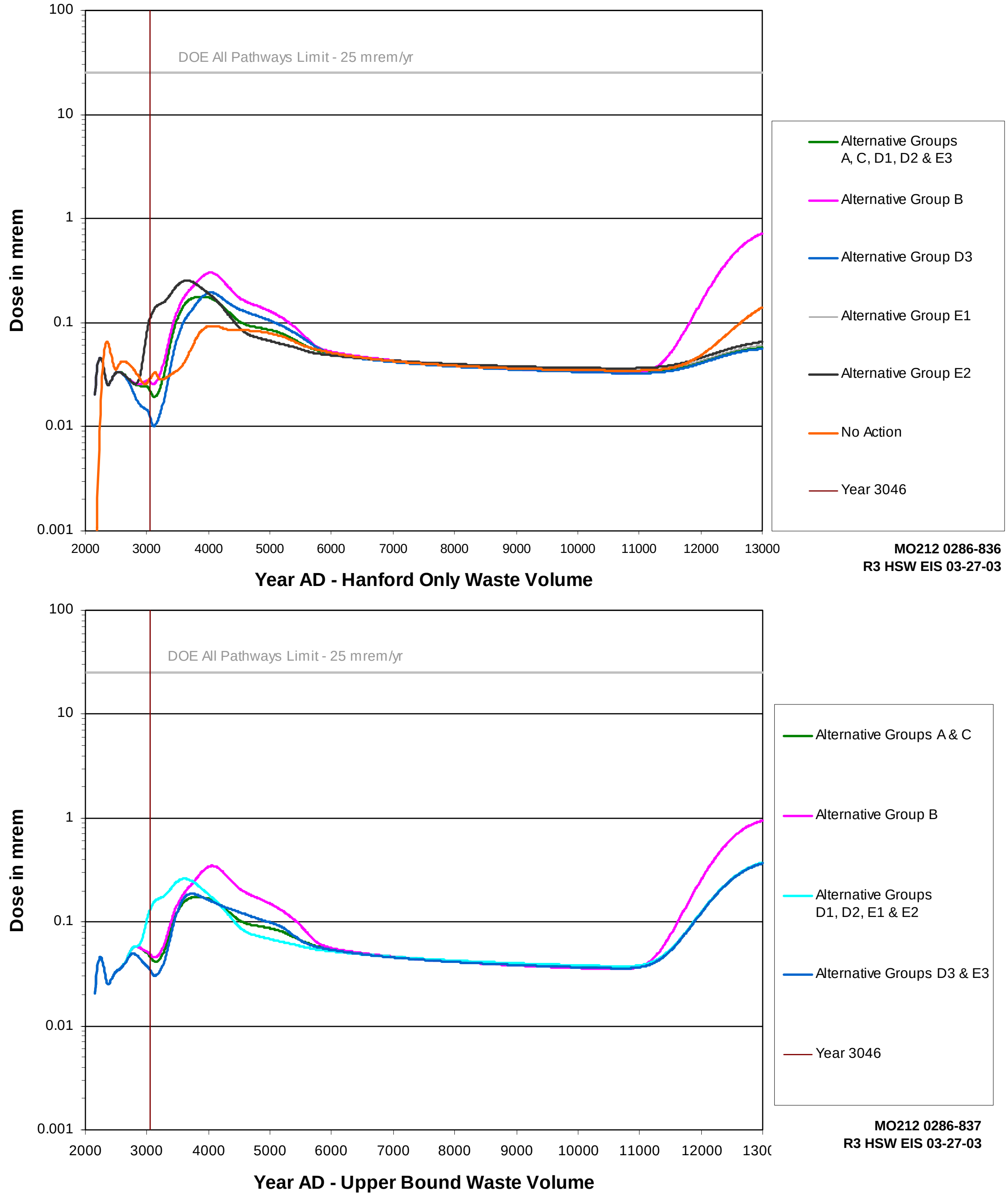


Figure 3.13. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well Adjacent to the Columbia River

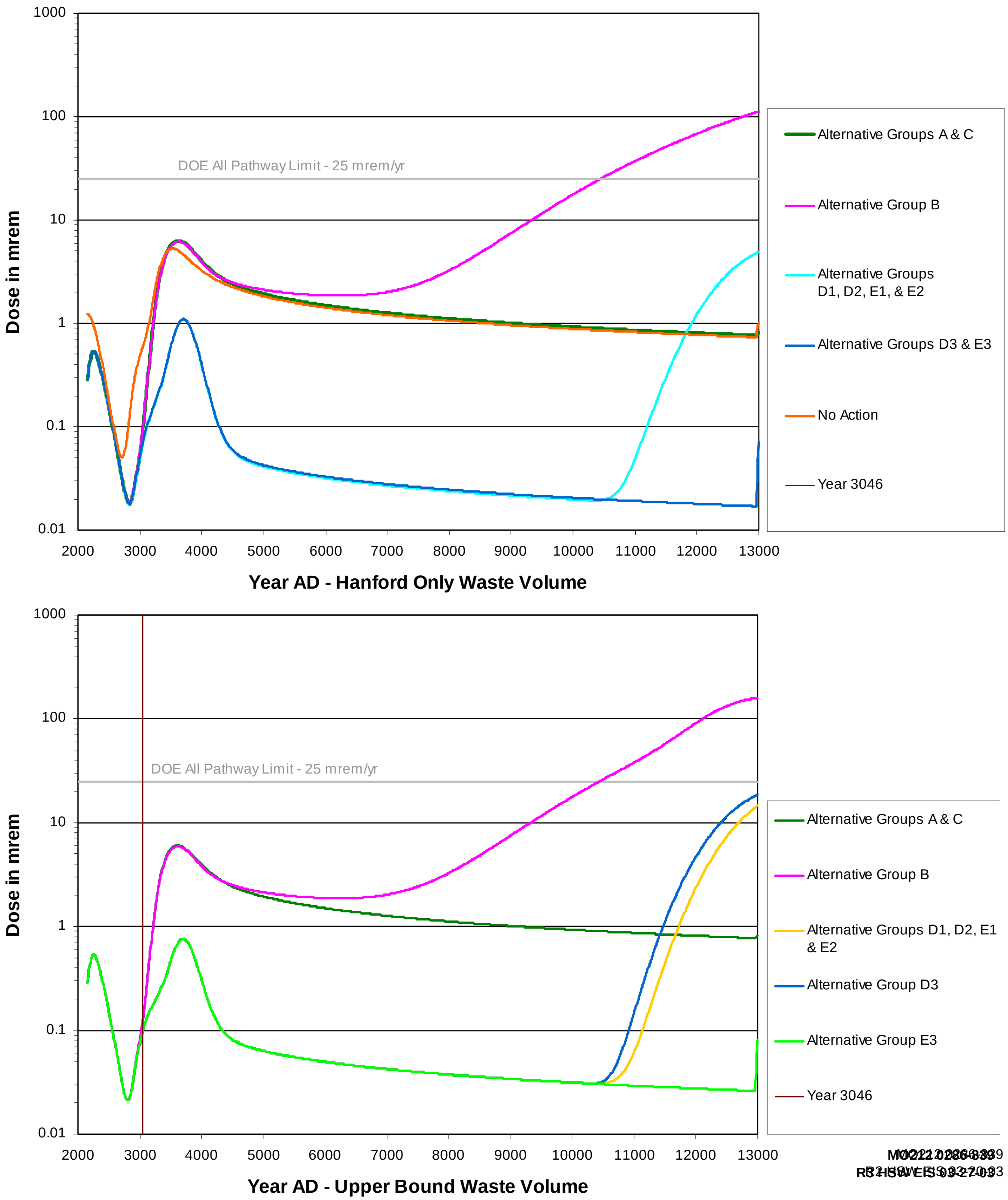


Figure 3.14. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from 200 West Area

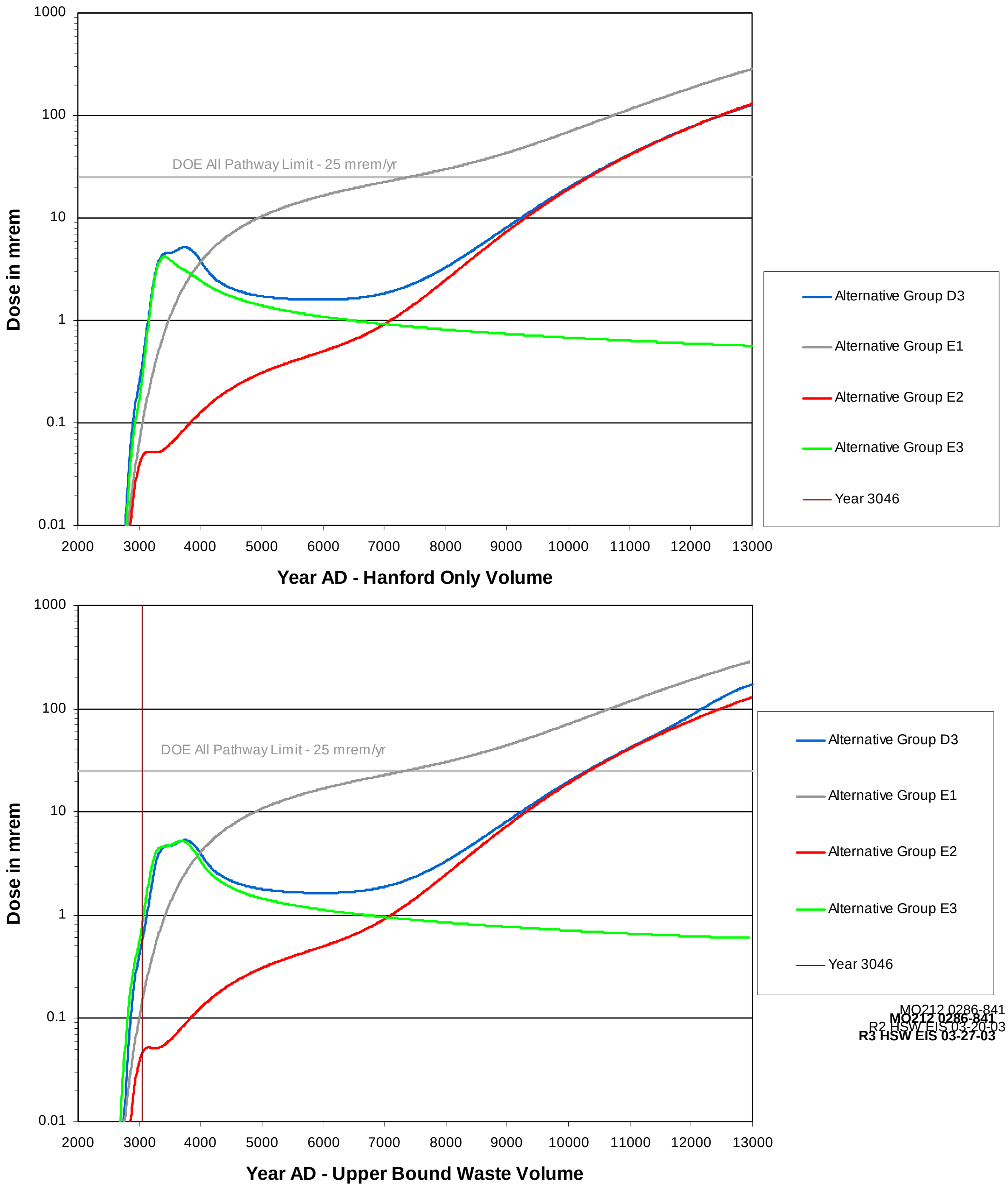


Figure 3.15. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient from ERDF

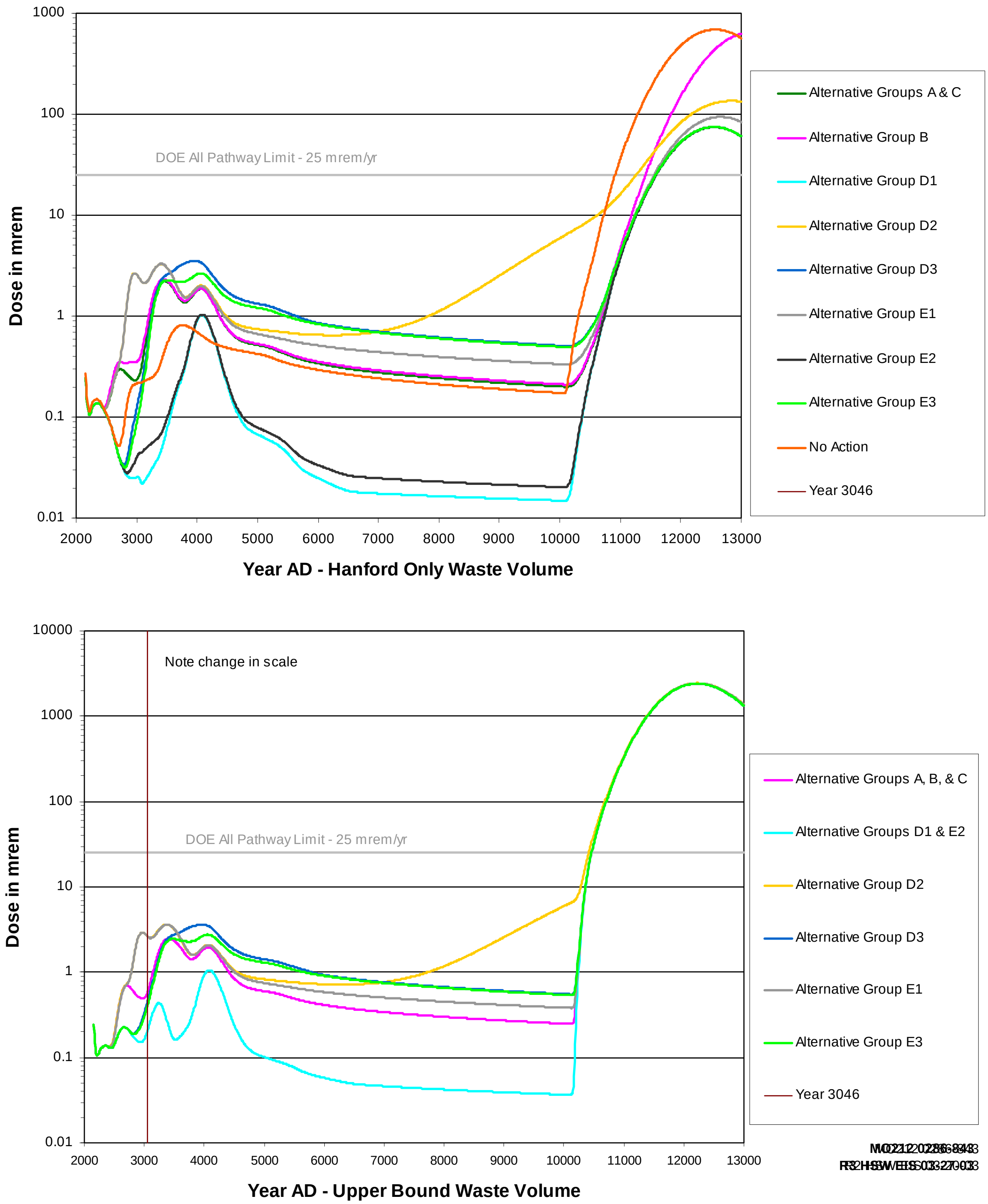


Figure 3.16. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Northwest from 200 East Area

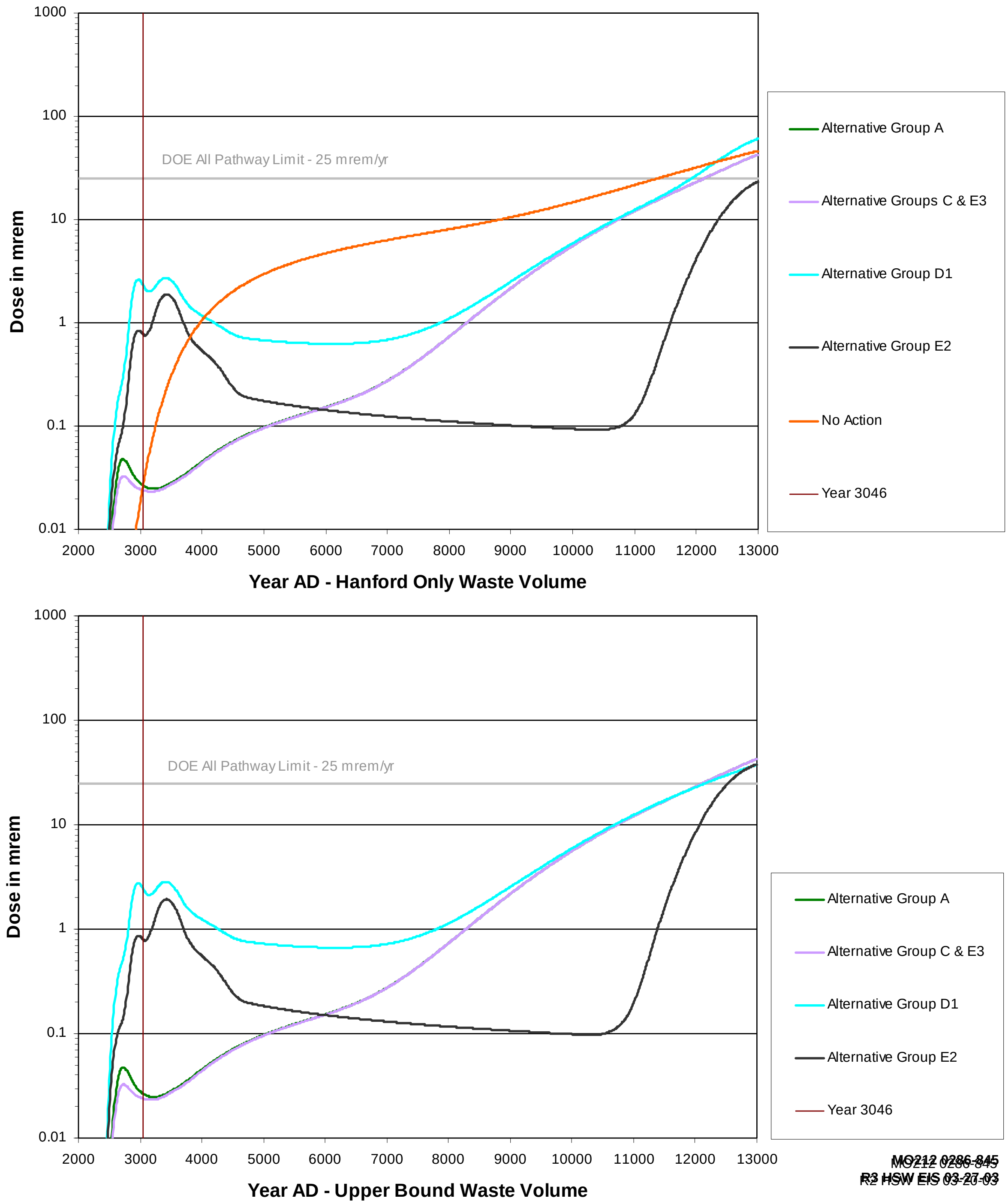


Figure 3.17. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well 1 km Downgradient Southeast from 200 East Area

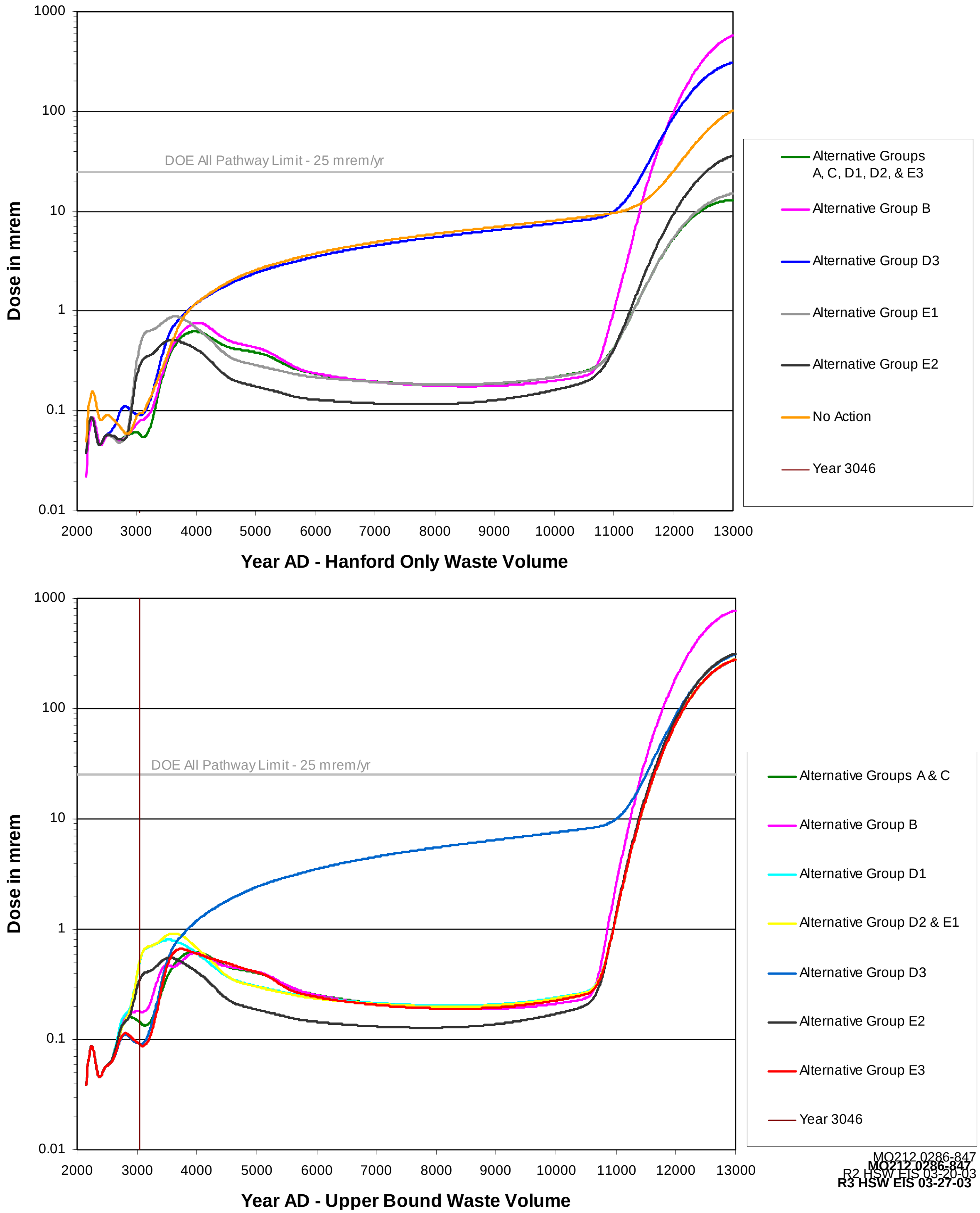


Figure 3.18. Annual Dose to a Hypothetical Resident Gardener with Sauna/Sweat Lodge at Various Times over 10,000 Years Using Water from a Well Adjacent to the Columbia River

3.4.12 Cumulative Impacts

Potential cumulative impacts associated with implementing the various alternative groups and waste volumes would be essentially the same for all alternatives (see Section 5.14). The cumulative impacts analysis focused on past, present, and reasonably foreseeable future actions. Other such current and future actions at Hanford include preparation for and disposal of tank waste and strontium and cesium capsules, CERCLA remediation projects, decontamination and decommissioning of the Hanford production reactors and canyon facilities, operation of a commercial LLW disposal site by US Ecology, and operation of the Columbia Generating Station by Energy Northwest. Cumulative impacts regarding worker health and safety, public health (for atmospheric, surface water, and groundwater pathways), land use, air quality, and ecological, cultural, and socioeconomic resources were evaluated. For most resource and potential impact areas, the combined affects from the HSW EIS proposed actions added to these activities are small.

Special emphasis was given to cumulative impacts associated with contamination of groundwater and the Columbia River. Cumulative groundwater impacts are examined in the context of existing sources of contamination in the soil, vadose zone, and groundwater. Groundwater beneath the operational areas and in plumes from the Central Plateau moving towards the Columbia River is currently contaminated with hazardous chemicals and radionuclides from past liquid and other disposal practices and unplanned releases. Radionuclides leached from wastes in the environment could eventually be transported through the vadose zone to groundwater. Although not used as a source of drinking water today nor in the foreseeable future, it was analyzed as such a scenario where and the dose to an individual who in the future might drill a well through the vadose zone to groundwater and consume two liters per day of the water.

To arrive at the cumulative impact from Hanford sources, all wastes intentionally or unintentionally disposed of on the Hanford Site since the beginning of operations and waste forecast to be disposed of through cleanup completion were taken into account. Technetium-99 and uranium isotopes were selected as representative of long-lived mobile radionuclides and were analyzed using the System Assessment Capability (SAC) (Kincaid et al. 2000) software and data (see Section 5.14 and Appendix L).

Using the SAC analysis, it was concluded that the potential dose from groundwater contamination by technetium-99 would be dominated by the existing groundwater plumes and releases from liquid waste disposal sites (e.g., cribs, ponds, ditches) over the next 2,000 years. Figure 3.19 illustrates the results of the analysis.

The SAC was also employed to evaluate the relative role in overall release of different waste types, including solid waste, past liquid discharges, past tank leaks, future tank losses, tank residuals, unplanned releases, and facilities including canyon buildings. In the simulation, the contribution to technetium-99 from solid waste releases to groundwater would amount to approximately 20 percent of the cumulative release from all Hanford sources. For uranium, releases from solid waste to groundwater are much lower. The majority of the technetium-99 and uranium releases from wastes (other than ILAW) were predicted to occur from liquid discharge sites (e.g., cribs, ponds, ditches) used in the past and from unplanned releases on the Central Plateau and from off-plateau waste sites.

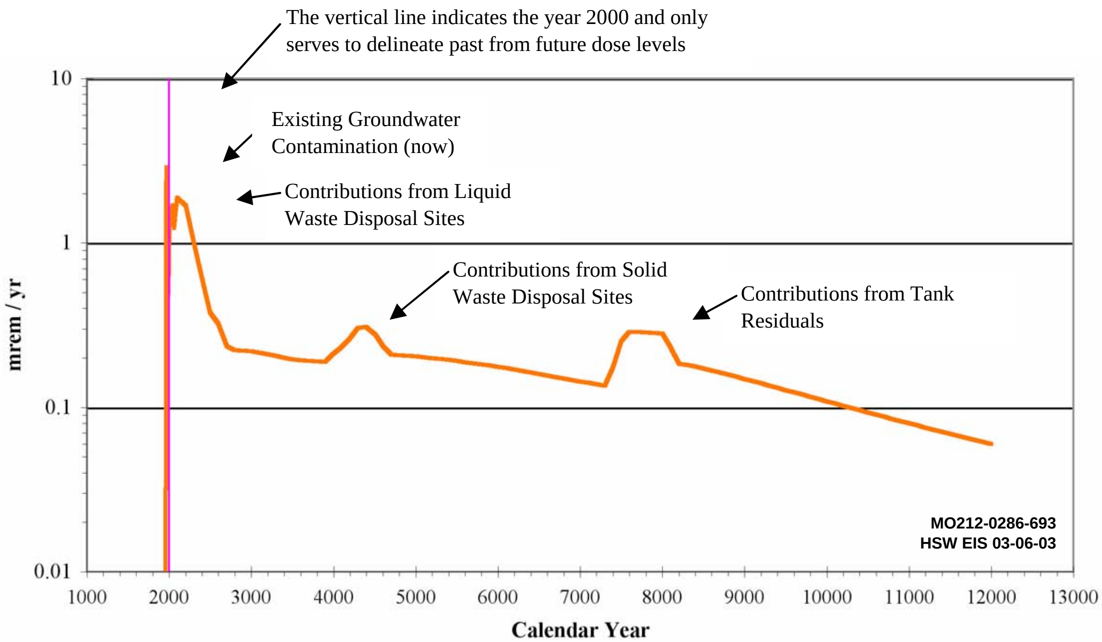


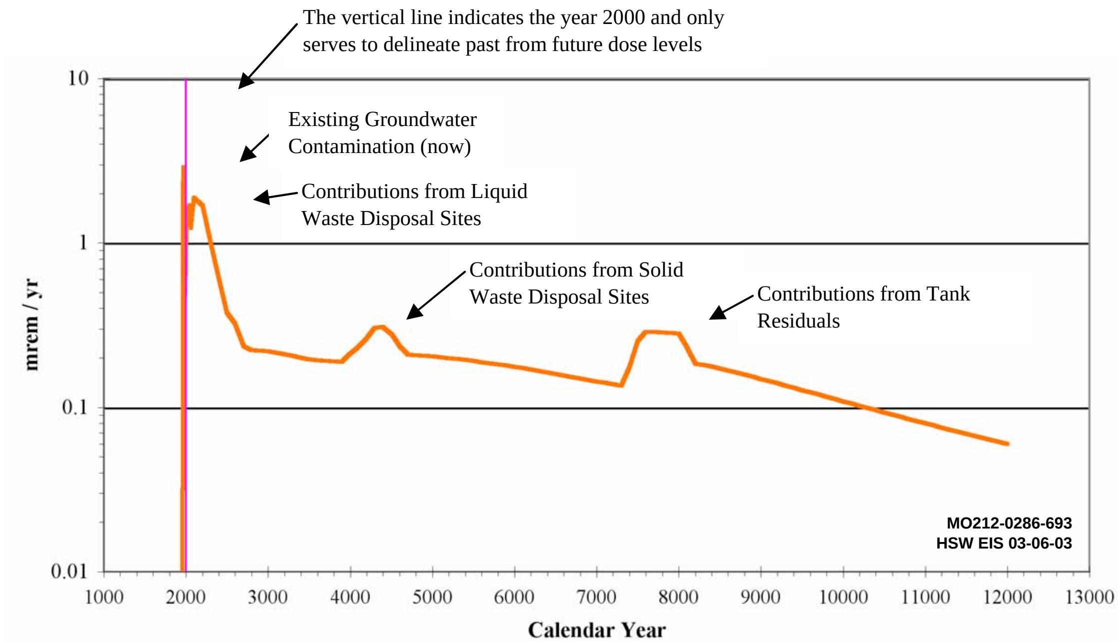
Figure 3.19. Annual Drinking Water Dose from Technetium-99 in Groundwater Southeast of the 200 East Area from All Hanford Sources Including ILAW

3.5 Areas of Uncertainty, Incomplete, or Unavailable Information

This section discusses uncertainties associated with alternatives evaluated in the HSW EIS, and takes into account areas where information is either incomplete or unavailable. Because an EIS is by nature a document prepared during the planning stages for a proposed action, information needed to evaluate environmental impacts of the activities in detail may not always be available. In some cases, there are uncertainties that cannot be resolved by collection or development of additional information, such as the uncertainties associated with projected environmental impacts at very long times in the future, or those associated with inherent variability in human and ecological systems. The approach used to account for these uncertainties would vary with the nature of the impact being evaluated and the methods used for the assessment. The individual analyses of environmental impact areas in Section 5 provide additional detail regarding uncertainties unique to each evaluation. Major areas of uncertainty associated with the proposed waste management alternatives evaluated in this HSW EIS are described in the following sections.

3.5.1 Waste Volumes

The volume of wastes that could ultimately be managed at Hanford represents one of the larger uncertainties associated with the analyses in this EIS. Many of the impact assessments depend on the waste volume that ultimately requires treatment or disposal onsite. Forecasts of future waste volumes from Hanford generators have been compiled for a number of years, and have been shown to be reasonably accurate, if somewhat conservative overall (See Appendix B). Potential waste receipts from



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3.5.2 Waste Inventories of Radioactive and Hazardous Materials

The quantities of radioactive and hazardous components in waste also contribute to environmental impacts, particularly those associated with air emissions and long-term performance of disposal facilities. The basis for waste inventories varies with the type of waste and its source, and may include information such as process knowledge or direct assay. In general, inventories for wastes received in recent years are expected to be associated with less uncertainty than those disposed of in the early 1970s. Wastes received in later years are more fully characterized because of improved analytical capabilities and added requirements for record keeping. Inventories of hazardous chemicals in mixed waste were not required to be determined or documented before the application of RCRA to mixed radioactive waste to DOE in 1987. Therefore uncertainty regarding the content of hazardous materials in wastes disposed of before that time is generally higher than for radionuclides. The HSW EIS analyses generally account for those uncertainties by making conservative assumptions regarding waste inventories based on process knowledge, assays of previously received waste, or other available information. For example, the inventory of iodine-129 in past and potential future waste receipts has been estimated using the total production at Hanford, sampling of releases to the atmosphere from fuel processing facilities, and analytical information on tank waste and other waste streams as described in Appendix L.

Chemical inventories in pre-1988 waste have not been specifically estimated for analysis in the HSW EIS because data are generally lacking in the absence of sampling and characterization of hazardous chemicals in the previously disposed waste. However, post-1988 solid waste has been characterized and typically contains only small quantities of hazardous materials (see Appendix F). Most hazardous materials used in large quantities at Hanford were organic liquids or solutions containing inorganic compounds and metals such as cadmium. Some of those contaminants have been detected in groundwater as a result of past liquid waste disposal practices. Other regulated hazardous materials, such as lead, were typically in a solid non-dispersible form and are not highly mobile in groundwater. Sampling of groundwater and soil in the vicinity of solid waste disposal facilities has not provided evidence that these facilities contributed to existing groundwater contamination (Hartman et al. 2002). A previous evaluation of waste disposal sites confirmed that groundwater contamination by hazardous chemicals was primarily a result of past liquid discharges rather than solid waste disposals (DOE 1996).

Disposal of untreated liquids to ground was discontinued in 1995, and there is an ongoing program to characterize and remediate soil and groundwater contaminated by past discharges (Hartman et al. 2002). For example, some LLBGs in the 200 West Area were sampled recently as part of an ongoing CERCLA investigation to characterize and remediate past carbon tetrachloride discharges in the vicinity of the Plutonium Finishing Plant. Sampling detected the presence of carbon tetrachloride vapor in soil at the bottom of some disposal trenches about 4.6–6.1 m (15–20 ft) below ground. The source of the vapor could not be determined from the initial sampling, but was estimated to be either waste in the disposal trench, or lateral migration of vapor from former liquid discharge sites in the vicinity. The sampling risers were capped except during sample collection, and measured vapor concentrations in air at the ground surface were well within workplace exposure standards. Because of those results, and because the vapor is approximately five times the density of air, there was no evidence that potentially hazardous releases to the atmosphere had occurred. However, additional soil sampling has been planned to investigate the source of the vapor and to determine whether there may have been liquid carbon tetrachloride releases to soil beneath the trenches. Depending on those future findings, remedial actions would be carried out during retrieval of stored transuranic waste from the trenches or at closure of the LLBGs.

MLLW currently in storage, and MLLW that may be received in the future, would be treated to applicable standards for land disposal, and is not expected to present a hazard over the long term because the hazardous components would either be destroyed or stabilized by the treatment. Inventories of hazardous materials in stored and forecast waste are either very small, or consist of metals with low mobility (see Appendix F). Disposal facilities containing pre-1988 waste would be evaluated using RCRA past practice or CERCLA processes to determine whether remedial action would be required before the facilities are closed. Therefore the long-term risks from these wastes would either be determined to be minimal, or the waste would be remediated by removal or treatment to reduce its potential hazard.

Hanford's high-level waste tanks also contain a complex mixture of radionuclides and chemicals, which adds a degree of uncertainty to the analyses associated with ILAW disposal. Historical data, such as chemical purchase invoices, records of waste transfers, and process knowledge, have been used to estimate total inventories of materials in the tank waste collectively. There is an ongoing waste characterization program to better determine the contents of each individual tank through sampling and analysis to support safety evaluations and remedial action decisions. Collection of that information continues, but is not yet complete. The lack of detailed characterization information on a tank-by-tank basis adds a level of uncertainty to certain aspects of the tank waste treatment project. However, that information is less critical to determining the long-term impacts of disposal, which are based on the total ILAW inventory. Treatment processes that would affect the composition and form of the final product are still under investigation as well. Some of the processes under consideration have not been applied to this type of waste, or have not been used on the scale necessary for the project, and some uncertainty will remain in these areas until the processes are more fully developed and tested. To account for these uncertainties, the assumptions in this EIS are based on waste characterization and processing data that are intended to provide a conservative, or bounding, analysis of impacts for the alternatives under consideration.

3.5.3 Fate and Transport of Radioactive and Hazardous Materials

Estimating transport of hazardous materials or radionuclides through various environmental pathways to human or ecological receptors is a complex process, often requiring extensive input data. In order to predict the potential for future impacts, it is typically necessary to use computer models to simulate their transport and receptor exposure rates. Computer modeling may also be used to estimate the impacts from past releases where the quantity of released material is too small to measure in the field, or where contaminants arrive at the receptor location at very long times after the release occurs. The amount of data required for a particular simulation depends on the transport medium and exposure pathways of interest. The information needed to model transport through the environment may be relatively straightforward, such as measurements of wind direction and velocity, or highly complex, such as groundwater flow rates and directions. Likewise, exposure of receptors can depend on the behaviors of individuals or populations, such as food consumption rates.

With respect to long-term performance of disposal facilities, the transport of contaminants depends on performance of the waste form, factors affecting infiltration of water through the waste, and flow rates of groundwater, all of which are subject to substantial uncertainty over the long term. Contaminant release rates depend on treatment processes and the resulting physical and chemical characteristics of the waste form. For example, future decisions regarding the tank waste treatment process may affect the composition and long-term performance of the ILAW product, and some uncertainty will remain in these areas until the processes are more fully developed and tested. Performance of different ILAW waste forms is discussed briefly in Appendix G. Performance of the engineered disposal system, such as the use of greater confinement (HICs or trench grouting), trench liners, or infiltration barriers over the disposal facility is also difficult to predict over the very long time periods used for the analyses in performance assessments and in this EIS. Other factors such as the geochemical environment, climate, and natural recharge rates in the future add to the uncertainty in predicting contaminant transport. In general, interactions among waste components that could change the geochemistry in the immediate vicinity of the disposal facility, such as the possible presence of organic chemicals in some previously disposed waste, are not expected to affect contaminant mobility over the long term. Such interactions would require relatively high concentrations of contaminants or large volumes of liquids to substantially influence contaminant mobility over the entire transport path. The solid wastes considered in this EIS do not typically contain large enough quantities of liquid organic chemicals or other potentially mobilizing agents to affect transport by this mechanism (See Appendix G).

After contaminants reach the accessible environment, potential impacts are controlled by the mechanisms that result in exposure to individuals or populations. Recent studies of long-term transport of contaminants in groundwater indicated that, for estimates of human health effects, variability with regard to individual behavior and exposure affects uncertainty in the result more than variability in inventory, release, or environmental transport of the contaminant (Bryce et al. 2002).

To account for these uncertainties, the assumptions in this EIS are based on waste characterization and processing data that are intended to provide a conservative, or bounding, analysis of impacts for the alternatives under consideration. Engineered systems are assumed to be effective for a reasonable but limited time compared to the period of analysis. Uncertainties associated with exposure parameters are typically addressed by using conservative assumptions in the model simulations, that is, assumptions that tend to maximize the exposure of individuals or populations to contaminants. An example is the use of unfavorable atmospheric dispersion conditions to maximize the downwind concentrations of hazardous materials in accident simulations, as in the analyses reported in Section 5.11. In other cases, each parameter input to a simulation can be assigned a distribution of values, and multiple simulations can be run using randomly selected values for each parameter to obtain a distribution of outcomes associated with various probabilities. That approach was used to some extent for the cumulative groundwater impacts analysis described in Section 5.14 and Appendix L.

3.5.4 Human and Ecological Risk Associated with Exposure to Radioactive and Hazardous Materials

Human and ecological risk estimates are subject to many of the same uncertainties associated with fate and transport as described in the previous section. An added uncertainty is the inherent variability in biological and ecological systems, such as the genetic variation in populations that may predispose a particular individual to adverse health effects following exposure to a potentially hazardous material. Data on relative risks from hazardous material exposure are typically more difficult to obtain because of the ethical constraints on experimentation with human subjects. Extrapolating risk from animal studies to humans, or extrapolations of ecological impacts between different animal species, introduces additional uncertainty into the consequence estimates. Estimates of cancer risk in very long-term analyses, such as those for groundwater quality, are likely to overestimate the risks, because they do not account for the possible development of medical treatments that could prevent those consequences in the future.

As with the environmental transport calculations the approach used in the HSW EIS was to assign conservative values to most of the input parameters used in modeling risk from hazardous material exposures. For example, the estimates of potential cancer risk from exposure to radiation at very low doses, such as those from most environmental exposures, are based on data obtained at higher exposure rates and by different exposure pathways. The effect is assumed to be proportional to the dose received, although in the case of radiation, there is no experimental or epidemiological evidence that such effects occur at very low doses. The estimates of cancer incidence or fatality from very low radiation doses are therefore conservatively high, and encompass a range of possible risks that includes zero risk.

3.5.5 Technical Maturity of Alternative Treatment Processes

Treatment technologies for most types of MLLW are specified by regulation. Where more than one technology might apply to a particular waste stream, a reference treatment technology was assumed for purposes of analysis. The consequences of waste treatment were typically estimated using conservative but realistic assumptions appropriate for the reference technology. For example, thermal treatment processes would be expected to result in greater emissions to the atmosphere than non-thermal technologies such as macroencapsulation. One uncertainty associated with MLLW treatment is the currently limited availability of thermal treatment processes for waste containing hazardous organic components. For purposes of analysis, this EIS assumed such treatment would be available at offsite commercial facilities within a reasonable time. However, an additional alternative was evaluated to consider the use of non-thermal options for those wastes in the event such treatment is not available.

With respect to ILAW, the reference treatment was assumed to be vitrification or another technology that produces a waste form having equivalent long-term performance. Other treatment technologies are currently under consideration for the low activity waste stream; however, those technologies are not sufficiently mature for detailed evaluation at this time. The uncertainties associated with long-term performance of ILAW are addressed in this EIS by considering a range of performance characteristics for this waste stream (see Appendix G).

3.5.6 Timing of Activities Evaluated in the Alternative Groups

Under all HSW EIS alternative groups, there are uncertainties related to the timing of their implementation. Timing uncertainties include:

- the technical maturity of waste treatment technologies and the amount of development necessary before design and construction of facilities could proceed
- the possibility that regulatory requirements could change, which could introduce delays by affecting the design and cost of selected alternatives
- the time required to obtain necessary permits and approvals for various treatment, storage and disposal actions
- the timely appropriation of funds by Congress to enable DOE to implement decisions resulting from this EIS
- the effect of proposals for accelerated cleanup at Hanford (DOE-RL 2002) and at other DOE facilities, which could potentially influence the timing and quantities of waste receipts.

In general, these uncertainties are addressed in this EIS by adopting conservative assumptions in analyses (that is, assumptions that would tend to maximize the estimated environmental impacts). The timing of activities evaluated in the EIS may differ from assumptions used in the analyses; however, the nature and extent of those actions are expected to be similar whenever they may occur.

3.6 Costs of Alternatives

Consolidated cost estimates were prepared for the continued operation of existing facilities, the modification of existing facilities, construction of new facilities, and operation of the new or modified facilities (FH 2003; Aromi and Freeburg 2002). The costs were calculated using a constant 2002 dollars. Some operations, such as capping the LLBGs and treatment of leachate from mixed waste trenches, would continue beyond 2046. These costs have been included as a separate category. The cost of each major facility for each alternative group is shown in Table 3.21. The increased costs for the operation of the LLBGs with the increased volume of waste can be seen. Because the additional MLLW in the Upper Bound waste volume do not need treatment, the costs for treatment facilities do not change. In the No Action Alternative Group, the increased needs for storage of MLLW and the limited volume of waste disposed of are reflected in the relative costs of the CWC and the MLLW trenches. The increased costs for the baseline operation of the T Plant Complex for the No Action Alternative Group compared with Alternative Groups A, B, and C result from the continuing need to store the K Basin sludge in the No Action Alternative. The combination of commercial MLLW treatment and modification of the T Plant Complex in Alternative Group A is less expensive than construction of a new facility, with DOE doing the majority of the treatment onsite in Alternative Group B. The consolidation of disposal facilities should lead to lower disposal costs – most easily noted in the total alternative group costs between Alternative Groups D and E and Alternative Group A.

3.7 DOE Preferred Alternative

Based on the results of the environmental consequences analyses as presented in Sections 3.4 and 5, cost, and other considerations, DOE has identified a preferred alternative for the HSW EIS. The preferred alternative consists of those actions identified in Alternative Group D for waste quantities up to the Upper Bound waste volumes, in addition to the use of modular facilities (from Alternative Group B) for the processing and certification of TRU waste, as follows:

Storage: The Central Waste Complex will continue as the primary storage facility for LLW, MLLW, and TRU waste. The storage of retrievably-stored TRU waste in the Low Level Burial Grounds would continue until retrieval operations are complete.

Treatment: LLW and MLLW would be treated using a combination of existing capabilities and processes, offsite commercial capabilities, and a modified T Plant. TRU waste would be processed and certified using a combination of the Waste Receiving and Processing Facility, a modified T Plant, and the modular facilities.

Disposal: LLW, MLLW, ILAW, and melters would be disposed of in a new modular facility. This new disposal facility would include a RCRA-compliant liner and a leachate collection system and upon closure would be capped with the modified RCRA Subtitle C cover. Existing Low Level Burial Grounds would be similarly capped. These existing Low Level Burial Grounds would continue to be used pending operation of the new disposal facility.

In general, alternatives outlined in Alternative Groups D and E would be the most environmentally preferable, operationally efficient, and marginally cost-effective. The differences in impacts between Alternative Groups D and E and their respective subgroups would be minor. However, Alternative Group D appears to offer a combination of low environmental impacts and low cost. Waste disposal operations would be combined in a single location that could provide a more efficient regulatory pathway to construction and operation.

3.8 References

40 CFR 141. “National Primary Drinking Water Regulations.” U.S. Code of Federal Regulations.

40 CFR 1500-1508. “Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.” U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfrv28_01.html.

46 FR 18026. “Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act regulations: 1. Range of Alternatives.” March 23, 1981. Online at: http://ceq.eh.doe.gov/nepa/regs/40/40p3.htm.

62 FR 8693. “Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland, Washington.” *Federal Register* (February 26, 1997).

4.0 Affected Environment

The purpose of this section is to provide a description of the environment that might be affected by the alternatives discussed in Section 3. Because the Hanford Site is so large, the description includes much of the Site itself, as well as the surrounding areas. Information used in this section was taken from the *Hanford Site National Environmental Policy Act (NEPA) Characterization Report* (Neitzel 2002a), unless otherwise noted.

The affected environment section includes:

- Land Use
- Meteorology and Air Quality
- Geology, Soils, and Seismology
- Hydrology
- Biology and Ecology
- Cultural Resources
- Socioeconomics
- Noise
- Occupational Safety
- Occupational Radiation Exposure.

4.1 Introduction

The focus of solid waste management activities related to the Hanford Solid (Radioactive and Hazardous) Waste Environmental Impact Statement (HSW EIS) is within the existing boundaries of the Hanford Site 200 Areas or at the Environmental Restoration and Disposal Facility (ERDF). Located on the Central Plateau (i.e., 200 Area Plateau) of the Hanford Site, the 200 East and 200 West Areas are approximately 8 and 11 km (5 and 7 mi), respectively, south and west of the Columbia River. The 200 Areas facilities were built to process irradiated fuel from the production reactors. Subsequent liquid wastes, produced as a result of the fuel processing, were placed in tanks or disposed of in cribs, ponds, or ditches in the 200 Areas. Treatment, storage, and disposal of solid wastes are accomplished in the 200 Areas.

The U.S. Department of Energy (DOE) Hanford Site (Figure 4.1) lies within the semiarid Pasco Basin of the Columbia Plateau in southeastern Washington State. The Site occupies an area of about 1,517 km^2 (586 mi^2) north of the confluence of the Yakima River with the Columbia River. The Hanford Site measures approximately 50 km (31 mi) north to south and 40 km (25 mi) east to west. The major portion of this land, with restricted public access, provides a buffer for the smaller areas currently used for nuclear materials storage, waste storage, and waste disposal.

4.0 Affected Environment

The purpose of this section is to provide a description of the environment that might be affected by the alternatives discussed in Section 3. Because the Hanford Site is so large, the description includes much of the Site itself, as well as the surrounding areas. Information used in this section was taken from the *Hanford Site National Environmental Policy Act (NEPA) Characterization Report* (Neitzel 2002a), unless otherwise noted.

The affected environment section includes:

- Land Use
- Meteorology and Air Quality
- Geology, Soils, and Seismology
- Hydrology
- Biology and Ecology
- Cultural Resources
- Socioeconomics
- Noise
- Occupational Safety
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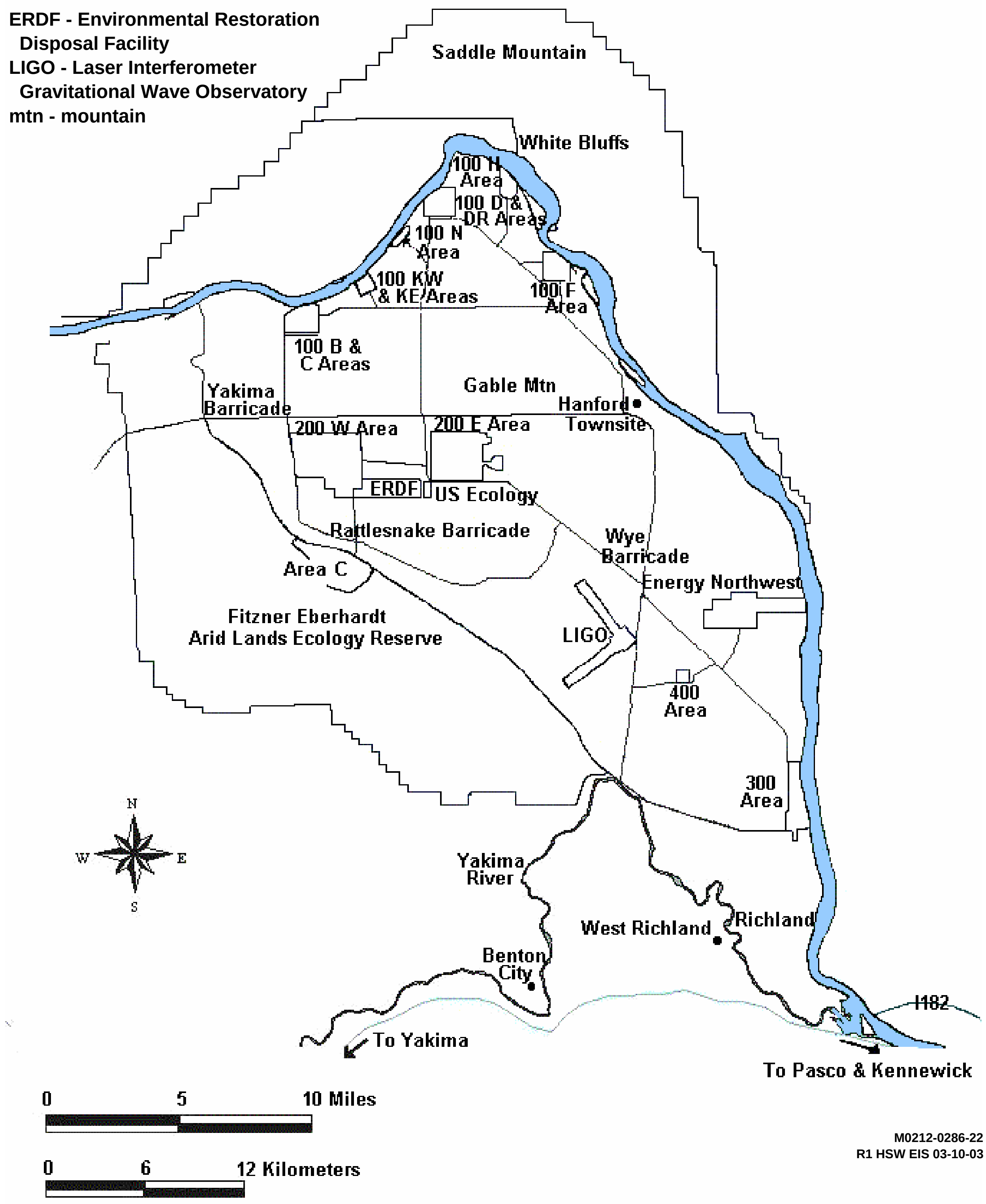

Figure 4.1. Department of Energy – Hanford Site (after Neitzel 2002a)

The Columbia River flows through the northern part of the Hanford Site and, turning south, forms part of the eastern Site boundary. The Yakima River runs near the southern boundary of the Hanford Site, joining the Columbia River at the city of Richland that bounds the Hanford Site on the southeast. Rattlesnake Mountain, Yakima Ridge, and Umtanum Ridge form the southwestern and western boundaries. Saddle Mountain constitutes the northern boundary of the Hanford Site. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau in the central part of the Hanford Site. Adjoining lands to the west, north, and east are principally agricultural and rangeland. The cities of Kennewick, Pasco, and Richland (Tri-Cities) and the city of West Richland constitute the nearest population centers and are located south-southeast of the Hanford Site.

4.2 Land Use

DOE completed the Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS; DOE 1999) in September 1999. A Record of Decision (ROD) was issued on November 2, 1999 (64 FR 61615), which adopted the Preferred Alternative as discussed in the EIS. The purpose of this land-use plan and its implementing policies and procedures is to facilitate decision-making about Hanford Site uses and facilities over at least the next 50 years. The Preferred Alternative map from the Final Hanford Comprehensive Land-Use Plan EIS ROD shown in Figure 4.2 represents the DOE future land-management values, goals, and objectives. The land-use plan consists of several key elements that are included in the DOE Preferred Alternative in the Final HCP EIS (DOE 1999). These elements include a land-use map that addresses the Hanford Site as five geographic areas—Wahluke Slope, Columbia River Corridor, Central Plateau, all other areas of the site, and the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE). The key elements of the Hanford Comprehensive Land-Use Plan include a map that depicts the planned future uses, a set of land-use designations defining the allowable uses for each area of the Hanford Site, and the planning and implementing policies and procedures that will govern the review and approval of future land uses. Together these four elements create the Hanford Comprehensive Land-Use Plan. Much of the land is undeveloped, providing a buffer area for the smaller operations areas. Public access to most facility areas is restricted.

The key features of the Hanford Site that form the basis for the five geographic areas used in the environmental impact analysis and land-use plans are summarized as follows:

Wahluke Slope. The area north of the Columbia River and the Hanford Site proper encompasses approximately 357 km^2 (138 mi^2) of relatively undisturbed or recovering shrub-steppe habitat managed by the U.S. Fish and Wildlife Service (FWS) for DOE. These lands consist of two overlay wildlife management units within the Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge, the 130 km^2 (50 mi^2) Saddle Mountain Unit, and the 225 km^2 (87 mi^2) Wahluke Unit. Portions of the Saddle Mountain Unit, which is closed to public access, still serve as buffer areas for the Hanford Site. The Wahluke Unit is open to public recreational access. A small strip of land approximately 1.62 km^2 (0.63 mi^2) located between State Route (SR) 243 and the Columbia River west of SR 24 is managed by the Washington State Department of Fish and Wildlife.

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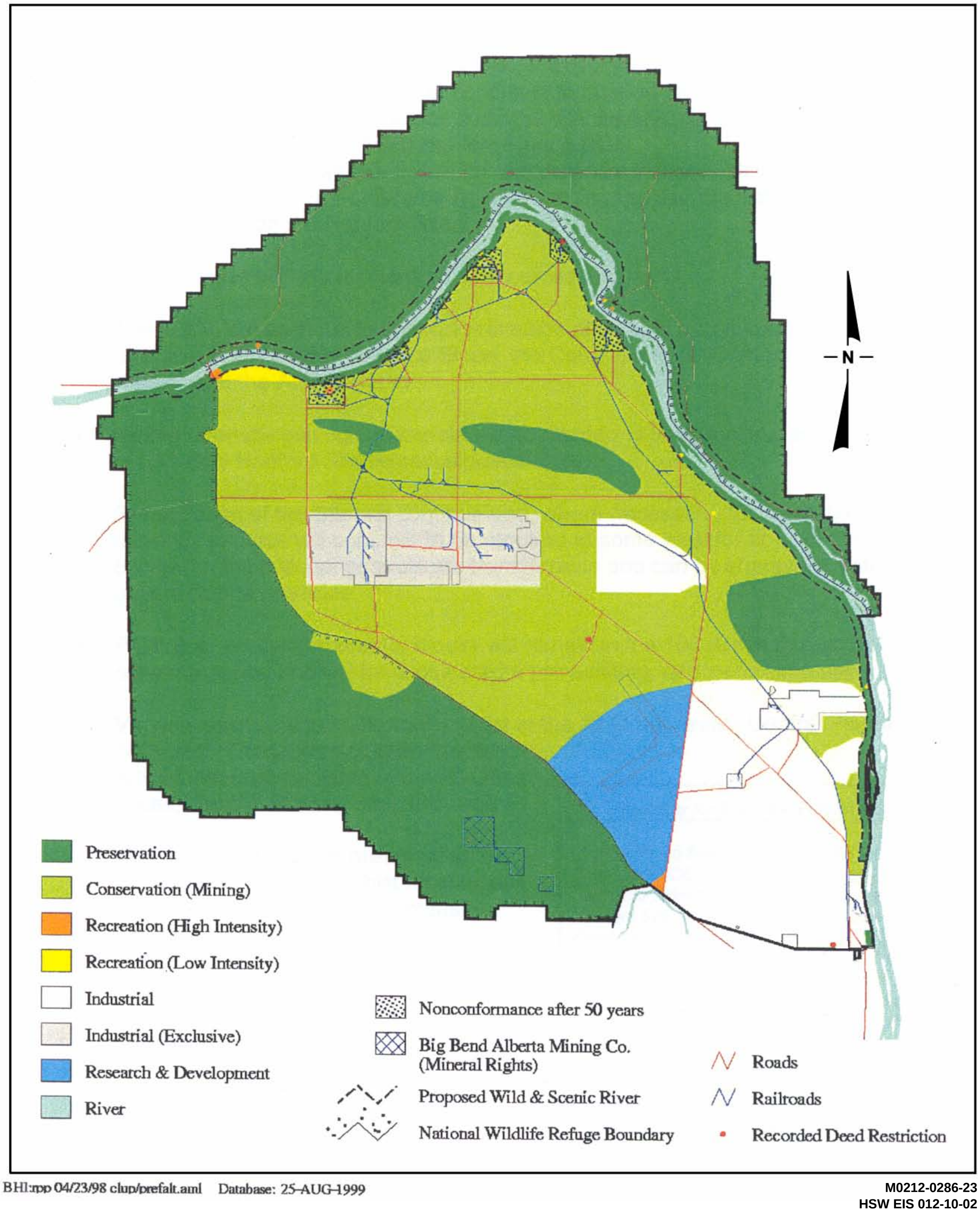

Figure 4.2. DOE Preferred Alternative for Land Use on the Hanford Site from the Final Hanford Comprehensive Land-Use Plan EIS Record of Decision (64 FR 61615)

Columbia River Corridor. The 111.6 km^2 (43.1 mi^2) Columbia River Corridor, which is adjacent to and runs through the Hanford Site, is used for boating, water skiing, fishing, and hunting of upland game birds and migratory waterfowl. Although public access is allowed on certain islands, access to other islands and adjacent areas is restricted because of unique habitats and the presence of cultural resources.

The area within the Columbia River Corridor known as the Hanford Reach includes a quarter mile (402-m) strip of land on either side of the Columbia River, as well as the islands and water surface area. Along the southern shoreline of the Columbia River Corridor, the 100 Areas occupy approximately 68 km^2 (26 mi^2). The facilities in the 100 Areas include nine retired plutonium production reactors, associated facilities, and structures. In the vicinity of the 100-H Area, closure permit restrictions of the Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901 et seq.) that are associated with the 183-H Solar Evaporation Basins have been instituted. Institutional controls are expected for the RCRA post-closure and Comprehensive Environmental Restoration, Compensation, and Liability Act of 1980 (CERCLA) remediation areas.

Central Plateau. The 200 East and 200 West Areas occupy approximately 51 km^2 (19.5 mi^2) in the Central Plateau (the 200 Area Plateau) of the Hanford Site. Facilities located on the 200 Area Plateau were built to process irradiated fuel from the production reactors. The operation of these facilities resulted in the need for treatment, storage, and disposal facilities for radioactive and hazardous wastes. Unplanned releases of radioactive and non-radioactive waste have contaminated some parts of the 200 Areas. The U.S. Navy also uses Hanford nuclear waste treatment, storage, or disposal facilities. Institutional controls are expected for the Central Plateau.

A commercial LLW disposal facility, operated by U.S. Ecology, Inc., currently occupies 0.4 km^2 (0.16 mi^2) of the 200 Area Plateau. The facility is located on a portion of the 100 ac (originally 1000 ac) leased by the State of Washington from the federal government and subleased to U.S. Ecology, Inc.

All Other Areas. All Other Areas comprise 689 km^2 (266 mi^2) and contain the 300, 400, and 1100 Areas, Energy Northwest facilities, and a section (2.6 km^2 [1 mi^2]) of land currently owned by the State of Washington for the disposal of hazardous substances.

The Hanford 1100 Area and the Hanford railroad southern connection (from Horn Rapids Road to Columbia Center) have been transferred from DOE ownership to Port of Benton ownership to support future economic development. Although the 1100 Area is no longer under DOE control, it was included in the HCP EIS to support the local governments with their State Environmental Policy Act (SEPA) EIS analyses of the Hanford sub-area of Benton County under the State of Washington Growth Management Act.

The 300 Area is located just north of the city of Richland and covers 1.5 km^2 (0.6 mi^2). The 300 Area is the site of former reactor fuel fabrication facilities and is also the principal location of nuclear research and development facilities serving the Hanford Site.

The 400 Area, located southeast of the 200 East Area, is the site of the Fast Flux Test Facility (FFTF). DOE has decided to permanently shut down this facility.

Energy Northwest currently operates Columbia Generating Station on land leased from DOE. The land is approximately 10 km (6 mi) north of the city of Richland. The land was leased for the operation of three nuclear power plants. Construction of two of the plants was halted. Other industrial options for the site are currently being considered. Under the terms of the lease agreements, DOE would need to approve alternative uses of the land.

In 1980, the federal government sold a 2.6 km^2 (1 mi^2) section of land (known as Section 1.0) south of the 200 East Area, near SR 240, to the State of Washington for the purpose of non-radioactive hazardous waste disposal. To date, this parcel has not been used for hazardous waste disposal. The deed requires that if it were used for any purpose other than hazardous waste disposal, ownership would revert to the federal government.

Additional activities in the All Other Areas include:

(1) *A specialized training center*: The Hazardous Materials Management and Emergency Response (HAMMER) Volpentest Training and Education Center is used to train hazardous materials response personnel. It is located north of the former 1100 Area and covers about 32 hectares (80 acres).

(2) *A regional law-enforcement training facility*: The Hanford Patrol Training Academy, located adjacent to HAMMER, provides a range of training environments including classrooms, library resources, practice shoot houses, an exercise gym, and an obstacle course.

(3) *A national research facility*: The Laser Interferometer Gravitational Wave Observatory (LIGO), built by the National Science Foundation for scientific research, is designed to detect cosmic gravitational waves. The facility consists of two optical tube arms, each 4 km (2.5 mi) long, arrayed in an L shape, and is extremely sensitive to vibrations.

(4) *Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve Unit:* The 308.7 km^2 (119.2 mi^2) ALE, a Research Natural Area, is part of the Hanford Reach National Monument and is managed by the U.S. Fish and Wildlife Service (FWS). ALE is located in the southwestern portion of the Hanford Site and is managed as a wildlife reserve and environmental research area. The public is generally restricted from the reserve.

4.2.1 Hanford Reach National Monument

On June 9, 2000, portions of the Hanford Site including ALE, Saddle Mountain Wildlife Refuge, Wahluke Slope, White Bluffs, the sand dune area northwest of the Energy Northwest Site, historic structures (including homesteads from small towns established along the riverbanks in the early 20th century), and land 0.4 km (¼ mi) inland on the south and west shores of the 82-km (51-mi) long Hanford Reach, the last free-flowing, non-tidal stretch of the Columbia River, were designated as a National Monument (Figure 4.3) by President Clinton (65 FR 37253). Also included in the 78,900-hectare (195,000-acre) monument were the McGee Ranch and Riverlands areas and the federally owned islands within that portion of the Columbia River.

On June 14, 2001, U.S. Department of Energy–Richland Operation Office (DOE-RL) and the FWS signed an amended Memorandum of Understanding (MOU) addressing management responsibilities for the Hanford Reach National Monument. As a result of the MOU, the FWS is the lead agency in producing a Comprehensive Conservation Plan (CCP) for management of the Hanford Reach National Monument. Development of the CCP will be a public process, including input from local governments, Native American Tribes, stakeholders, and others, including a Federal Advisory Committee for the Hanford Reach National Monument. The DOE will participate in writing the CCP and, in cooperation with the FWS, approve the plan. Under the MOU, which is intended to remain in effect for 25 years, DOE and the FWS will produce agreements for site access, security, emergency preparedness, mutual assistance, wildland fire response, and cultural and biological resource management.

4.2.2 200 Areas

The focus of the HSW EIS is on waste storage, treatment, and disposal activities. For a description of the facilities, refer to Section 2. The Central Waste Complex (CWC) is located in the 200 West Area (Figure 4.4). Low-level waste (LLW), mixed low-level waste (MLLW), and transuranic (TRU) waste from onsite and offsite generators are stored in CWC pending treatment or disposal.

The Waste Receiving and Processing Facility (WRAP) is located in the 200 West Area. It began operations in 1997 and can process TRU waste, certify TRU waste and LLW for disposal, and provide limited treatment of MLLW. The 4,800 m^2 (52,000 ft^2) facility is located near the CWC, and is designed to process 6,800 drums and 70 boxes of waste annually for 30 years (Poston et al. 2001).

T Plant Complex, located in the northeast corner of the 200 West Area, consists of two major facilities: T Plant canyon and 2706-T Facility. T Plant Complex is used for waste verification, decontamination of equipment, repackaging of radioactive wastes, and storage of pressurized water reactor spent fuel from an offsite reactor. It is also capable of macroencapsulation of debris and

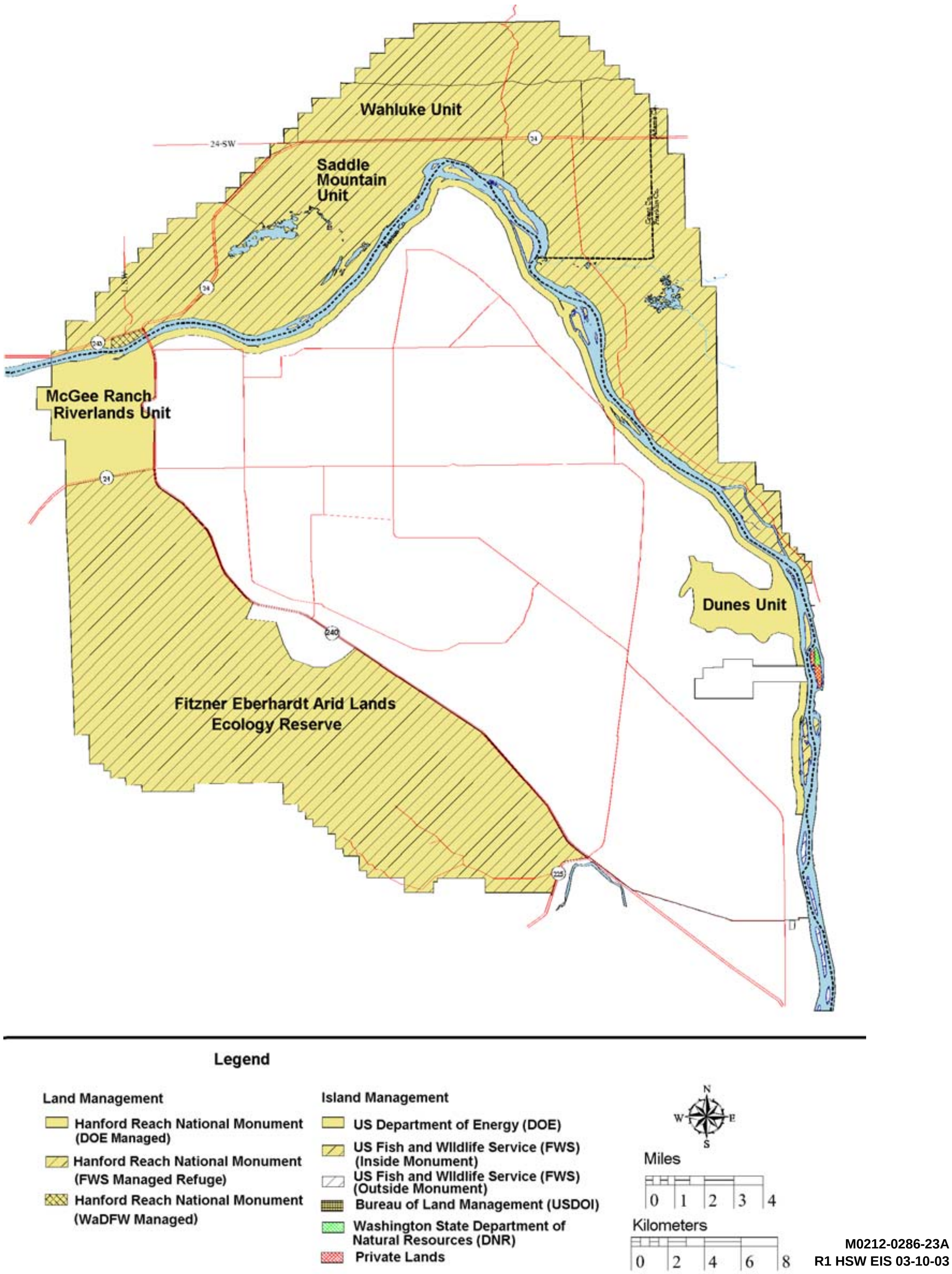

Figure 4.3. Hanford Reach National Monument

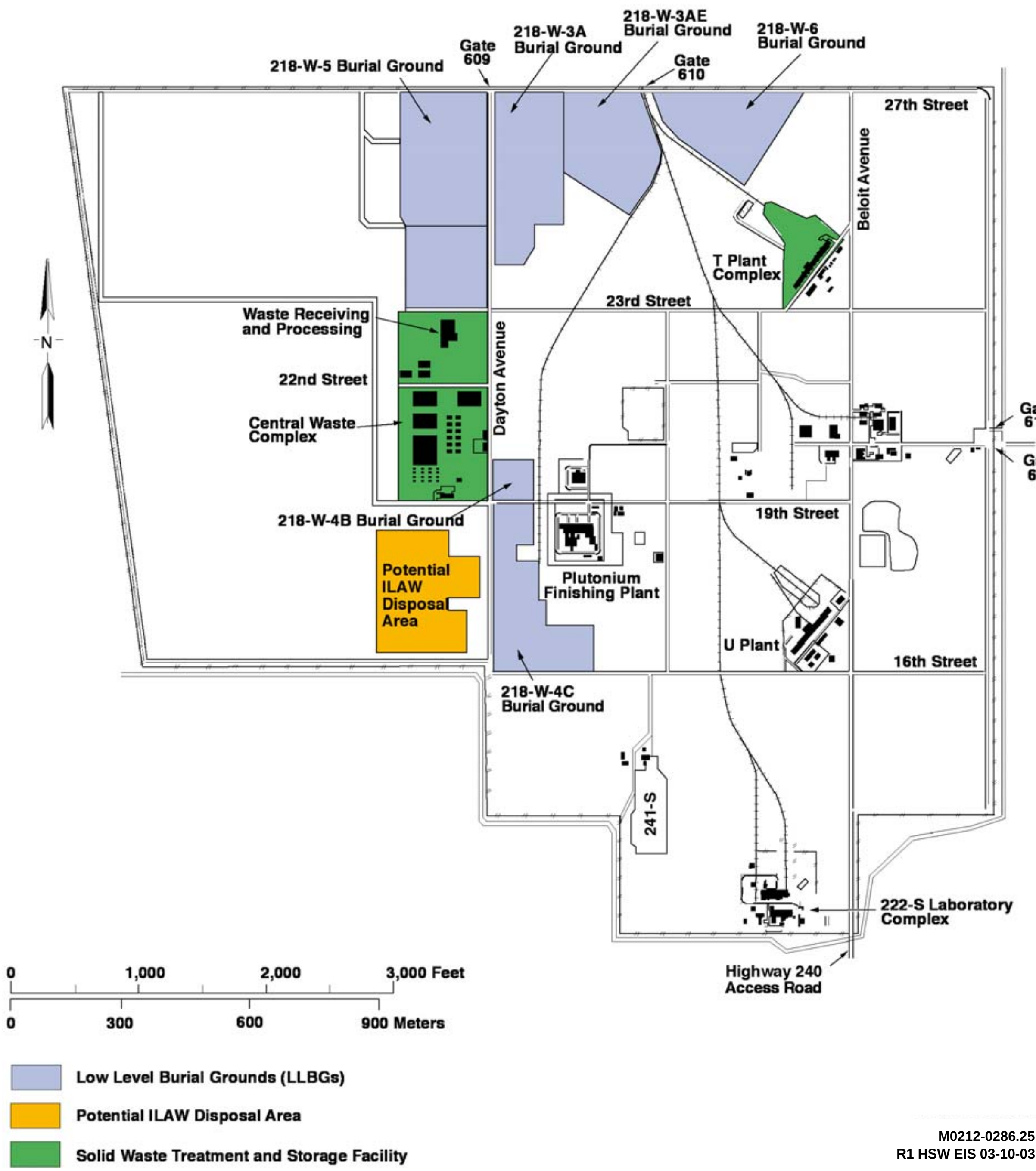

Figure 4.4. 200 West Area

contaminated equipment, and neutralization and repackaging of organic and inorganic lab packs. Twenty-seven metric tons (30 tons) of spent nuclear reactor fuel from Shippingport, Pennsylvania, stored at T Plant Complex, are being moved to the Hanford Canister Storage Building. DOE ultimately plans to ship this fuel to Yucca Mountain. K Basins sludge will be moved to T Plant and stored in cells.

The 200 Areas Effluent Treatment Facility (ETF), located in the 200 East Area (Figure 4.5), provides treatment and storage for hazardous and radioactive liquid waste. Liquid effluents are treated to remove metals, radionuclides, and ammonia, as well as to destroy organic compounds. The facility, in operation since 1995, is capable of treating 570 L (150 gal) per minute. Treated effluent is stored in verification tanks, sampled and analyzed, and discharged via pipeline to the State-Approved Land Disposal Site (SALDS), north of the 200 West Area or to the Treated Effluent Disposal Facility (TEDF) east of the 200 East Area (Poston et al. 2002).

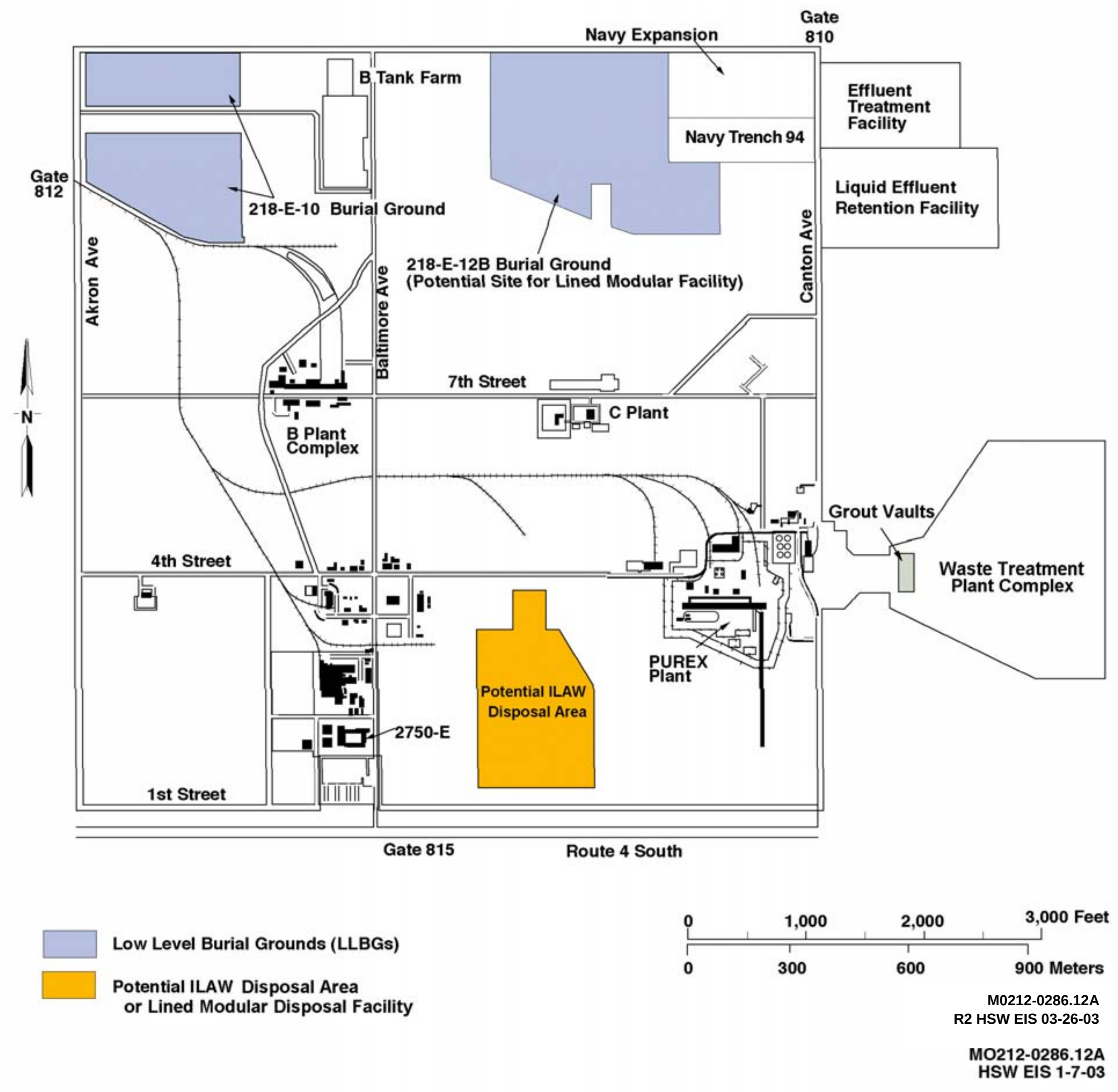

Figure 4.5. 200 East Area

The Liquid Effluent Retention Facility (LERF), located in the 200 East Area, consists of three surface impoundments for the temporary storage of process condensate from the 242-A evaporator and other aqueous wastes. Each basin has a capacity of 29.5 million L (7.8 million gal) and is constructed of two flexible high-density polyethylene membrane liners. Beneath the secondary liner is a soil/bentonite barrier. Each basin is covered by a mechanically tensioned floating membrane cover, designed to minimize evaporation of the contents and screen unwanted material from entering the basin. The facility began operation in 1994 and receives liquid waste from the RCRA- and CERCLA-regulated cleanup activities.

The 200 Areas Treated Effluent Disposal Facility (TEDF) began operation in 1995 and is a collection and disposal system for permitted waste streams. TEDF has a capacity of 12,900 L/min (3,400 gal/min). Effluent to the ponds must meet drinking water standards before discharge.

The Low Level Burial Grounds (LLBGs) are eight separate waste disposal areas located in the 200 Areas. Information summarizing specifics concerning the LLBGs are found in Appendix D.

The Biological Control Program was established in 1999 to control the growth of deep-rooted vegetation over contaminated and potentially contaminated waste sites. Deep-rooted vegetation growing on or near contaminated waste sites can take up radionuclides and other contaminants into their roots and transport them to the surface. Those contaminants can subsequently spread outside controlled areas as the plants are eaten by animals or are transported by weather. As part of the Biological Control Program, herbicides are applied to kill deep-rooted plants and noxious weeds. The effectiveness of the program is directly related to the timeliness of herbicide application. Spraying herbicides is typically performed in all seasons of the year except deep winter, although the early spring application is most critical, as all later applications depend on it for effectiveness. The elimination of contaminated plant species reduces the number of potential mechanisms for spreading contaminants, as well as reducing biological uptake by insects, small mammals, and birds. Selective herbicides are sometimes applied to minimize deep-rooted vegetation, while allowing shallow-rooted vegetation to remain for erosion control and evapotranspiration (soil water removal). The 200 Areas, including some LLBGs, contain relatively small areas of surface contamination as a result of biotic intrusion by deep-rooted plants or burrowing animals. Surface contamination is present in three of the older LLBGs (218-E-10, 218-E-12B, and 218-W-3AE) and amounts to less than 0.1 ha (0.25 ac) of contaminated surface area compared to a total of about 100 ha (250 ac) in the 200 East and 200 West Areas. As part of the Biological Control Program, areas of underground contamination, such as the LLBGs, cribs, ponds, ditches, trenches, and inactive disposal sites, are cleaned up and stabilized as needed to prevent further spread of surface contamination. Areas of surface contamination are posted, monitored, and surveyed at least annually to document their radiological status. Personal protective clothing and special procedures are required for entry into these surface contamination areas. However, surveys of the 200 Area contaminated soil sites during 2001 indicated that radionuclide concentrations were below soil concentration limits established to protect onsite workers (Poston et al. 2002).

The Environmental Restoration Disposal Facility (ERDF) for CERCLA cleanup wastes is located in the 200 Area Plateau between the 200 East and 200 West Areas (Figure 4.1). It is used for the disposal of radioactive, hazardous, dangerous, and mixed wastes generated during waste management and remediation activities at the Hanford Site. ERDF began operation in July 1996 and currently consists of 4 cells, covering an area of approximately 20 hectares (50 acres). Two cells received wastes until September 2000 and are no longer active. The third cell began receiving wastes in June 2000, and the fourth cell has not been used to date (Poston et al. 2002). Alternatives proposed in the HSW EIS include the use of ERDF for the treatment and disposal of operational wastes.

Alternatives for ILAW disposal include disposal in newly constructed trenches southwest of the Plutonium-Uranium Extraction (PUREX) Facility in the 200 East Area (Figure 4.5) or the construction of new trenches on a site just south of the CWC (Figure 4.4).

Area C, a large polygonal area approximately 368 ha (909 ac) located adjacent to the south side of State Route (SR) 240 and centered approximately on the intersection of Beloit Avenue and SR 240, has been identified as a borrow-use area for the fine-grade silt loam and coarse-grade basalt needed to cap the LLBG (Figure 4.1).

4.3 Meteorology and Air Quality

Air resources addressed in this section include climate and meteorology, atmospheric dispersion, and ambient air quality.

4.3.1 Climate and Meteorology

The Hanford Site is categorized as a mid-latitude semiarid region. Summers are warm and dry, while winters are cool with occasional precipitation. Intense heating during the day and nocturnal cooling produce large diurnal temperature variations. The Cascade Mountain range, beyond Yakima to the west, greatly influences the climate of the Hanford area by means of its rain shadow effect. The Cascade Mountains limit the Pacific Ocean maritime influence by blocking the passage of frontal systems and causing less rain and cloud-cover on the lee (east) side of the mountains. This mountain range also serves as a source of cold air drainage with a considerable effect on the wind regime at the Hanford Site.

Climatological data for the Hanford Site are compiled at the Hanford Meteorology Station (HMS). The HMS is located just outside the northeast corner of 200 West Area and about 4 km (3 mi) west of the 200 East Area. Data from the HMS are representative of the general climatic conditions for the region and describe the specific climate of the 200 Area Plateau. Meteorological measurements have been made at the HMS since late 1944. Prior to the establishment of the HMS, local meteorological observations were made at the old Hanford townsite (1912 through late 1943) and in Richland (1943-1944). A climatological summary for Hanford is provided in Hoitink et al. (2002). To accurately characterize meteorological differences across the Hanford Site, the HMS operates a network of automated monitoring stations. These stations, which currently number 30, are located throughout the site and in neighboring areas (Figure 4.6). A 124-m (408-ft) instrumented meteorological tower operates at the HMS, station 21. A 61-m (200-ft) instrumented tower operates at each of the 100-N, 300, and 400 Area meteorology-monitoring sites. Most of the other network stations utilize short-instrumented towers with heights of about 9 m (30 ft). Instrumentation on each tower is described in Table 4.1. Data are collected and processed at each monitoring site and key information is transmitted to the HMS every 15 minutes. This monitoring network has been in full operation since the early 1980s.

Table 4.8. Radionuclides Emitted to the Atmosphere at the Hanford Site, 2001 (Poston et al. 2002)

Radionuclide	Half-Life in Years	Emission, Ci (a)				
		100 Areas	200 East Area	200 West Area	300 Area	400 Area
Tritium (as HT)(b)	12.3 yr	NM(c)	NM	NM	8.9E+01	NM
Tritium (as HTO)(b)	12.3 yr	NM	NM	NM	2.4E+02	3.1E-01
Cobalt-60	5.3 yr	3.0E-08	ND(d)	ND	ND	NM
Strontium-90	29.1 yr	9.0E-06	1.2E-04(e)	1.4E-04(e)	2.8E-05(e)	NM
Technetium-99	2.13×10^5 yr	NM	NM	NM	ND	NM
Antimony-125	2.77 yr	ND	ND	ND	ND	NM
Iodine-129	1.6×10^7 yr	NM	8.4E-04	NM	NM	NM
Cesium-137	30 yr	2.1E-05	1.2E-04	5.5E-05	3.7E-06	7.5E-06(f)
Uranium-234	2.4×10^5 yr	NM	NM	NM	1.5E-10	NM
Uranium-238	4.5×10^9 yr	NM	NM	NM	3.3E-11	NM
Plutonium-238	87.7 yr	1.5E-07	4.4E-08	4.5E-06	7.7E-09	NM
Plutonium-239, 240	2.4×10^4 yr	1.2E-06	2.1E-06(g)	2.6E-04(g)	1.9E-07(g)	6.9E-07(g)
Plutonium-241	14.4 yr	1.2E-05	3.1E-06	1.4E-04	NM	NM
Americium-241	432 yr	9.5E-07	2.6E-06	4.2E-05	2.5E-08	NM
Americium-243	7380 yr	NM	NM	NM	ND	NM

(a) 1 Ci = 3.7 E+10 Bq;
(b) HTO = tritiated water vapor; HT = elemental tritium.
(c) NM = not measured;
(d) ND = not detected (i.e., either the radionuclide was not detected in any sample during the year or the average of all the measurements for that given radionuclide or type of radioactivity made during the year was below background levels).
(e) This value includes gross beta release data. Gross beta and unspecified beta results assumed to be strontium-90 for dose calculations.
(f) This value includes gross alpha release data. Gross alpha and unspecified alpha results assumed to be plutonium-239/240 for dose calculations.
(g) Analyses were conducted for gross alpha activity, but none was detected. If detected, it would have been assumed to be plutonium-239/240 for dose calculations.

uranium series; cosmogenic radionuclides, such as carbon-14 and tritium; and cosmic radiation. The radionuclides are present in varying amounts in nearly all media including soil, air, water, food, biota, and humans.

4.4 Geologic Resources

Geologic considerations for the Hanford Site include topography and geomorphology, stratigraphy, soil characteristics, and seismicity. This section, which provides an overview of the Hanford Site subsurface environment, focuses primarily on the 200 Area Plateau, located in the center of the site.

4.4.1 Topography and Geomorphology

The sites associated with the Hanford solid waste program are located on a broad flat area of the Hanford Site commonly referred to as the Central Plateau. The Central Plateau is within the Pasco Basin, a topographic, structural depression in the southwest corner of the Columbia Basin physiographic subprovince. This subprovince is characterized by generally low-relief hills with deeply carved river drainage. The elevation of the Central Plateau is approximately 200 m (650 ft) to 230 m (750 ft) above mean sea level. The Plateau decreases in elevation to the north, northwest, and east toward the Columbia River. Plateau escarpments have elevation changes of 15 m (50 ft) to 30 m (100 ft). The Pasco Basin is an area of generally low relief ranging from 120 m (390 ft) above mean sea level at the Columbia River level, to 230 m (750 ft) above mean sea level in the 200 East Area. The Pasco Basin is bounded on the north by the Saddle Mountains; on the west by Umtanum Ridge, Yakima Ridge, and the Rattlesnake Hills; on the south by Rattlesnake Mountain and the Rattlesnake Hills; and on the east by the Palouse Slope. The Pasco Basin is shown in Figure 4.9.

Surface topography at the Hanford Site is the result of the uplift of anticlinal ridges, Pleistocene cataclysmic flooding, Holocene eolian activity, and landslides (Delaney et al. 1991). Uplift of the ridges began in the Miocene Epoch (24 to 5 million years ago), concurrent with the eruption of the flood basalts. Cataclysmic flooding occurred when glacial ice dams in western Montana and northern Idaho were breached, allowing large volumes of water to spill across eastern and central Washington State.

Much of the landscape in the path of the floodwater was stripped of sediments and basalt bedrock was scoured, forming scabland topography (elevated areas underlain by flat-lying basalt flows that generally exhibit deep, dry channels scoured into the surface). The last major flood occurred approximately 13,000 years ago during the late Pleistocene Epoch. Since then, winds have locally reworked the flood sediments, depositing dune sands in the lower elevations and loess (windblown silt) around the margins of the Pasco Basin. Anchoring vegetation has stabilized many sand dunes. Where human activity or natural events have disturbed this vegetation, dunes have been reactivated. For example, dunes have been reactivated by the removal of vegetation as a consequence of a large wildfire that occurred on the Hanford site in July 2000.

The 200 Areas are situated between the Gable Mountain anticline and the Cold Creek syncline. The Gable Mountain anticline is of particular importance to the groundwater flow. Portions of this anticline have been uplifted to a point where basalt is above the current water table. These basalts have a low hydraulic conductivity and act as a barrier to horizontal groundwater flow in the unconfined aquifer.

4.4.2 Stratigraphy

The stratigraphy of the Hanford Site consists of Miocene-age and younger rocks. Older Cenozoic sedimentary and volcaniclastic rocks underlying the Miocene rocks are not exposed at the surface. Figure 4.10 summarizes the Hanford Site stratigraphy. A generalized west to east cross-section depicting site structure and topography is shown as Figure 4.11.

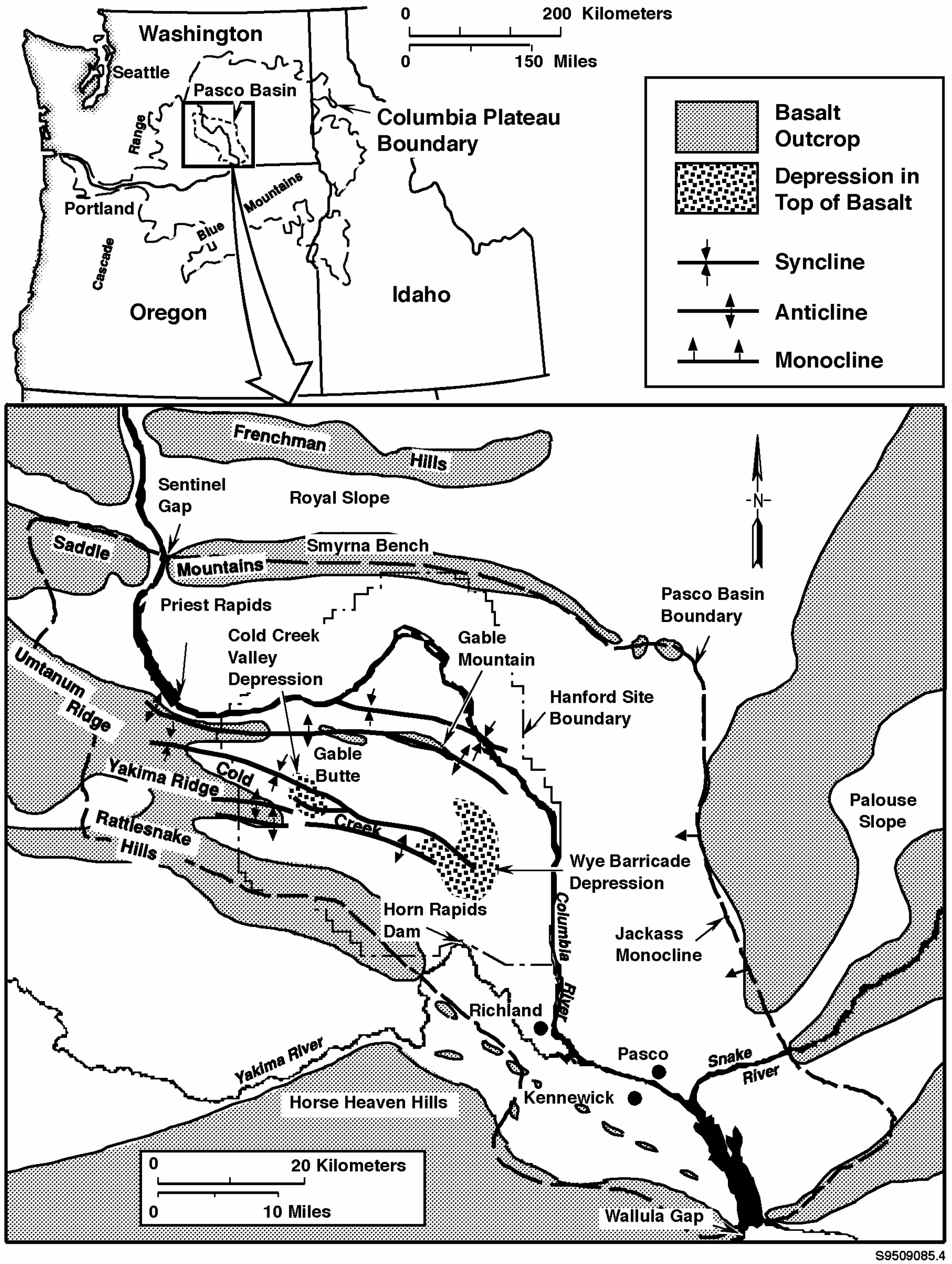

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Figure 4.9. Geographic Setting and General Structural Geology of the Pasco Basin and Hanford Site (Bergstrom et. al 1983)

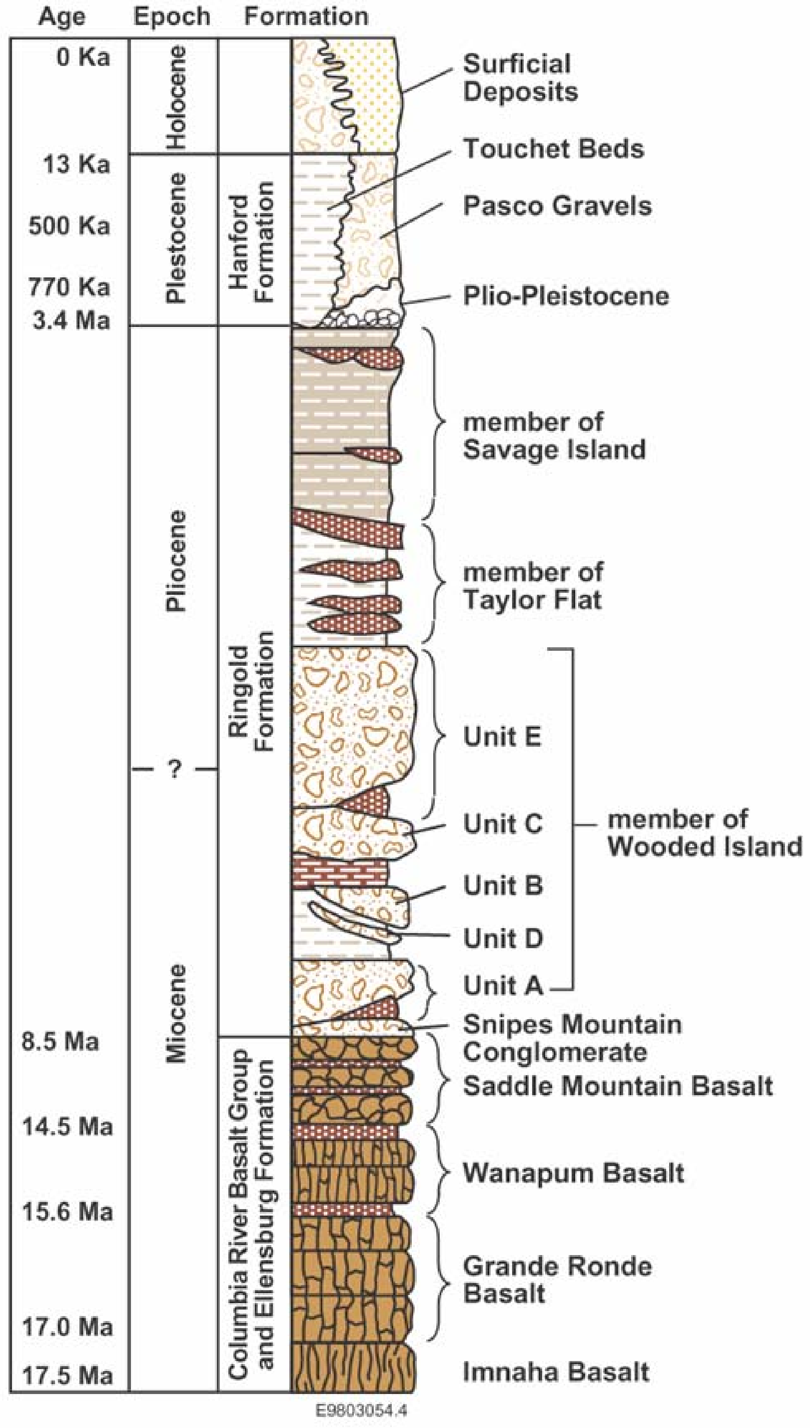

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Figure 4.10. Stratigraphic Column for the Hanford Site (Reidel et al. 1992; Ka = thousand years; Ma = million years)

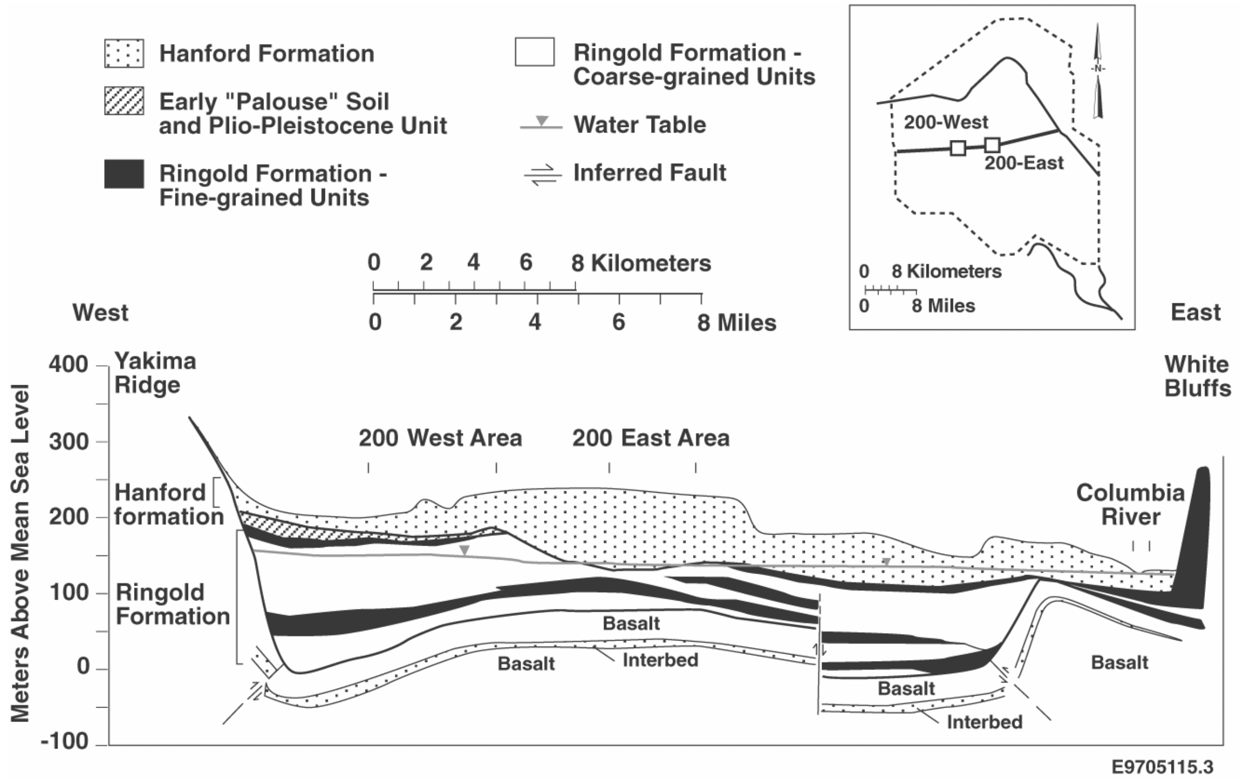

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Figure 4.11. Generalized West to East Cross-Section of the Hanford Site Structure and Topography (DOE-RL 1999)

Over 100 basalt flows of the Columbia River Basalt Group, with a total thickness exceeding 3000 m (10,000 ft), lie beneath the Hanford Site. Interbedded between many of these basalt flows are sedimentary rocks of the Ellensburg Formation, a series of sand, gravel, or silt layers that were deposited by the ancestral Columbia River system. Sediments up to 230 m (750 ft) thick overlie the Columbia River Basalt Group, and include the Ringold and Hanford formations. Thin, laterally discontinuous sedimentary deposits, referred to as the Plio-Pleistocene unit, pre-Missoula gravels, and early Palouse soil, locally separate the Ringold Formation from the overlying Hanford formation.

The Ringold Formation consists of siltstones, sandstones, and conglomerates deposited by the ancestral Columbia River system between 8 and 3 million years ago. The Ringold Formation reaches 180 m (600 ft) in thickness in the Cold Creek syncline south of the 200 West Area but thins and pinches out to the north. It is subdivided into five gravel layers referred to as Units A, B, C, D, and E that are separated by finer-grained units, including the lower mud (Figure 4.10).

The Hanford formation was deposited between 2 million years and 10,000 years ago by cataclysmic flooding from glacial Lake Missoula. The Hanford formation consists of pebble to boulder gravel, fine to coarse-grained sand, and silt, and is thickest (up to 65 m [210 ft]) under the 200 Areas. Gravel dominates the Hanford formation in the northern part of the area, while sand-dominated material is found most commonly in the central to southern parts. Holocene surficial deposits consisting of silt, sand, and gravel form a thin (less than 10-m [33-ft]) surface layer across much of the Hanford Site. Eolian (wind) and alluvial processes deposited these surficial materials.

The geology in the 200 West Area is notably different from the 200 East Area, considering a distance of only 6 km (4 mi) separates them. One of the most complete suprabasalt stratigraphic sections on the Hanford Site containing most Ringold units, the Plio-Pleistocene unit, early Palouse soil, and the Hanford formation, is present in the 200 West Area.

In the 200 East Area, most of the Ringold Formation units are present in the southern part but have been eroded in a complex pattern to the north. On the north side of the 200 East Area, the Hanford formation rests directly on the basalt, and no Ringold sediments are present. Erosion by the ancestral Columbia River and catastrophic flooding are believed to have removed the Ringold Formation from this area. A unit of questionable origin locally overlies basalt within the B-BX-BY Waste Management Area (Schalla et al. 2000). This unit, referred to informally as H/PP deposits, may be equivalent or partially equivalent to the Plio-Pleistocene unit or it may represent the earliest ice-age flood deposits overlain by a locally thick sequence of fine-grained non-flood deposits.

4.4.3 Soils

Hajek (1966) describes 15 different soil types on the Hanford Site, varying from sand to silty and sandy loam. These soils are shown in Figure 4.12 and briefly described in Table 4.9.

The majority of the 200 West Area soils are Rupert Sand; the remaining third is Burbank Loamy Sand. The 200 East Area soils are composed of Ephrata Sandy Loam, Rupert Sand, and Burbank Loamy Sand.

4.4.4 Seismicity

The Hanford Site lies in an area of relatively low seismic activity. Figure 4.13 shows the locations of known earthquakes that occurred in the Columbia Plateau between 1850 and 1969 with a Modified Mercalli Intensity (MMI) of V or more and at Richter magnitude 4.0 or more. The largest earthquake that may have occurred in the eastern Washington area shown in Figure 4.13 happened in 1872, with MMI IX and estimated magnitude near 7.0, but its location has been variously estimated from Wenatchee to British Columbia. Figure 4.14 shows the locations of all earthquakes that occurred from 1969 to 2000 at Richter magnitudes of 3.0 or more. The largest known earthquake in the Columbia Plateau occurred in 1936 near Milton-Freewater, Oregon. This earthquake had a Richter magnitude of approximately 6.0 and a maximum MMI of VII, and was followed by a number of aftershocks indicating a northeast-trending fault plane. Other earthquakes with Richter magnitudes $\geq$5 or MMI of VI occurred along the boundaries of the Columbia Plateau in a cluster near Lake Chelan in 1872 extending into the northern Cascade Range, in northern Idaho and Washington, and along the boundary between the western Columbia Plateau and the Cascade Range. Three MMI VI earthquakes have occurred within the Columbia Plateau, including one event in the Milton-Freewater, Oregon, region in 1921; one near Yakima, Washington, in

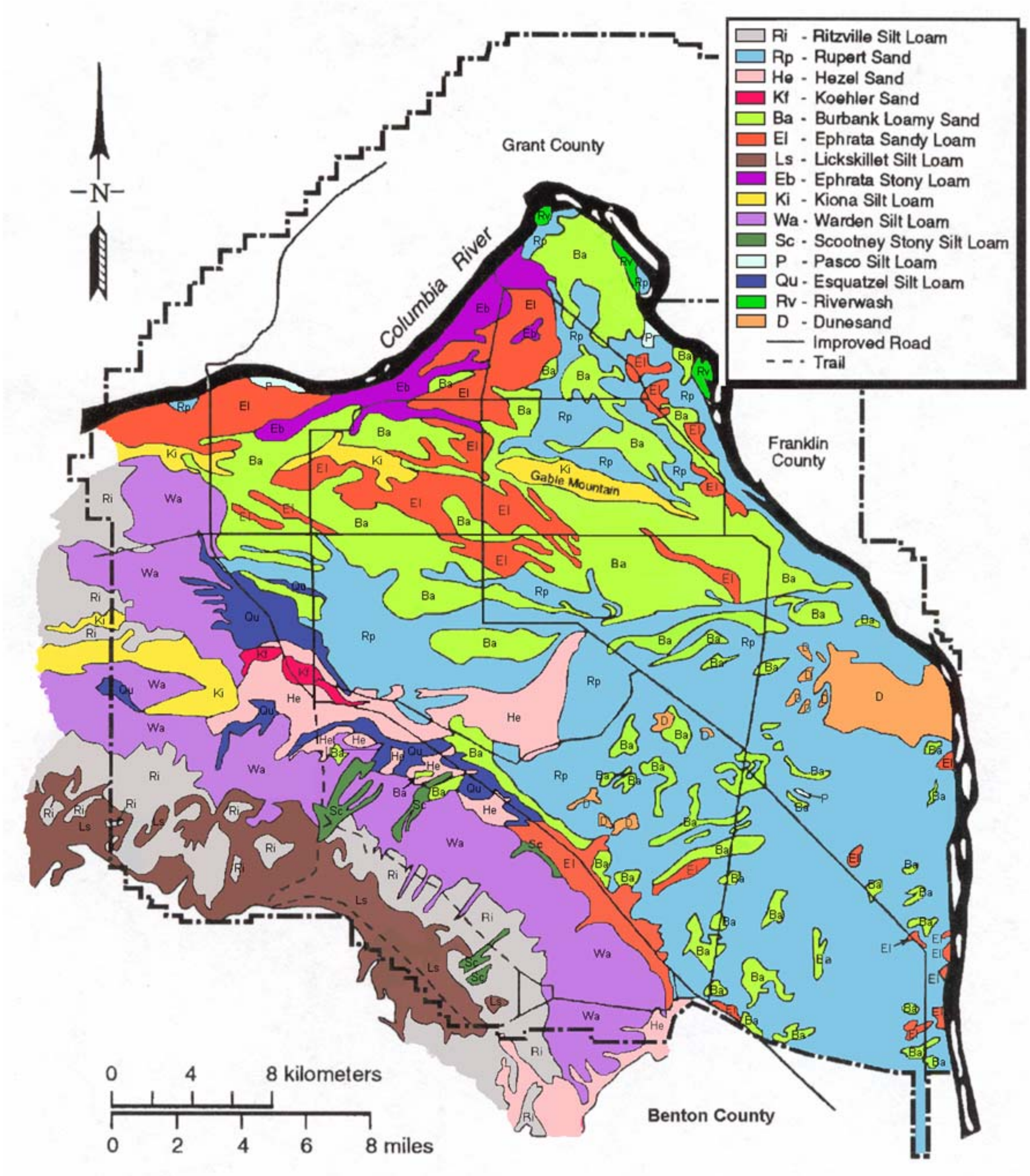

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Figure 4.12. Soil Map of the Hanford Site (after Hajak 1966). See Table 4.9 for description of soil types.

Table 4.9. Soil Types on the Hanford Site (after Hajek 1966)

Name (symbol)	Description
Ritzville Silt Loam (Ri)	Dark-colored silt loam soils midway up the slopes of the Rattlesnake Hills. Developed under bunch grass from silty wind-laid deposits mixed with small amounts of volcanic ash. Characteristically greater than 150 cm (60 in.) deep, but bedrock may occur between 75 and 150 cm (30 and 60 in.).
Rupert Sand (Rp)	One of the most extensive soils on the Hanford Site. Brown-to grayish-brown coarse sand grading to dark grayish-brown at 90 cm (35 in.). Developed under grass, sagebrush, and hopsage in coarse sandy alluvial deposits that were mantled by wind-blown sand. Hummocky terraces and dune-like ridges.
Hezel Sand (He)	Similar to Rupert sands; however, laminated grayish-brown strongly calcareous silt loam subsoil is usually encountered within 100 cm (39 in.) of the surface. Surface soil is very dark brown and was formed in wind-blown sands that mantled lake-laid sediments.
Koehler Sand (Kf)	Similar to other sandy soils on the Hanford Site. Developed in a wind-blown sand mantle. Differs from other sands in the sand mantles a lime-silica cemented Hardpan layer. Very dark grayish-brown surface layer is somewhat darker than Rupert. Calcareous subsoil is usually dark grayish-brown at about 45 cm (18 in.).
Burbank Loamy Sand (Ba)	Dark-colored, coarse-textured soil underlain by gravel. Surface soil is usually about 40 cm (16 in.) thick but can be 75 cm (30 in.) thick. Gravel content of subsoil ranges from 20 percent to 80 percent.
Ephrata Sandy Loam (El)	Surface is dark colored and subsoil is dark grayish-brown medium-textured soil underlain by gravelly material that may continue for many feet. Level topography.
Lickskillet Silt Loam (Ls)	Occupies ridge slopes of Rattlesnake Hills and slopes greater than 765 m (2509 ft) elevation. Similar to Kiona series except the surface soils are darker. Shallow over basalt bedrock, with numerous basalt fragments throughout the profile.
Ephrata Stony Loam (Eb)	Similar to Ephrata sandy loam. Differs in that many large hummocky ridges are made up of debris released from melting glaciers. Areas between hummocks contain many boulders several feet in diameter.
Kiona Silt Loam (Ki)	Occupies steep slopes and ridges. Surface soil is very dark grayish-brown and about 10 cm (4 in.) thick. Dark-brown subsoil contains basalt fragments 30 cm (12 in.) and larger in diameter. Many basalt fragments are found in surface layer. Basalt rock outcrops present. A shallow stony soil normally occurring in association with Ritzville and Warden soils.

Table 4.9. (contd)

Name (symbol)	Description
Warden Silt Loam (Wa)	Dark grayish-brown soil with a surface layer usually 23 cm (9 in.) thick. Silt loam subsoil becomes strongly calcareous at about 50 cm (20 in.) and becomes lighter colored. Granitic boulders are found in many areas. Usually greater than 150 cm (60 in.) deep.
Scootney Stony Silt Loam (Sc)	Developed along the north slope of Rattlesnake Hills; usually confined to floors of narrow draws or small fan-shaped areas where draws open onto plains. Severely eroded with numerous basaltic boulders and fragments exposed. Surface soil is usually dark grayish-brown grading to grayish-brown in the subsoil.
Pasco Silt Loam (P)	Poorly drained very dark grayish-brown soil formed in recent alluvial material. Subsoil is variable, consisting of stratified layers. Only small areas found on the Hanford Site, located in low areas adjacent to the Columbia River.
Esquatzel Silt Loam (Qu)	Deep dark-brown soil formed in recent alluvium derived from loess and lake sediments. Subsoil grades to dark grayish-brown in many areas, but color and texture of the subsoil are variable because of the stratified nature of the alluvial deposits.
Riverwash (Rv)	Wet, periodically flooded areas of sand, gravel, and boulder deposits that make up overflowed islands in the Columbia River and adjacent land.
Dunesand (D)	Miscellaneous land type that consists of hills or ridges of sand-sized particles drifted and piled up by wind. Are either actively shifted or so recently fixed or stabilized that no soil horizons have developed.

1892; and one near Umatilla, Oregon, in 1893. In the central portion of the Columbia Plateau, the largest earthquakes near the Hanford Site are two earthquakes that occurred in 1918 and 1973. These two events were magnitude 4.4 and intensity V, and were located north of the Hanford Site near Othello.

In addition, earthquake swarms of small magnitudes that are not associated with mapped faults occur on and around the Hanford Site. The region north and east of the Hanford Site is a region of concentrated earthquake swarm activity, but earthquake swarms have also occurred in several locations within the Hanford Site. The frequency of earthquakes in a swarm tends to gradually increase and decay with no one outstanding large event within the sequence. Roughly 90 percent of the earthquakes in swarms have Richter magnitudes of 2 or less. These earthquake swarms generally occur at shallow depths, with 75 percent of the events located at depths <4 km (<2.5 mi). Each earthquake swarm typically lasts several weeks to months, consists of several to 100 or more earthquakes, and the locations are clustered in an area 5 to 10 km (3 to 6.2 mi) in lateral dimension.

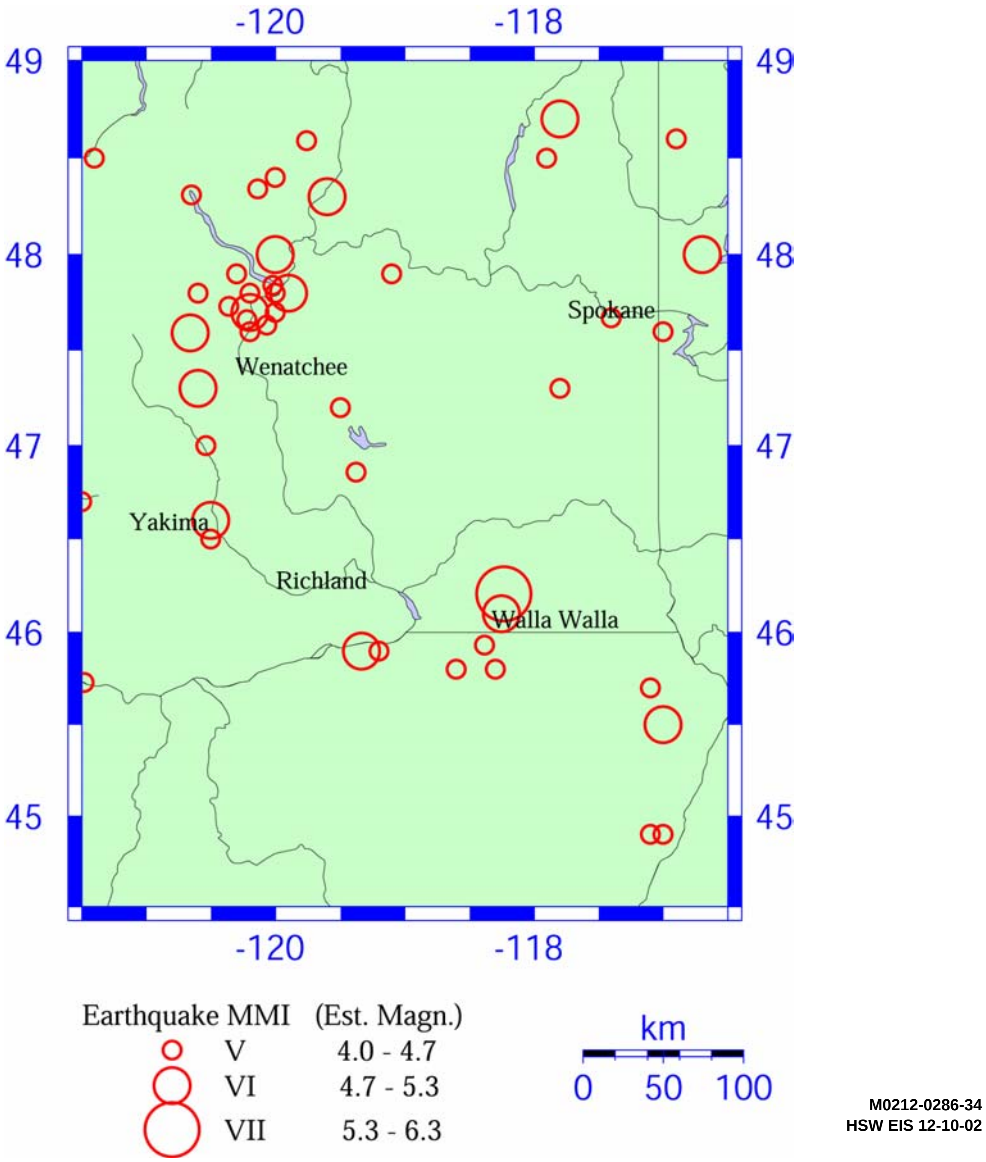

Figure 4.13. Historical Seismicity of the Columbia Plateau and Surrounding Areas. All earthquakes between 1850 and March 20, 1969, with a Modified Mercalli Intensity of V or larger or a Richter magnitude of 4.0 or larger, are shown (Rohay 1989). The magnitude ranges correspond to the original intensity estimated historically. Symbol sizes are only approximately related to those used in Figure 4.14. The uncertain location of the 1872 earthquake is not shown.

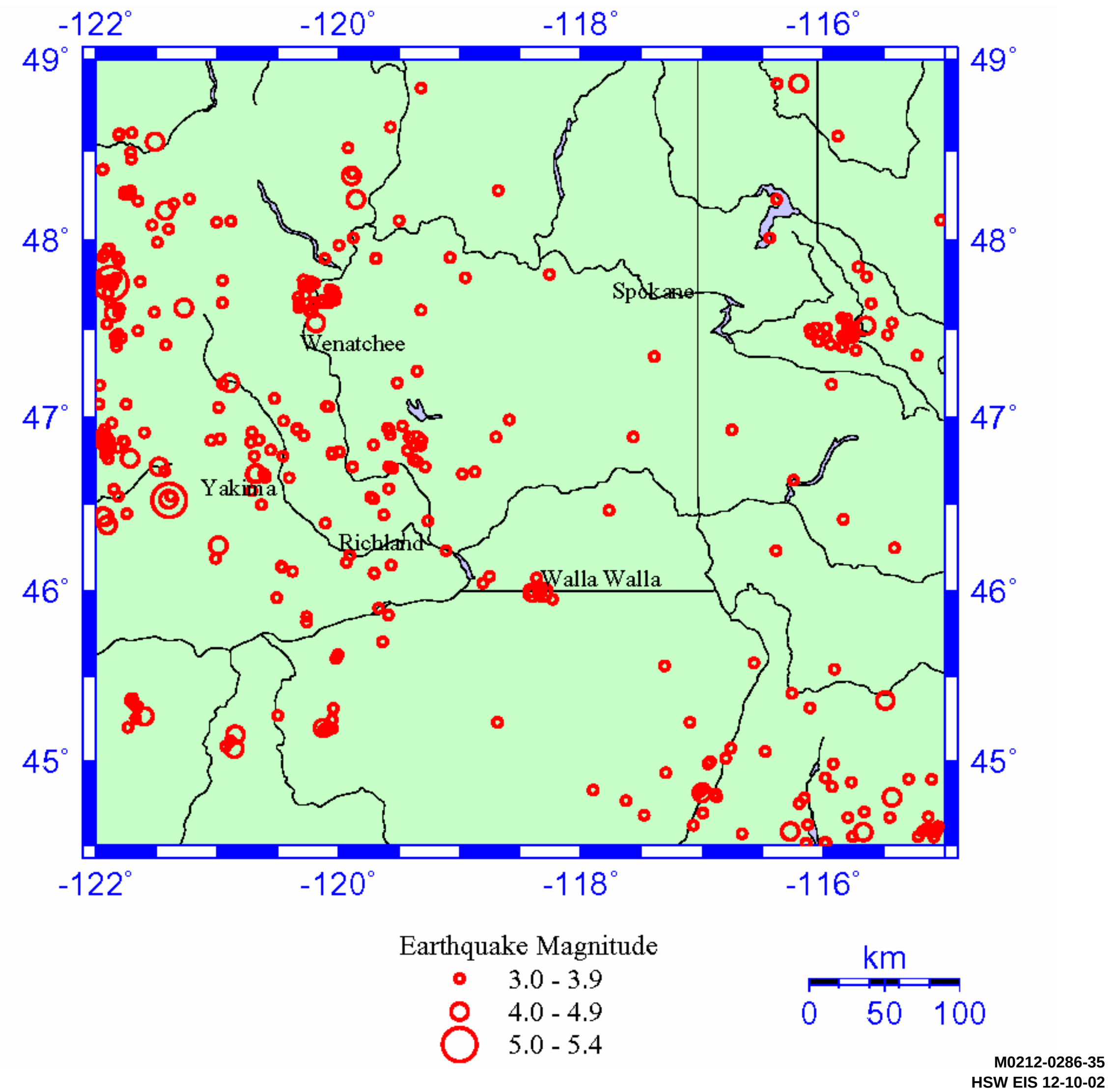

Figure 4.14. Seismicity of the Columbia Plateau and Surrounding Areas as Measured by Seismographs. All earthquakes from 3/20/1969 to 12/31/2000 with Richter magnitude 3 or larger are shown. Data sources: Council of the National Seismic System (CNSS 2001), University of Washington Geophysics Program (UWGP 2001).

Estimates for the earthquake potential of structures and zones in the central Columbia Plateau have been developed during the licensing of nuclear power plants at the Hanford Site. In reviewing the operating license application for the Washington Public Power Supply System (now Energy Northwest) Columbia Generating Station (formerly WNP-2), the U.S. Nuclear Regulatory Commission (NRC) concluded that four earthquake sources should be considered for seismic design: the Rattlesnake-Wallula alignment, Gable Mountain, a floating earthquake in the tectonic province, and a swarm area (NRC 1982).

For the Rattlesnake-Wallula alignment, which passes along the southwest boundary of the Hanford Site, the NRC estimated a maximum Richter magnitude of 6.5; for Gable Mountain, an east-west structure that passes through the northern portion of the Hanford Site, a maximum Richter magnitude of 5.0 was estimated. These estimates were based upon the inferred sense of slip, the fault length, and the fault area. The floating earthquake for the tectonic province was developed from the largest event located in the Columbia Plateau, the Richter magnitude 5.75 Milton-Freewater earthquake. The maximum swarm earthquake for the purpose of Columbia Generating Station seismic design was a Richter magnitude 4.0 event, based on the maximum swarm earthquake in 1973. (The NRC concluded the actual magnitude of this event was smaller than estimated previously.)

Probabilistic seismic hazard analyses have been used to determine the seismic ground motions expected from multiple earthquake sources, and these are used to design or evaluate facilities on the Hanford Site. The most recent Hanford Site-specific hazard analysis (Geomatrix 1994, 1996) estimated that 0.10 g (1 g is the acceleration of gravity) horizontal acceleration would be experienced on average every 500 yr (or with a 10 percent chance every 50 yr). This study also estimated that 0.2 g would be experienced on average every 2500 yr (or with a 2 percent chance in 50 yr). These estimates are in approximate agreement with the results of national seismic hazard maps produced by the U.S. Geological Survey (Frankel et al. 1996).

The Pacific Northwest National Laboratory (PNNL) and the University of Washington (UW) operate a 40-station seismic monitoring network in eastern Washington, which has been used to determine the locations and magnitudes of earthquakes since 1969. In addition, PNNL operates a network of five strong motion accelerometers near Hanford facilities to measure ground motion levels from larger earthquakes (Hartshorn et al. 2001).

4.5 Hydrology

Hydrology considerations at the Hanford Site include surface water, the vadose zone, and groundwater. The vadose zone is the unsaturated or partially saturated region between ground surface and the saturated zone. Water in the vadose zone is called soil moisture. Groundwater refers to water within the saturated zone. Permeable saturated units in the subsurface are called aquifers.

4.5.1 Surface Water

Surface water at Hanford includes the Columbia River, Columbia riverbank seepage, springs, and ponds. Intermittent surface streams, such as Cold Creek, may also contain water after large precipitation or snowmelt events. In addition, the Yakima River flows near a short section of the southern boundary of the Hanford Site (Figure 4.15).

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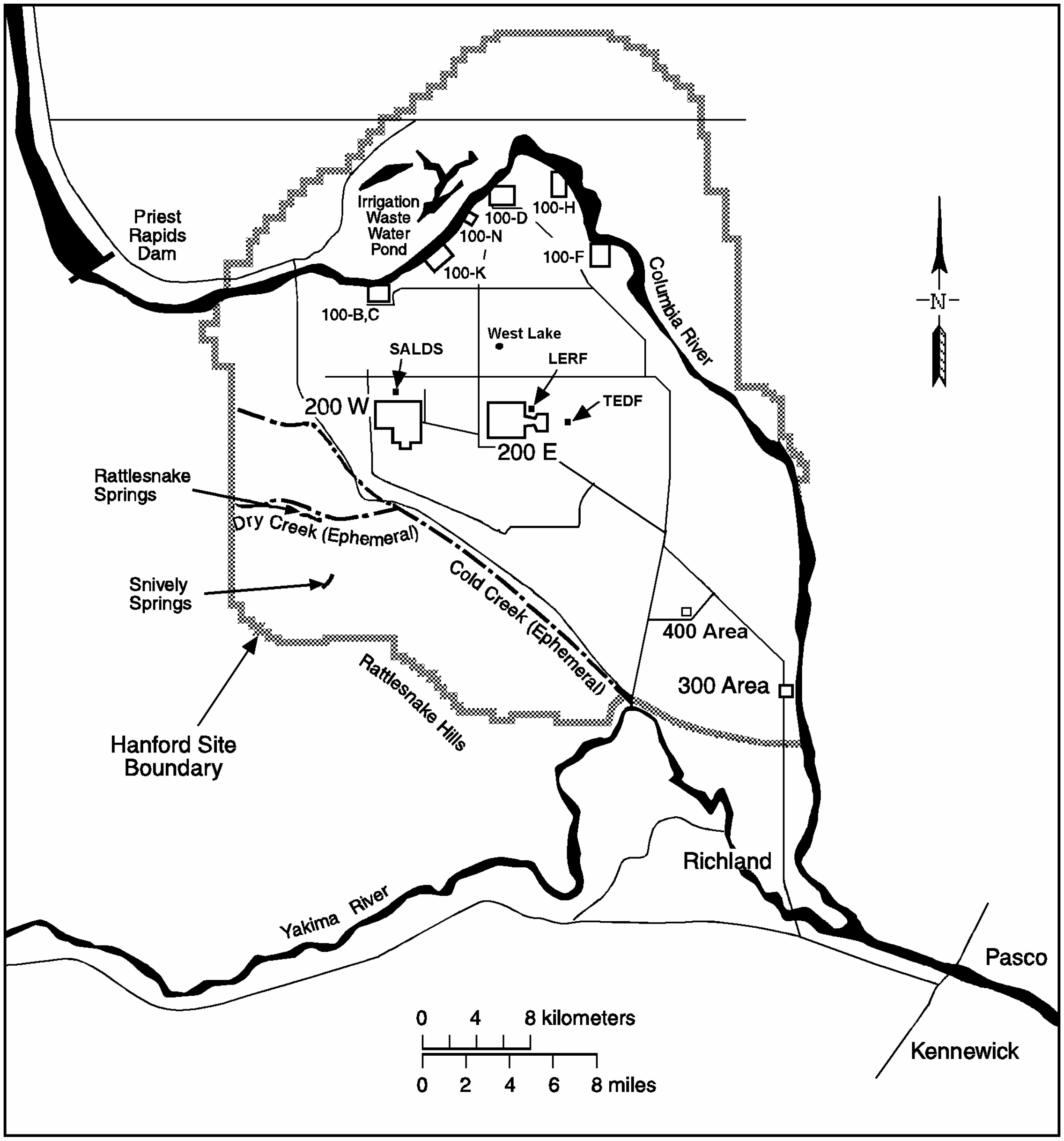

LERF – Liquid Effluent Retention Facility
SALDS – State-Approved Land Disposal Structure
TEDF – Treated Effluent Disposal Facility

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Figure 4.15. Surface Water Features Including Rivers, Ponds, Major Springs, Ephemeral Streams, and Artificial Ponds on the Hanford Site (after Neitzel 2002a)

4.5.1.1 Columbia River

In terms of total flow, the Columbia River is the second largest river in the contiguous United States and is the dominant surface-water body on the Hanford Site. The original selection of the Hanford Site for plutonium production and processing was based, in part, on the abundant water provided by the Columbia River.

Originating in the mountains of eastern British Columbia, Canada, the Columbia River drains an area of about 680,000 km^2 (260,000 mi^2) en route to the Pacific Ocean. The primary uses of the Columbia River include the production of hydroelectric power, irrigation of cropland in the Columbia Basin, and transportation of materials by barge. Many communities located on the Columbia River rely on the river as their source of drinking water (see Section 4.8.9). The Columbia River is also used as a source of drinking water and industrial water for several Hanford Site facilities (Dirkes 1993). In addition, the Columbia River is used extensively for recreation that includes fishing, bird hunting, boating, sail boarding, water skiing, diving, and swimming.

4.5.1.2 Springs and Streams

Rattlesnake Springs and Snively Springs, two small spring-fed streams on the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE), are the only naturally occurring streams on the Hanford Site. Rattlesnake Springs, located 10 km (6 mi) west of the 200 West Area, forms a small surface stream that flows for approximately 2.5 km (1.6 mi) before it disappears into the ground as a result of seepage. Base flow of this stream is about 0.01 m^3/s (0.4 ft^3/s) (Cushing and Wolf 1982). Snively Springs is located to the west and at a higher elevation than Rattlesnake Springs.

Cold Creek and its tributary, Dry Creek, are ephemeral streams within the Yakima River drainage system in the southwestern portion of the Hanford Site. These streams drain areas to the west of the Hanford Site and cross the southwestern part of the site toward the Yakima River. When it occurs, surface flow infiltrates rapidly and disappears into the surface sediments in the western part of the site.

4.5.1.3 Columbia Riverbank Seepage

The seepage of groundwater into the Columbia River has been known to occur for many years. Riverbank seeps were documented along the Hanford Reach long before Hanford operations began during the Second World War (Jenkins 1922). Seepage occurs below the river surface and also on the exposed riverbank, particularly noticeable at low-river stage. The seeps flow intermittently, apparently influenced primarily by changes in river level. Groundwater contaminants attributed to Hanford operations reach the Columbia River through these seeps.

4.5.1.4 Onsite Ponds and Artificial Water Bodies

West Lake is the only naturally occurring pool on the Hanford Site. West Lake is several hectares in size and is located approximately 8 km (5 mi) northeast of the 200 West Area and about 3 km (2 mi) north of the 200 East Area. It is situated in a topographically low-lying area and is sustained by groundwater inflow resulting from an intersection with the groundwater table. Water levels of West Lake fluctuate with water table elevation, which is influenced by wastewater discharge in the 200 Areas. The water level and size of the lake has been decreasing over the past several years because of reduced wastewater discharge. West Lake water quality samplings demonstrate elevated dissolved solids and nitrates. Total dissolved solids are approximately 15,000 mg/L, and pH is over 9. Nitrate concentrations are about 1.8 mg/L and ammonia concentrations are about 2.6 mg/L (Neitzel 2002a). Evaporation has also led to relatively high levels of uranium due to concentration of natural sources (Poston et al. 1991).

The Nature Conservancy (Hall 1998) has documented the existence of several naturally occurring vernal ponds near Gable Mountain and Gable Butte. These ponds appear to occur where a depression is present in a relatively shallow buried basalt surface. Water collects within the depression over the winter, resulting in a shallow pond that dries during the summer months. The formation of these ponds in any particular year depends on the amount and temporal distribution of precipitation and snowmelt events. The vernal ponds ranged in size from about 6.1 m x 6.1 m to 45.73 m x 30.5 m (20 ft x 20 ft to 150 ft x 100 ft), and were found in three clusters. Approximately ten vernal ponds were documented at the eastern end of Umtanum Ridge, six or seven were observed in the central part of Gable Butte, and three were found at the eastern end of Gable Mountain.

The 200 Area Treated Effluent Disposal Facility (TEDF) consists of two man-made disposal ponds. These ponds are each 2 hectares (5 acres) in size and receive industrial wastewater permitted in accordance with the State Waste Discharge Permit Program (WAC 173-216). The treated effluent percolates into the ground from the disposal ponds.

The Liquid Effluent Retention Facility (LERF) is a wastewater holding facility consisting of three surface impoundments with a total capacity of 29.5 million L (7.8 million gal) each. The LERF provides storage until the waste is transferred to the ETF for final treatment. These ponds are equipped with double liners, a leak detection system, and floating covers (Poston et al. 2002). The LERF also includes piping and pumping systems, utilities, and a basin operations structure. Aqueous waste from the LERF is transferred to the 200 Area Effluent Treatment Facility (ETF) via pipelines.

The State-Approved Land Disposal Structure (SALDS) is located north of the 200 West Area. The SALDS is a Washington State permitted facility containing drain fields where tritium-bearing wastewater discharge is authorized as per the permit.

4.5.1.5 Floodplains and Runoff

No floodplains are found in the 200 Areas. Although floods in Cold Creek and Dry Creek have occurred historically, no historic flood events have been observed in the 200 Areas. The flooding of Cold Creek and Dry Creek infiltrated into the permeable sediments before reaching the 200 Areas.

Natural runoff generated onsite or from offsite up-gradient sources is not known to occur in the 200 Areas. Measurable runoff occurs during brief periods in two locations, Cold Creek Valley and Dry Creek Valley west and southwest of the 200 West Area (Newcomb et al. 1972). This surface runoff either infiltrates into the valley floor or evaporates. During periods of unusually rapid snowmelt or heavy rainfall, surface runoff extends beyond Rattlesnake Springs in the upper part of Dry Creek. However, this runoff quickly infiltrates into the alluvial sediments of Cold Creek Valley.

Evaluation of flood potential is conducted in part through the concept of the probable maximum flood, which is determined from the upper limit of precipitation falling on a drainage area and other hydrologic factors, such as antecedent moisture conditions, snowmelt, and tributary conditions that could result in maximum runoff. The probable maximum flood for the Columbia River downstream of Priest Rapids Dam has been calculated to be 40,000 m^3/s (1.4 million ft^3/s) and is greater than the 500-year flood. This flood would inundate parts of the 100 Areas located adjacent to the Columbia River, but the Central Plateau region of the Hanford Site would remain unaffected (DOE 1986).

In 1980, a flood risk analysis of Cold Creek, an ephemeral stream within the Yakima River drainage system, was conducted as part of the characterization of a basaltic geologic repository for high-level radioactive waste. Such design work is usually done according to the criteria of Standard Project Flood or probable maximum flood, rather than the worst-case or 100-year flood scenario. Therefore, in lieu of 100- and 500-year floodplain studies, a probable maximum flood evaluation was performed (Skaggs and Walters 1981). The probable maximum flood discharge rate for the lower Cold Creek Valley was 2265 m^3/s (80,000 ft/s) compared to 564 m^3/s (19,900 ft^3/s) for the 100-year flood. Modeling indicated that State Route (SR) 240 along the Hanford Site's southwestern and western areas would not be usable (Figure 4.16). Water from a probable maximum flood could potentially reach the southwest corner of the 200 West Area, but not the waste management areas.

4.5.2 Hanford Site Vadose Zone

The vadose zone is that part of the subsurface found between the ground surface and the top of the saturated zone. At the Hanford Site, the thickness of the vadose zone ranges from 0 m (0 ft) near the Columbia River to greater than 100 m (328 ft) beneath parts of the central plateau (Hartman 2000). Unconsolidated glacio-fluvial sands and gravels of the Hanford formation make up most of the vadose zone. In some areas, however, such as west and south of 200 East Area and in some of the 100 Areas, the fluvial-lacustrine sediments of the Ringold Formation make up the lower part of the vadose zone.

Moisture movement through the vadose zone is important at the Hanford Site because it is the driving force for migration of most contaminants. Radioactive and hazardous wastes in the soil column from past intentional liquid-waste disposals, unplanned leaks, solid waste disposal, and underground tanks are potential sources of future vadose zone and groundwater contamination. Contaminants may continue to move slowly downward for long periods (tens to hundreds of years depending on recharge rates) after termination of liquid waste disposal.

Except for SALDS, the 200 Area TEDF ponds, and septic drain fields, artificial recharge (the process by which excess surface water is directed into the ground) to the vadose zone ended in the mid-1990s. Natural infiltration in the vadose zone causes older preexisting water to be displaced downward by newly infiltrated water. The amount of recharge at any particular site is highly dependent on the soil type and the presence of vegetation. Usually, vegetation reduces the amount of infiltration through the biological process of evapotranspiration.

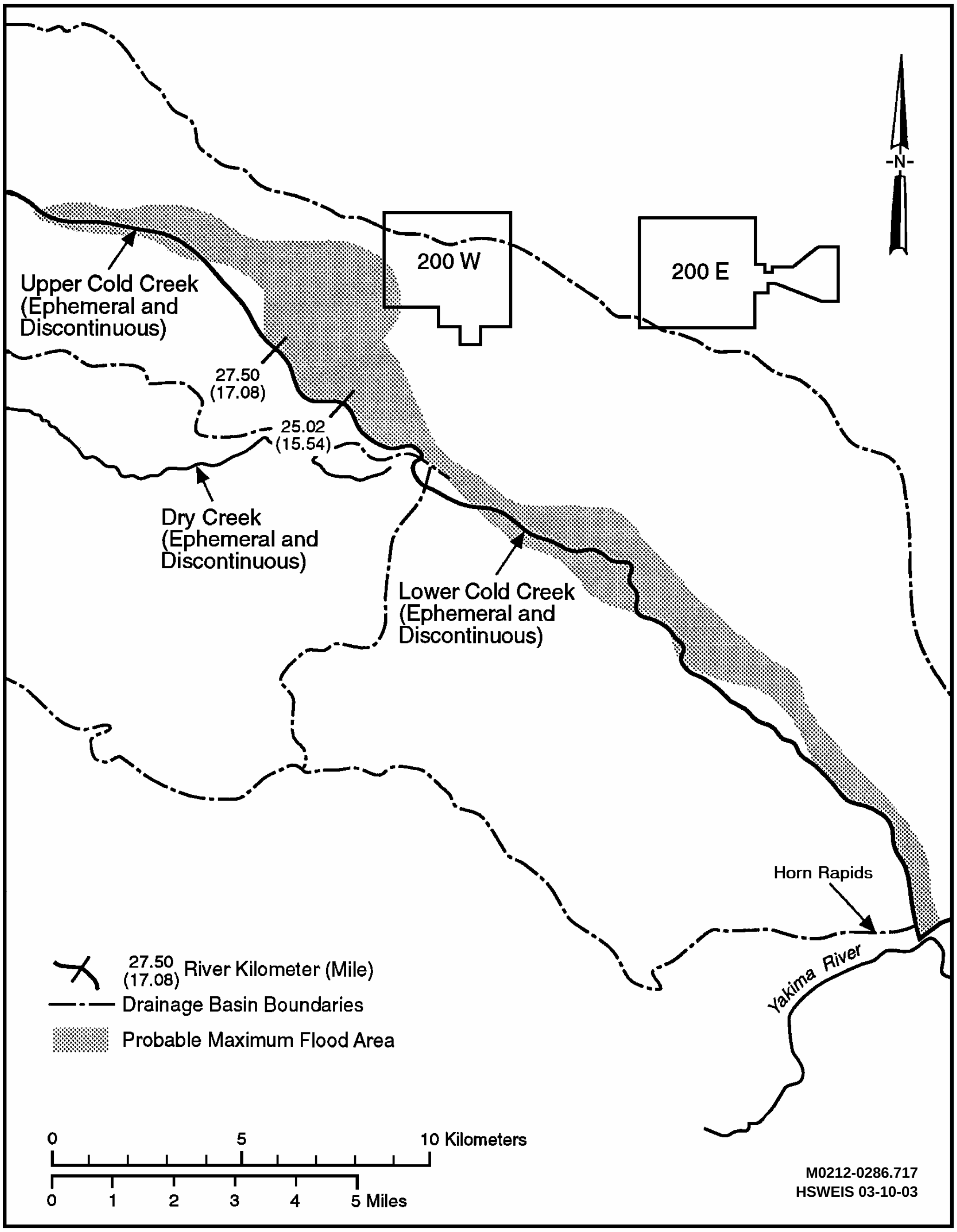

Figure 4.16. Extent of Probable Maximum Flood in Cold Creek Area (Skaggs and Waters 1981)

Although most natural recharge is probably uniform flow (Jones et al. 1998), the vadose zone stratigraphy influences the movement of liquid through the soil column. Where conditions are favorable, lateral spreading of liquid effluent or local perched water zones may develop. Perched water zones form where downward moving moisture accumulates on top of low-permeability soil lenses or highly cemented horizons.

Preferential flow may also occur along discontinuities, such as clastic dikes and fractures. Clastic dikes are a common geologic feature in the suprabasalt sediments at the Hanford Site. Their most important feature is their potential to either enhance or inhibit vertical and lateral movement of contaminants in the subsurface, depending on textural relationships. Preferential flow may also take place via old, abandoned, or poorly sealed vadose zone and groundwater wells.

Subsurface source characterization, sediment sampling and characterization, and vadose zone monitoring are employed to describe the current and future configuration of contamination in the vadose zone.

4.5.2.1 Vadose Zone Contamination

The Hanford Site has more than 800 former (referred to as past-practice) liquid disposal facilities. Radioactive liquid waste was discharged to the vadose zone through reverse (injection) wells, French drains, cribs, ponds, trenches, and ditches. Over the last 56 years, 1.5 to 1.7 billion m^3 (396 to 449 billion gal) of effluent were disposed to the soils (Gephart 1999). Most effluent was released in the 200 Areas. The major groundwater contaminant plumes emanating from the 200 Areas are tritium and nitrate. The major source for both contaminants was liquid discharges resulting from chemical processing activities. These discharges also included technetium-99 and iodine-129 which, like tritium and nitrate, are mobile in groundwater. Carbon tetrachloride was also discharged to cribs near the Plutonium Finishing Plant in the 200 West Area. Vadose zone sources for these contaminants almost certainly remain beneath many past-practice disposal facilities.

Approximately 280 unplanned releases in the 200 Areas also contributed contaminants to the vadose zone (DOE-RL 1997). Many of these were releases from underground tanks and have contributed significant contamination to the vadose zone. In addition, approximately 50 active and inactive septic tanks and drain fields and numerous radioactive and non-radioactive landfills and dumps have impacted the vadose zone (DOE-RL 1997). The landfills are and were used to dispose of solid wastes, which, in most instances, are easier to locate, retrieve, and remediate than are liquid wastes.

A total of 149 single-shell tanks and 28 double-shell tanks have been used to store high-level radioactive and mixed wastes in the 200 Areas. The wastes resulted from uranium and plutonium recovery processes and, to a lesser extent, from strontium and cesium recovery processes. Of the single-shell tanks, 67 are assumed to have leaked an estimated total of 2839 to 3975 m^3 (750,000 to 1,050,000 gal) of contaminated liquid to the vadose zone (Hanlon 2001). The three largest tank leaks were 435,320 L (115,000 gal), 37,850 to 1,048,560 L (10,000 to 277,000 gal), and 265,980 L (70,365 gal). The average tank leak was between 41,640 and 60,565 L (11,000 and 16,000 gal) (Hanlon 2001).

The amount of contamination remaining in the vadose zone is uncertain. Several compilations of vadose zone contamination have been formulated through the past years. DOE-RL (1997) and Kincaid et al. (1998) contain the most recent inventories of contaminants disposed to past-practice liquid disposal facilities in the 200 Areas. Dorian and Richards (1978) list contaminant inventories disposed to most 100 Area past-practice facilities. Anderson (1990) lists inventories of effluents sent to single-shell tanks. A series of reports estimate the curies of gamma-emitting radionuclides and the volumes of contaminated soil associated with each single-shell tank farm. (See the series of online reports at the Hanford Tank Farm Vadose Zone Project (http://www.gjo.doe.gov/programs/hanf/HTFVZ.html). Their estimates for all locations for the three most widespread contaminants are 8901 Ci of cesium-137 in 395,550 m^3 of soil, 0.8611 Ci of europium-154 in 30,133 m^3 of soil, and 0.7424 Ci of cobalt-60 in 74,369 m^3 of soil.

4.5.2.2 Vadose Zone Monitoring and Characterization Activities

Although disposal of untreated wastewater to the ground stopped in 1995 (Schmidt et al. 1996), contaminant movement still occurs in the soil column beneath past-practice sites. Vadose zone monitoring/characterization is one approach for evaluating the status of possible leaks or remobilization of contaminants caused by natural or artificial infiltration. The objectives of vadose-zone monitoring/characterization are to document the location of the contamination, determine the moisture and contaminant movement in the soil column, and assess the effectiveness of remedial actions.

DOE has been conducting an expedited response action to treat carbon tetrachloride contamination since 1992 at the 200-ZP-2 Operable Unit, located in the 200 West Area, with the concurrence of the EPA and the Washington State Department of Ecology (Ecology). Soil-vapor extraction is being used to remove carbon tetrachloride from the vadose zone as part of this expedited response action (Rohay 1999; Hartman et al. 2001). To track the effectiveness of the remediation effort, measurement of soil-vapor concentrations of chlorinated hydrocarbons are made at the inlet to the soil-vapor-extraction system and at individual off-line wells and probes through the soil-vapor extract sites. As of September 1999, 76,500 kg (168,683 lb) of carbon tetrachloride had been removed from the groundwater and vadose zone beneath the 200 West Area. The soil-vapor concentrations monitored deep within the vadose zone during the past few years suggest that soil vapor-extraction remediation has removed a substantial amount of the carbon tetrachloride from the vadose zone (Hartman et al. 2001).

Baseline vadose zone characterization has been conducted at the single-shell tank farms since 1995. Spectral gamma-ray logging detectors were used in approximately 800 boreholes at the 149 single-shell tanks to locate man-made gamma-emitting radionuclides in the soil. During the initial logging of the drywells, several areas were found with levels of contamination high enough to effectively saturate the gamma-ray detectors. Those areas were relogged in 2000 with more robust systems. The maximum radionuclide concentration (cesium-137) detected was about 100 million pCi/g. In addition, during 2000, 88 boreholes that were logged previously were relogged to determine whether contamination continues to move in the vadose zone. Data acquired in 22 of the 88 boreholes showed increases in concentration, suggesting possible continued contaminant movement through the vadose zone (Poston et al. 2001).

During 1999, boreholes around 25 inactive 200 East Area facilities, termed specific retention facilities, were monitored by spectral gamma-ray and neutron moisture methods. Specific retention facilities were designed to use the moisture-retention capability of the soil to retain contaminants. Ideally, liquids disposed to specific retention facilities would be limited to less than about 10 percent of the soil volume between the facility and the groundwater, resulting in retention of the liquid in the soils (Waite 1991). Significant quantities of radionuclides and chemicals were discharged to specific retention trenches with some trenches receiving up to 1570 Ci of cesium-137, 475 Ci of strontium-90, and 89 Ci of technetium-99. The volume of liquid discharged to each trench is thought to be insufficient to drive contaminants through the vadose zone to groundwater. Therefore, the discharged contaminants remain in the soil column and these sites represent potential sources for future groundwater contamination at the Hanford Site. Of the 29 boreholes logged, 4 had previous spectral gamma-logs for comparison. Logs from two of those boreholes showed that changes in subsurface distribution of man-made radionuclides had occurred since 1992 (Horton and Randall 2000), indicating continued movement of contaminants in the vadose zone years after the facilities ceased operations.

4.5.3 Groundwater

Groundwater originates as surface water, either from natural recharge, such as rain, streams, and lakes, or from artificial recharge, such as reservoirs, excess irrigation, canal seepage, deliberate augmentation, industrial processing, and wastewater disposal.

4.5.3.1 Hanford Site Aquifer System

Groundwater beneath the Hanford Site is found in an upper unconfined aquifer system and deeper basalt-confined aquifers. The unconfined aquifer system is also referred to as the suprabasalt aquifer system because it is within the sediments that overlie the basalt bedrock. Low-permeability layers of fine-grained sediment locally confine portions of the suprabasalt aquifer system. However, because the entire suprabasalt aquifer system is interconnected on a sitewide scale, it is referred to in this report as the Hanford unconfined aquifer system.

Basalt-Confined Aquifer System. Relatively permeable sedimentary interbeds and the more porous tops and bottoms of basalt flows form the confined aquifers within the Columbia River Basalts. The horizontal hydraulic conductivities of most of these aquifers fall in the range of 10^{-10} to 10^{-4} m/s (3 x 10^{-10} to 3 x 10^{-4} ft/s). Saturated but relatively impermeable dense interior sections of the basalt flows have horizontal hydraulic conductivities ranging from 10^{-15} to 10^{-9} m/s (3 x 10^{-15} to 3 x 10^{-9} ft/s), about five orders of magnitude lower than some of the confined aquifers that lie between these basalt flows (DOE 1988). 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 communication with the unconfined aquifer system (Hartman et al. 2001; DOE 1988; Spane 1987).

Recharge to the upper basalt-confined aquifer is believed to occur along the margins of the Pasco Basin as a result of precipitation infiltration and surface water where the basalt and interbeds are exposed at ground surface. Recharge may also occur through the Hanford/Ringold aquifer system, where a downward hydraulic gradient exists between the Ringold Formation and the confined and upper basalt-confined aquifers or from deeper basalt aquifers having an upward gradient.

South of the Umtanum Ridge/Gable Mountain area, groundwater in the upper basalt-confined aquifer system generally flows from west to east across the Hanford Site toward the Columbia River. The elevated regions to the west and southwest of the Site are believed to be recharge areas for the system, and the Columbia River represents a discharge area.

Unconfined Aquifer System. The unconfined aquifer is generally located in the unconsolidated to semi-consolidated Ringold and Hanford formation sediments that overlie the basalt bedrock. Where it is below the water table, the coarse-grained Hanford formation makes up the most permeable zones of the unconfined aquifer system.

The saturated thickness of the unconfined aquifer on the Hanford Site is greater than 61 m (200 ft) in some areas but pinches out along the flanks of the basalt ridges. Depth to the water table ranges from less than 0.3 m (1 ft) near the Columbia River to more than 106 m (348 ft) near the 200 Areas. Perched water-table conditions have been encountered in sediments above the unconfined aquifer in the 200 West Area (Airhart 1990; Last and Rohay 1993) and in irrigated offsite areas east of the Columbia River (Brown 1979). Because the Ringold sand and gravel sediments are more consolidated and are partially cemented, they are about 10 to 100 times less permeable than the sand and gravel sediments of the overlying Hanford formation. Horizontal hydraulic conductivities of sand and gravel facies within the Ringold Formation generally range from about 0.27 to 2.7 m/d (0.9 to 9 ft/d), compared to 305 to 3050 m/d (1000 to 10,000 ft/d) for the Hanford formation (DOE 1988). Mud-dominated units with the Ringold Formation are relatively impermeable.

Groundwater in the unconfined aquifer at Hanford generally flows from recharge areas in the elevated region near the western boundary of the Hanford Site, and toward the Columbia River on the eastern and northern boundaries. The Columbia River is the primary discharge area for the unconfined aquifer. A map showing water table elevations for the Hanford Site and adjacent areas across the Columbia River is displayed in Figure 4.17. Figure 4.18 details the water table elevations for the 200 Areas. The Yakima River borders the Hanford Site on the southwest and is generally regarded as a source of recharge. Along the Columbia River shoreline, daily river level fluctuations may result in water table elevation changes of up to 3 m (10 ft). As the river stage rises, a pressure wave is transmitted inland through the groundwater.

Natural area recharge from precipitation across the entire Hanford Site ranges from about 0 to 10 cm/yr (0 to 4 in./yr), but is probably less than 2.5 cm/yr (1 in./yr) over most of the site (Gee and Heller 1985; Bauer and Vaccaro 1990; Fayer and Walters 1995). Between 1944 and the mid-1990s, the volume of artificial recharge from Hanford wastewater disposal was significantly greater than the natural recharge. An estimated 1.7×10^{12} L (4.44×10^{11} gal) of liquid was discharged to disposal ponds, trenches, and cribs during this period (Hartman et al. 2001). Because of the reduction in discharges, groundwater levels are falling, particularly around the operational areas (Hartman 2000).

After the beginning of Hanford operations, the water table rose about 27 m (89 ft) under the U Pond disposal area in the 200 West Area and about 9 m (30 ft) under disposal ponds near the 200 East Area. The volume of water that was discharged to the ground at the 200 West Area was actually less than that discharged at the 200 East Area. However, the lower conductivity of the aquifer near the 200 West Area inhibited groundwater movement in this area resulting in a higher groundwater mound. The presence of the groundwater mounds locally affected the direction of groundwater movement, causing radial flow from the discharge areas. Zimmerman et al. (1986) documented changes in water table elevations between 1950 and 1980. Until about 1980, the edge of the mounds migrated outward from the sources over time. Water levels have declined over most of the Hanford Site since 1984 because of decreased

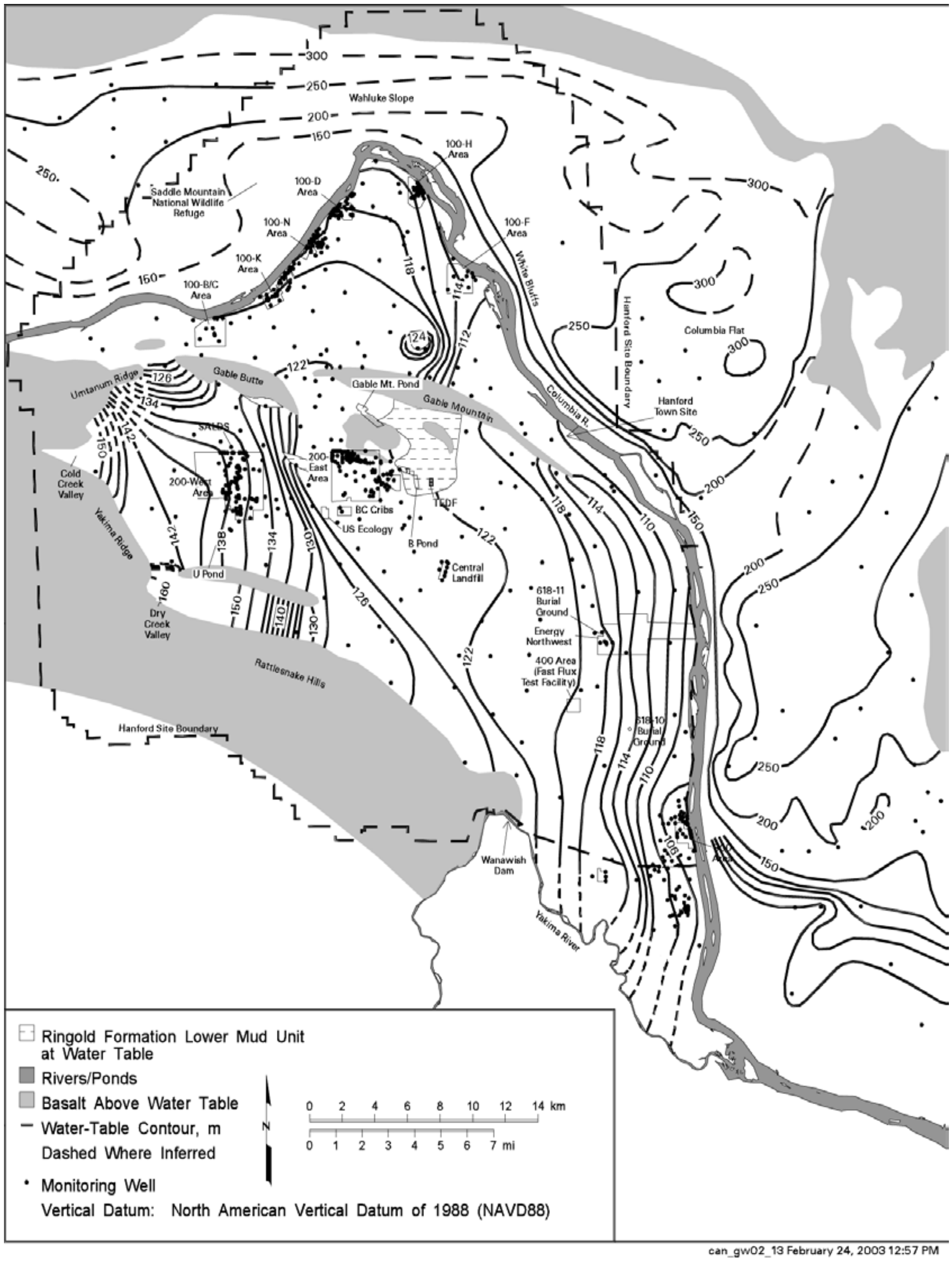

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Figure 4.17. Groundwater Elevations for the Unconfined Aquifer at Hanford, March 2001 (after Hartman et al. 2002)

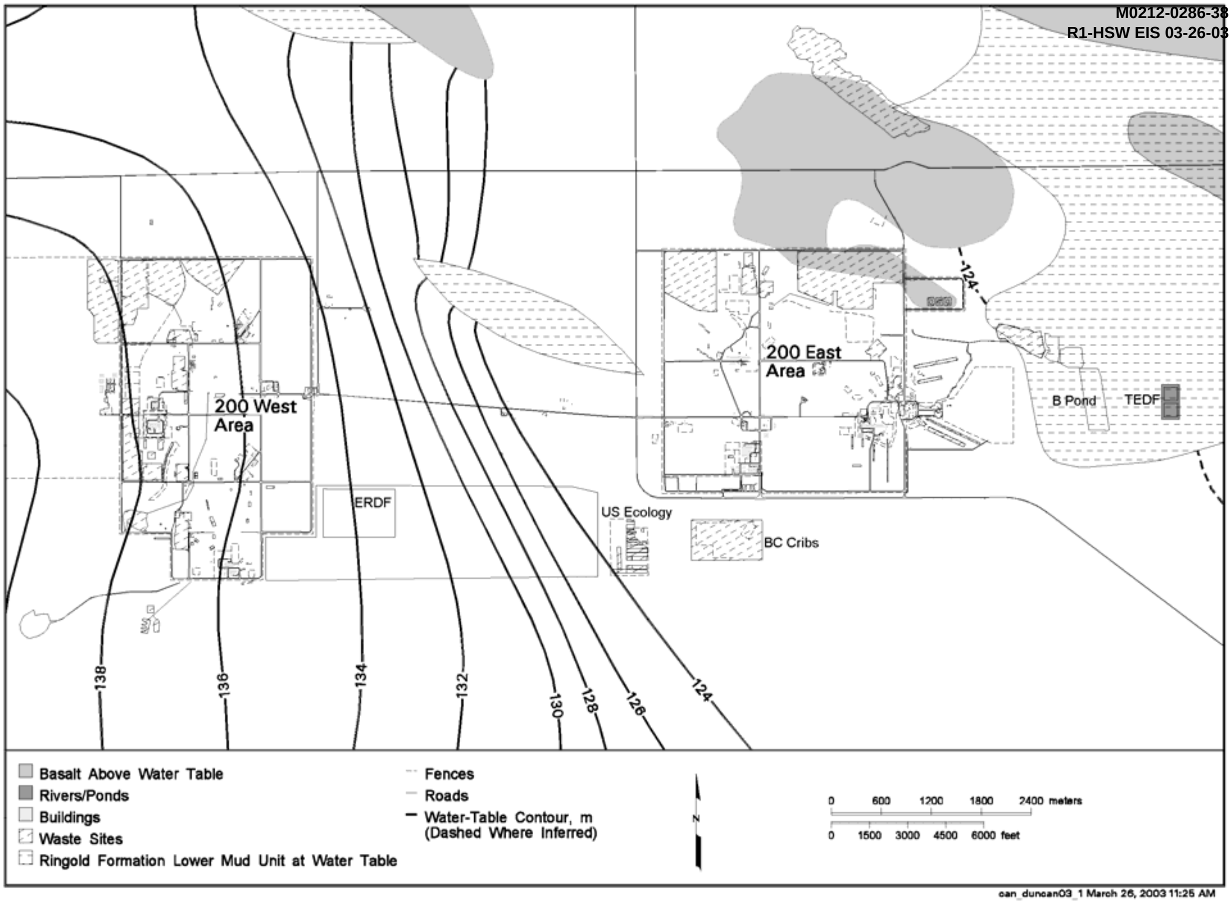


Figure 4.18. Groundwater Elevations for the Unconfined Aquifer at the 200 Areas (after Hartman et al. 2002)

wastewater discharges (Hartman 2000). Although the reduction of wastewater discharges has caused water levels to drop significantly, a residual groundwater mound beneath the 200 West Area is still shown by the curved water table contours near this area (Figures 4.17 and 4.18).

The saturated thickness and flow conditions in the unconfined aquifer are expected to return to pre-Hanford conditions with the decline and eventual cessation of artificial discharges at Hanford. Water levels have dropped in the vicinity of central areas in the site where the basalt crops out above the water table. Analyses by Cole et al. (1997) suggest the saturated thickness of the unconfined aquifer will decrease and areas of the aquifer may actually dry out. With this thinning and drying of the aquifer, which is predicted to occur in the area between Gable Butte and the outcrop south of Gable Mountain, the potential exists for the northern area of the unconfined aquifer to become hydrologically separated from the area south of Gable Mountain and Gable Butte. Therefore, flow from the 200 West Area and the northern half of the 200 East Area, that currently migrates through the gap between Gable Butte and Gable Mountain, will be effectively cut off in the next 200 to 300 years. In time, the overall water table (including groundwater mounds near the 200 East and West Areas) will decline, and groundwater movement from the 200 Area Plateau will shift to a dominantly west-to-easterly pattern of flow toward points of discharge along the Columbia River between the Old Hanford townsite and the Energy Northwest facility.

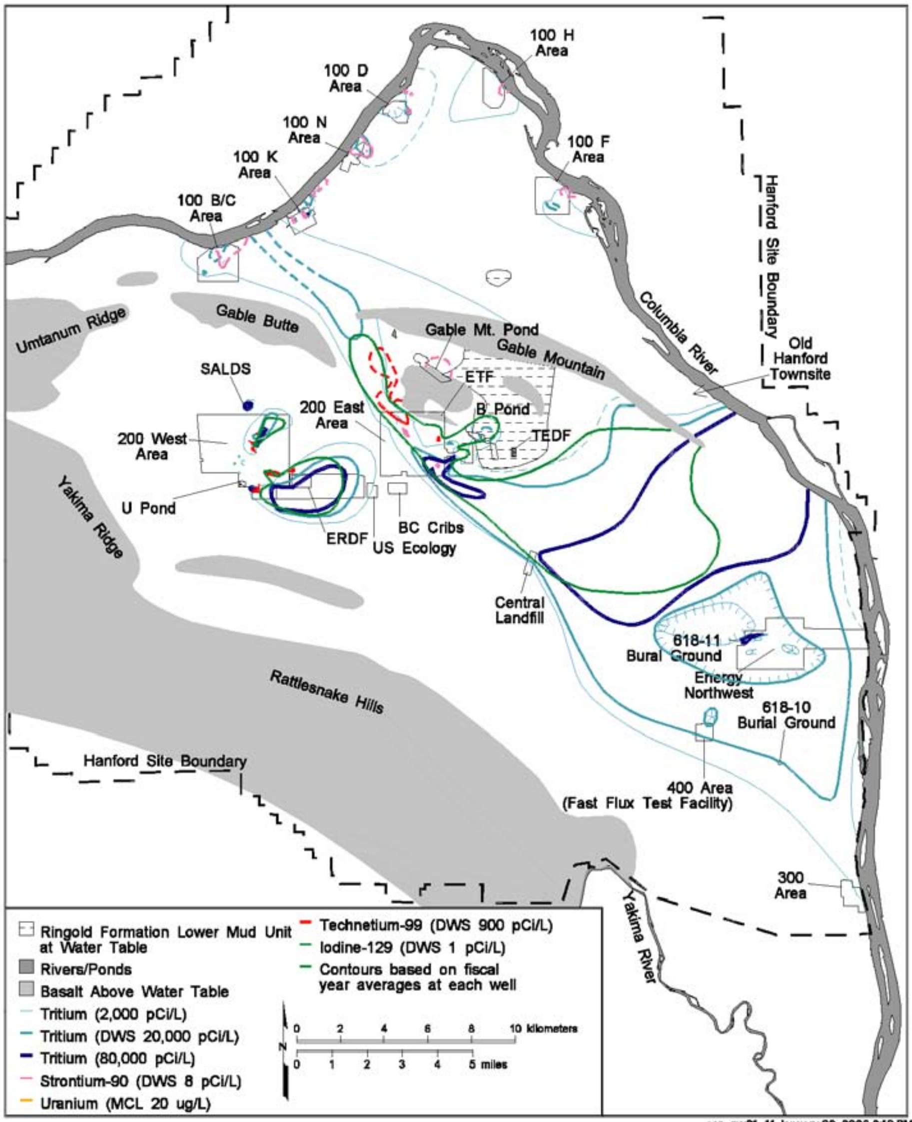
During 2000, the groundwater mounds have become less prominent. Water levels east of the 200 East Area have dropped below the top of a fine-grained confining unit, creating a barrier to movement in the surrounding unconfined aquifer (Hartman et al. 2001). Beneath this confining unit, the uppermost aquifer is a transmissive unit in the Ringold Formation. Groundwater flow in the confined aquifer is still influenced by the recharge mound.

4.5.3.2 Groundwater Quality

Groundwater beneath large areas of the Hanford Site has been impacted by radiological and chemical contaminants resulting from past Hanford Site operations. These contaminants were primarily introduced through wastewater discharged to cribs, ditches, injection wells, trenches, and ponds (Kincaid et al. 1998). Additional contaminants from spills, leaking waste tanks, and 618-10 and 618-11 Burial Grounds 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. However, contaminants also exist within the vadose zone beneath waste sites (see Section 4.5.2), as well as in waste storage and disposal facilities. These contaminants have a potential to continue to move downward into the aquifer. Some contaminants, such as tritium, move with the groundwater while the movement of other contaminants is slower because they react with or are sorbed on the surface of minerals within the aquifer or the vadose zone. Groundwater contamination is monitored and is being actively remediated in several areas through pump-and-treat operations.

Contaminant concentrations in groundwater were compared with established drinking water standards as a benchmark for quality of the groundwater resource. These benchmark standards include the maximum contaminant level (MCL) and drinking water standard (DWS) for specific chemicals and radionuclides, which are legally enforceable limits for public drinking water supplies set by EPA or the Washington State Department of Health (WDOH). DOE Order 5400.5 establishes a limit for dose from radionuclides in public drinking water supplies operated by DOE or its contractors (DOE 1993). The dose limit is 4 mrem/yr from consumption of water at 2 L/day, which provides protection equivalent to that of the EPA and state standards. The published DOE derived concentration guide (DCG) for a specific radionuclide in drinking water may also be used as a benchmark for groundwater quality in the same manner as the EPA and state standards. The DCG represents the concentration of each radionuclide in drinking water that would result in a dose of 100 mrem/yr at a consumption rate of 2 L/day. Therefore, the DOE standard for a given radionuclide in drinking water corresponds to 4 percent of the DCG for that radionuclide.

Radiological constituents, including carbon-14, cesium-137, iodine-129, strontium-90, technetium-99, total alpha, total beta, tritium, uranium, and plutonium 239/240, were detected at levels greater than the MCL in one or more onsite wells within the unconfined aquifer. Concentrations of strontium-90, tritium, uranium, and plutonium were detected at levels greater than their respective DOE DCGs. Certain non-radioactive chemicals regulated by the EPA or the State of Washington (carbon tetrachloride, chloroform, chromium, cyanide, cis-1, 2 dichloroethene, fluoride, nitrate, sulfate, and trichloroethene) were also present in Hanford Site groundwater. Figure 4.19 shows the distribution of some radiological contamination in Hanford Site groundwater and Figure 4.20 shows the distribution of some hazardous



ERDF – Environmental Restoration Disposal Facility
ETF – Effluent Treatment Facility
SALDS – State-Approved Land Disposal Structure
TEDF – Treated Effluent Disposal Facility

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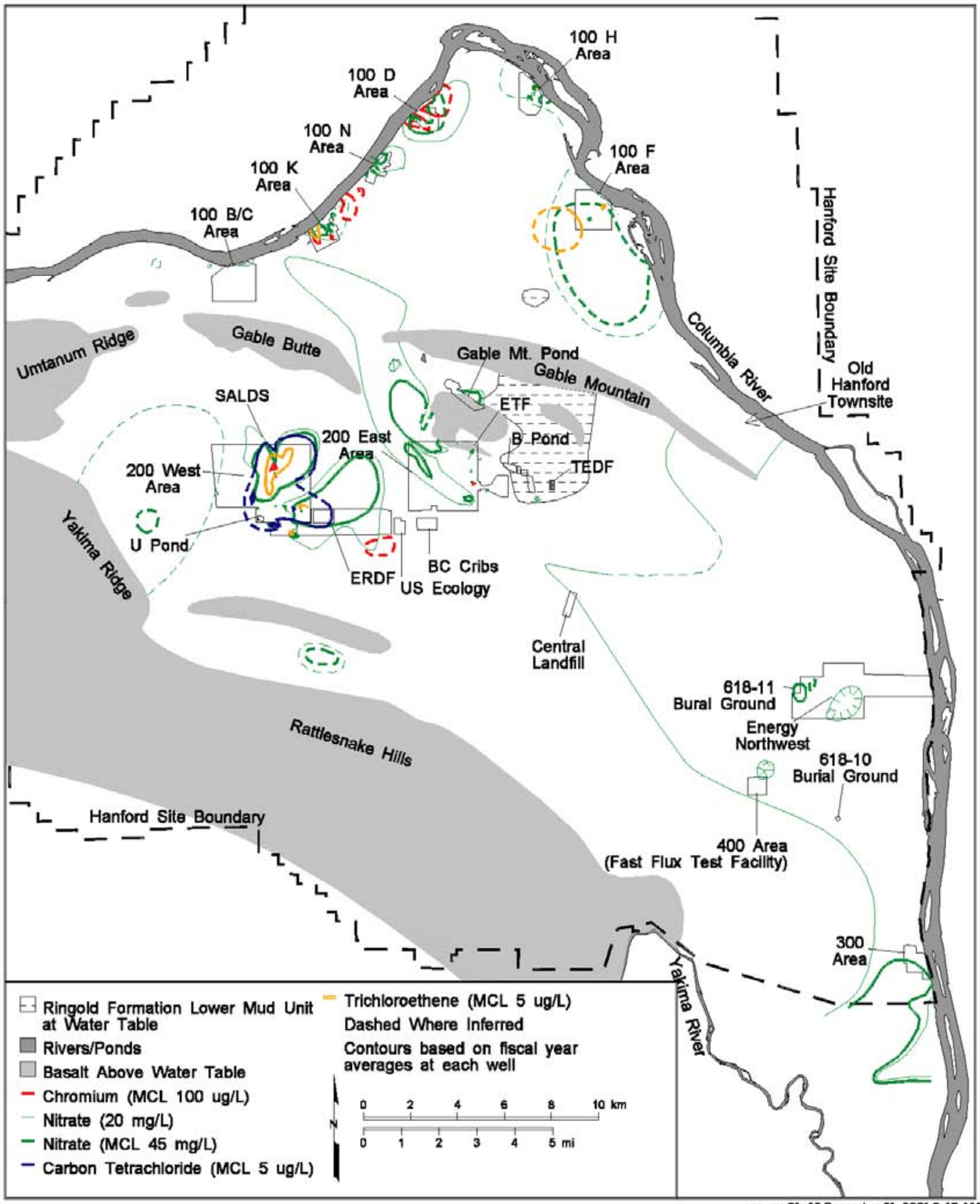
Figure 4.19. Distribution of Major Radionuclides in Groundwater at Concentrations Above the Drinking Water Standards During FY 2001 (after Hartman et al. 2002). Maximum concentrations are listed in Table 4.10.



ERDF – Environmental Restoration Disposal Facility
ETF – Effluent Treatment Facility
SALDS – State-Approved Land Disposal Structure
TEDF – Treated Effluent Disposal Facility

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Figure 4.20. Distribution of Major Hazardous Chemicals in Groundwater at Concentrations Above the Drinking Water Standards During FY 2001 (after Hartman et al. 2002). Maximum concentrations are listed in Table 4.10.

chemical constituents above the applicable DWS. The area of contaminant plumes on the Hanford Site with concentrations exceeding drinking water standards was estimated to be 208 km^2 (80.3 mi^2) in fiscal year (FY) 2001. This estimate is 1 percent smaller than that for FY 2000. The decrease is primarily due to shrinkage of the tritium plume from 200 East Area, which was caused primarily by radioactive decay. Table 4.10 shows the maximum concentrations of groundwater contaminants observed on the Hanford Site during FY 2001, along with DWS and DCG values (Hartman et al. 2002).

The upper basalt-confined aquifer is monitored by about 40 wells that are sampled annually to triennially. Most of these wells are located near the 200 Areas. During the year 2001, seventeen upper basalt-confined aquifer wells were sampled. Tritium, iodine-129 and nitrate were sampled in most of the wells, as they are most mobile in groundwater, the most widespread in the overlying unconfined aquifer, and provide an early warning of potential contamination in the upper basalt-confined aquifer. Results for each of these constituents were less than their respective drinking water standards for 2001. Monitoring results for the groundwater in the upper basalt-confined aquifer in 2000 indicate a tritium concentration of 5770 pCi/L beneath B Pond. Levels of tritium in this location are believed to be a result of downward migration from the overlying unconfined aquifer and have declined since 1996. The highest nitrate concentration, 38 mg/L, was found in the northern section of the 200 East Area in well 299-E33-12. Iodine-129 was not detected in 2001 (Hartman et al. 2002).

4.5.3.3 200 Areas Hydrology

In the 200 West Area, the water table occurs almost entirely in the Ringold Unit E gravels, while in the 200 East Area, it occurs primarily in the Hanford formation and in the Ringold Unit A gravels. Along the southern edge of the 200 East Area, the water table is in the Ringold Unit E gravels. The upper Ringold facies were eroded in most of the 200 East Area by the Missoula floods that subsequently deposited Hanford gravels and sands on the remains of the Ringold Formation. Because the Hanford formation sand and gravel deposits are much more permeable than the Ringold gravels, the water table is relatively flat in the 200 East Area, but groundwater flow velocities are higher. On the north side of the 200 East Area, evidence appears of erosional channels that may allow communication between the unconfined and uppermost basalt-confined aquifer (Graham et al. 1984; Jensen 1987).

Groundwater occurs in the 200 West Area within the Ringold Formation primarily under unconfined conditions, approximately 61 to 87 m (200 to 285 ft) beneath the surface. The saturated section is 110 m (360 ft) thick. Hydraulic conductivities measured in the 200 West Area in the Ringold Unit E aquifer range from approximately 0.02 to 60 m/day (0.06 to 200 ft/day). Hydraulic conductivities range from 0.5 to 1.2 m/day (1.6 to 4 ft/day) in the semi-confined to confined Ringold Unit A gravels. Groundwater in the 200 West Area generally flows east toward the 200 East Area. In the northwest corner of the 200 East Area, groundwater has flowed northward through the gap between Gable Butte and Gable Mountain. This northward flow appears to be diminishing (Hartman et al. 2002).

Table 4.10. Maximum Concentrations of Groundwater Contaminants at Hanford in FY 2001 (Hartman et al. 2002)

Contaminant (alphabetical order)	DWS or MCL [DCG][(a)]	Units	100-B/C Wells	100-B/C Shore[(b)]	100-K Wells	100-K Shore[(b)]	100-N Wells	100-N Shore[(b)]	100-D Wells	100-D Shore[(b)]	100-H Wells	100-H Shore[(b)]	100-F Wells	100-F Shore	200 West Wells
Carbon tetrachloride	5	µg/L													**7400**
Carbon-14	2000 [70,000]	pCi/L			**16,300**	ND									
Cesium-137	200 [3000]	pCi/L													
Chloroform	100	µg/L													160
Chromium (dissolved)	100	µg/L	86	48	**1332**	**110**	**173**	12	**4750**	**521**	**160**	88	79	19	**248**
Cobalt-60	100 [5000]	pCi/L													
Cyanide	200	µg/L													
cis-1,2 Dichloroethene	70	µg/L													
Fluoride	4	mg/L									0.32				**4.9**
Gross alpha	15	pCi/L									**33**				**18**
Gross beta	50	pCi/L	**270**	50	**8670**	**82**	**3440**	5.9	**75**	14	**278**	27	**80**	10	**28,700**
Iodine-129	1 [500]	pCi/L													**64**
Nitrate (as NO_3^-)	45	mg/L	34	**67**	**160**	**74**	**125**	22	**86**	**88**	**150**	17	**158**	(c)	**1300**
Nitrite (as NO_2)	3.3	mg/L							**8.3**						**27**
Plutonium 239/240	NA [30]	pCi/L													undetected
Strontium-90	8 [1000]	pCi/L	**135**	**15.8**	***5210***	ND	***9690***	***9690***	**12**	1.4	**38**	**14**	**38**	1.7	**69**
Technetium-99	900 [100,000]	pCi/L									471				**81,500**
Trichloroethene	5	µg/L			**19**								**16**		**21**
Tritium	20,000 [2,000,000]	pCi/L	**40,700**	**31,300**	**1,750,000**	6140	**36,900**	**29,700**	18,600	**22,100**	7740	5460	**38,600**	1380	**1,540,000**
Uranium[(d)]	30 [790]	µg/L									**49**		23		***2140***

Note: Table lists highest concentration for fiscal year 2001 in each geographic region. Concentrations in **bold** exceed drinking water standards. Concentrations in ***bold italic*** exceed DOE derived concentration guides. Blank spaces indicate the constituent is not of concern in the given area.

(a) DWS = drinking water standard; MCL = maximum contaminant level; DCG = derived concentration guide. See PNNL-13080 (Hartman 2000) for more information on these standards.

(b) Shoreline sampling includes aquifer sampling tubes, seeps, and shoreline wells from fall 2000. 200 East Area plumes monitored at Old Hanford Townsite.

(c) Fiscal year 2001 results appear erroneous. Past year's results up to 55 mg/L.

(d) Uranium standard of 30 µg/L becomes effective December 2003.

Table 4.10. (contd)

Contaminant (alphabetical order)	DWS or MCL [DCG](a)	Units	200 East Wells	200 East Shore(b)	400 Wells	600 Wells	300 Wells	300 Shore(b)	618-11 Wells	Richland North Wells	Basalt-Confined Wells
Carbon tetrachloride	5	µg/L				ND					
Carbon-14	2000 [70,000]	pCi/L									
Cesium-137	200 [3000]	pCi/L	**1910**								
Chloroform	100	µg/L				0.43					
Chromium (filtered)	100	µg/L	**1640**			17					
Cobalt-60	100 [5000]	pCi/L78	78								ND
Cyanide	200	µg/L	**423**								29
cis-1,2 Dichloroethene	70	µg/L					**190**				
Fluoride	4	mg/L								**15**	**8.5**
Gross alpha	15	pCi/L	**357**				**43**	**88**	8.0	10	3.5
Gross beta	50	pCi/L	**25,700**	36			**282**	33	**84**	24	**330**
Iodine-129	1 [500]	pCi/L	**10**	0.27							ND
Nitrate (as NO_3^-)	45	mg/L	**748**	**100**	**87**	22	**89**	**104**	**93**	**162**	38
Nitrite (as NO_2)	3.3	mg/L			0.36						
Plutonium 239/240	NA [30]	pCi/L	**63**								
Strontium-90	8 [1000]	pCi/L	***12,000***								ND
Technetium-99	900 [100,000]	pCi/L	**13,000**	112							**1120**
Trichloroethene	5	µg/L					**5.3**			**5.1**	
Tritium	20,000 [2,000,000]	pCi/L	***4,300,000***	**107,000**	**57,600**	**49,800**	**57,700**	11,700	***8,370,000***	551	5770
Uranium (d)	30 [790]	µg/L	**678**				**205**	**210**	11	23	

Note: Table lists highest concentration for fiscal year 2001 in each geographic region. Concentrations in **bold** exceed drinking water standards. Concentrations in ***bold italic*** exceed DOE derived concentration guides. Blank spaces indicate the constituent is not of concern in the given area.

(a) DWS = drinking water standard; MCL = maximum contaminant level; DCG = derived concentration guide. See PNNL-13080 (Hartman 2000) for more information on these standards.

(b) Shoreline sampling includes aquifer sampling tubes, seeps, and shoreline wells from fall 2000. 200 East Area plumes monitored at Old Hanford Townsite.

(c) Fiscal year 2001 results appear erroneous. Past year's results up to 55 mg/L.

(d) Uranium standard of 30 µg/L becomes effective December 2003.

Natural recharge from precipitation falling on the Hanford Site is highly variable spatially and temporally, ranging from near zero to more than 100 mm/yr, depending on climate, vegetation, and soil texture (Gee et al. 1992; Fayer and Walters 1995). Areas with shrubs and fine-textured soils like silt loams tend to have low recharge rates, while areas with little vegetation and coarse-textured soils, such as dune sands, tend to have high recharge rates. Recharge is also generally higher near the basalt ridges because of greater precipitation and runoff. Past estimates of recharge have been summarized in earlier status reports (Thorne and Chamness 1992; Thorne et al. 1993). Fayer and Walters (1995) developed a natural recharge map for 1979 conditions to support the Hanford Site three-dimensional groundwater and transport model. The distributions of soil and vegetation types were mapped first. A recharge rate was then assigned to each combination on the basis of data from lysimeters, tracer studies, neutron probe measurements, and computer modeling. Estimated recharge rates for 1992 were found to range from 2.6 to 127 mm/yr, and the total volume of natural recharge from precipitation over the Hanford Site was estimated at 8.47×10^6 m^3/yr. This value is of the same order of magnitude as the artificial recharge to the 200 Area waste disposal facilities during 1992 and is about half the volume of discharge to these facilities during 1979 (Fayer and Walters 1995).

The other source of recharge to the unconfined aquifer is artificial recharge from wastewater disposal. Over the past 50 years, the large volume of wastewater discharged to disposal facilities at the Hanford Site has significantly affected groundwater flow and contaminant transport in the unconfined aquifer. The volume of artificial recharge has decreased significantly during the past 10 years and continues to decrease. Wurstner et al. (1995) summarized the major discharge facilities incorporated in the three-dimensional model. Cole et al. (1997) summarized the major wastewater discharges from past and future sources.

Depth to groundwater in the 200 East Area ranges from 97 m (320 ft) in the southeast to 37 m (120 ft) in the vicinity of the 216-B-3C pond (B Pond mound). A downward gradient has formed in the B Pond vicinity due to groundwater mounding from discharges. Based on data collected in March 2002 for well pair 699-43-42J (water table) and 699-42-42B (7.37 m deeper), the downward gradient was 0.038. This is greater than the horizontal gradient, 0.002. Groundwater flow in the 200 East Area is to the southeast. Interconnection between the unconfined and lower confined aquifer is possible across the Central Plateau. However, except for the area near the erosional windows that occur in the basalt several kilometers north of the 200 East Area and B Pond vicinity in the 200 East Area, no indication is shown of aquifer interconnection. Several kilometers north of the 200 East Area, an absence of confining layer(s) is associated with an erosional window that has resulted in enhanced interconnection of the aquifers in this area. Hydraulic conductivities of the unconfined aquifer in the 200 East Area range from 150 to 300 m/day (500 to 1000 ft/day). Flow may split east of Gable Butte, one path heading north toward the gap between Gable Butte and Gable Mountain, and the other path east to the Columbia River.

Groundwater is monitored in the vicinity of the LLBGs as a result of interim status requirements of WAC 173-303. The LLBGs are divided into five low-level waste management areas (LLWMAs). Since 1996, groundwater has not been monitored within LLWMA-5, the location of the 218-W-6 Burial Ground, as the site has never received waste.

LLWMA-1 consists of the 218-E-10 Burial Ground. Well 299-E33-34, a downgradient monitoring well, exceeded the critical mean for specific conductance in 2000, but this was related to the nitrate plume with an upgradient source in the northern portion of this LLWMA (Poston et al. 2001).

LLWMA-2 is located in the 200 East Area and includes all of the 218-E-12B Burial Ground. Upgradient well 299-E34-7 exceeded the critical mean value for specific conductance in 2000. Sulfate and calcium are the major contributors to the increase and their source is not known. However, only 0.6 m (2 ft) of water remains in this well, which is at the top of the basalt, and the increases may be due to basalt chemistry. Well 299-E34-7 also exceeded the comparison value for total organic carbon in 2000. Results for volatile and semi-volatile organics were less than detection limits, with the exception of bis (2-ethylhexyl) phthalate at 1.7 µg/L.

LLWMA-3 includes the 218-W-3A, 218-W-3AE, and 218-W-5 Burial Grounds in the 200 West Area. Indicator parameter data from upgradient wells were statistically evaluated and values from downgradient wells were compared to established values from upgradient wells in 2000. The critical mean value for specific conductance was exceeded in an upgradient well, but is due to increases in sulfate and nitrate from upgradient sources. None of the other wells in LLWMA-3 exceeded contamination parameters during 2000. Several of the wells in LLWMA-3 have gone dry, as the water table continues to decline. EPA, Ecology, and DOE have an integrated groundwater monitoring well network for the Central Plateau. This includes new wells to be installed for the LLBGs.

LLWMA-4 is located in the 200 West Area and includes 218-W-4B and 218-W 4C Burial Grounds. Indicator parameter data from upgradient wells were statistically evaluated and values from downgradient wells were compared to established values from upgradient wells in 2000. The critical mean value for total organic halides was exceeded in one downgradient well in 2000, caused by carbon tetrachloride from an upgradient source. Groundwater in LLWMA-4 is being actively remediated using pump-and-treat methods.

4.6 Biological and Ecological Resources

The Hanford Site is characterized as a shrub-steppe ecosystem (Daubenmire 1970). Such ecosystems are typically dominated by a shrub overstory with a grass understory. In the early 1800s, the dominant plant in the area was big sagebrush underlain by perennial Sandberg's bluegrass and bluebunch wheatgrass. With the advent of settlement, livestock grazing and agricultural production contributed to colonization by nonnative vegetation species that currently dominate the landscape. Although agriculture and production of livestock were the primary activities at the beginning of the twentieth century, these activities ceased when the site was established in 1943. Remnants of past agricultural practices are still evident.

The Columbia River borders the DOE-managed portion of the Hanford Site to the east. Operation of Priest Rapids Dam upstream of the site accommodates maintenance of intakes at the Hanford Site and helps to manage anadromous fish populations. The Columbia River and associated riparian zones provide habitat for numerous wildlife and vegetation species.

Nitrogen inputs are higher with greater water infiltration. Soil surface stability is related to cyanobacterial biomass as well as total moss and lichen cover (Belnap et al. 2001). The lichen and mosses of the Hanford Site were surveyed and evaluated by Link et al. (2000). They found 29 soil lichens in 19 genera and 6 moss species in 4 genera. Twelve (41 percent) lichen species are of the crustose growth form (flat and firmly attached to the substrate), eight (28 percent) are squamulose (having small, flat scales that do not adhere tightly to substrate), seven (24 percent) are foliose (having leaf-like lobes, attached in the center to substrate by clusters of rhizomes) and two (7 percent) are fruticose (plant-like growth attached at one point).

4.6.6 Biodiversity

The Hanford Site is located within the Columbia Basin Ecoregion, an area that historically included over 6 million ha (14.8 million acres) of steppe and shrub-steppe vegetation across most of central and southeastern Washington State, as well as portions of north-central Oregon. The pre-settlement vegetation consisted primarily of shrubs, perennial bunchgrasses, and a variety of forbs. An estimated 60 percent of shrub-steppe in Washington has been converted to agriculture or other uses. Much of what remains is in small parcels, in shallow rocky soils, or has been degraded by historic land uses (mostly livestock grazing) (TNC 1999).

The Hanford Site retains some of the largest remaining blocks of relatively undisturbed shrub-steppe in the Columbia Basin Ecoregion. Hanford's importance as a refuge for the shrub-steppe ecosystem is not solely size-related, however. The presence of a high diversity of physical features and examples of rare, undeveloped deep and sandy soil has led to a corresponding diversity of plant and animal communities. Many places on the Hanford Site are relatively free of non-native species and are extensive enough to retain characteristic populations of shrub-steppe plants and animals that are absent or scarce in other areas. Because of its location, the Site provides important connectivity with other undeveloped portions of the ecoregion.

4.7 Cultural, Archaeological, and Historical Resources

The Hanford vicinity is one of the most culturally rich resource areas in the western Columbia Plateau. The site comprises a series of cultural landscapes containing the cumulative record of multiple occupations by Native and non-Native Americans. These landscapes contain numerous well-preserved archaeological sites representing prehistoric, ethnographic, and historic periods. Period resources include sites with cultural materials that are thousands of years old, traditional cultural places, and buildings and structures from the pre-Hanford, Manhattan Project, and Cold War eras. The National Historic Preservation Act (16 USC 470), the Native American Graves Protection and Repatriation Act (25 USC 3001), the Archaeological Resources Protection Act, and the DOE American Indian Policy (DOE 2000b), among other legislation and guidelines, require the identification and protection of areas and resources of concern to the Native American community (see Sections 6.13 and 6.14).

4.7.1 Native American Cultural Resources and Archaeological Resources

Traditional Native American religion is manifest in the earth, the water, the sky, and all animate or inanimate beings that inhabit a given location. In prehistoric and early historic times, Native Americans of various tribal affiliations populated the Hanford Reach of the Columbia River. The Wanapum and the Chamnapum dwelt along the Columbia River from south of Richland upstream to Vantage (Relander 1956; Spier 1936). Some of their descendants (Wanapum) still live nearby at Priest Rapids; others live on the Yakama and Umatilla Reservations. Palus people, who lived on the lower Snake River, joined the Wanapum and Chamnapum to fish the Hanford Reach of the Columbia River and some inhabited the east bank of the river (Relander 1956; Trafzer and Scheuerman 1986). Many descendants of the Palus now live on the Colville Reservation. The Nez Perce, Yakama,Walla Walla, and Umatilla, and other Native American peoples also periodically visited to fish in the area. Traditional uses of the Hanford Site included fishing, hunting, and gathering roots and medicinal plants. The area was also used as a wintering ground. Descendants of these people retain traditional secular and religious ties to the region and many have knowledge of the ceremonies and life ways of their ancestral culture.

The Hanford Reach and the greater Hanford Site, geographic centers for regional Native American religious belief, are central to the practice of Indian religion of the region, and many believe the creator made the first people here (DOI 1994). Indian religious leaders began their teachings here, including Smoholla, a prophet of Priest Rapids who brought the Washani religion to the Wanapum and others during the late nineteenth century. Native plant and animal foods, some of which can be found on the Hanford Site, are used in the ceremonies performed by tribal members. Certain landforms, especially Rattlesnake Mountain, Gable Mountain, Gable Butte, and various sites along and including the Columbia River, remain sacred to them. Aesthetic and scenic resources are discussed in Section 4.8.10. The Gable Mountain Block Survey conducted by tribal members in 2000, recorded important attributes that contribute to the significance of Gable Mountain to Native Americans (Poston et al. 2001). Native American traditional cultural places within the Hanford Site include, but are not limited to, a wide variety of places and landscapes: archaeological sites, cemeteries, trails and pathways, campsites and villages, fisheries, hunting grounds, plant-gathering areas, holy lands, landmarks, important places in Indian history and culture, places of persistence and resistance, and landscapes of the heart (Bard 1997). Traditional cultural places of importance to Native Americans are determined through methods that are mutually agreed upon by DOE and the Native American community.

Native Americans have lived in and around the present-day Hanford Site for thousands of years (Relander 1956; Spier 1936; Sturtevant and Walker 1998). When Euro-Americans arrived in the 1800s, peoples presently referred to as the Wanapum inhabited villages and fishing camps. Neighboring groups known today as the Yakama, Umatilla, Cayuse, Walla Walla, Palus, Nez Perce, and Middle Columbia Salish frequented the area to trade, gather resources, and conduct other activities. Many descendants of these tribes are affiliated with the Wanapum, Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, or the Confederated Tribes of the Colville Reservation, and they retain traditional, cultural, and religious ties to Hanford's places and resources. (See Section 6.14 for further information on the treaties associated with the Hanford Site). This record of Native American use and history is reflected in the archaeological sites and traditional cultural places that are located across the Hanford Site.

People have inhabited the Middle Columbia River region since the end of the glacial period. More than 8000 years of prehistoric human activity in this largely arid environment have left extensive archaeological deposits along the river shores (Chatters 1989; Leonhardy and Rice 1970). Well-watered areas inland from the river also show evidence of concentrated human activity (Chatters 1982, 1989; Daugherty 1952; Leonhardy and Rice 1970; Neitzel 2002a), and recent surveys have indicated extensive, although dispersed, use of arid lowlands for hunting. Throughout most of the region, hydroelectric development, agricultural activities, and domestic and industrial construction have destroyed or covered the majority of these deposits. Amateur artifact collectors have had an immeasurable impact on what remains at numerous sites. However, by virtue of their inclusion in the Hanford Site from which the public is restricted, archaeological deposits found in the Hanford Reach of the Columbia River and on adjacent plateaus and mountains largely have not been destroyed.

Archaeological sites and isolated finds totaling 439 associated with the prehistoric period have been recorded on the site; of these, approximately 68 contain historic components as well. Prehistoric period sites common to the Hanford Site include remains of numerous pit house villages, various types of open campsites, spirit quest monuments (rock cairns), hunting camps, game drive complexes, and quarries in nearby mountains and rocky bluffs (Rice 1968a, b; Neitzel 2002a); hunting/kill sites in lowland stabilized dunes; and small temporary camps near perennial sources of water located away from the river (Rice 1968b).

Many recorded sites were found during four archaeological reconnaissance projects conducted between 1926 and 1968 (Krieger 1928; Rice 1968a,b). Much of this early archaeological survey and reconnaissance activity concentrated on islands and on a strip of land about 400 m (1300 ft) wide on either side of the river (Neitzel 2001). Reconnaissance of selected locations conducted through the mid-1980s, as well as systematic archaeological surveys conducted from the middle 1980s through 1996, added to the recorded site inventories, (Chatters 1989; Chatters and Cadoret 1990; Chatters and Gard 1992; Chatters et al. 1990, 1991, 1992; Last et al. 1994; Andrefsky et al.1996).

During his reconnaissance of the Hanford Site in 1968, Rice (1968b) inspected portions of Gable Mountain, Gable Butte, Snively Canyon, Rattlesnake Mountain, and Rattlesnake Springs. Rice also inspected additional portions of Gable Mountain and part of Gable Butte in the late 1980s (Neitzel 2001). Some reconnaissance of the Basalt Waste Isolation Project (BWIP) Reference Repository Location (Neitzel 2001), a proposed land exchange in T. 22 N., R. 27 E., Section 33 (Neitzel 2001), and three narrow transportation and utility corridors (Morgan 1981; Smith et al. 1977) was also conducted. Other large-scale project areas completed in recent years include the 100 Areas from 1991 through 1993 and 1995 (Chatters et al. 1992; Wright 1993); McGee Ranch (Gard and Poet 1992); the Laser Interferometer Gravitational Wave Observatory Project; the Environmental Restoration Disposal Facility; and the Washington State University 600 Area Block Survey (Andrefsky et al. 1996). To date, approximately 12 percent of the Hanford Site has been surveyed for archaeological resources.

4.7.2 Historic Archaeological Resources

Two of the early Euro-Americans who passed near the Hanford Site were Lewis and Clark, who traveled along the Columbia and Snake rivers during their 1803 to 1806 exploration of the Louisiana

Territory. The first European explorer to cross the Hanford Site was David Thompson, who traveled along the Columbia River from Canada during his 1811 exploration of the Columbia River. Other visitors included fur trappers, military units, and miners who traveled through the Hanford Site on their way to lands up and down the Columbia River and across the Columbia Basin. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach. Chinese miners soon began to work the gravel bars for gold. Cattle ranches were established in the 1880s, and farmers soon followed. Agricultural development, irrigation districts, and roads soon dotted the landscape, particularly in the eastern portion of the central Hanford Site. Several small thriving towns, including Hanford, White Bluffs, Richland, and Ringold, grew up along the riverbanks in the early twentieth century. Community accessibility to outside markets grew with the 1913 arrival of the Chicago, Milwaukee, and St. Paul Railroad branch line (Priest Rapids-Hanford Line) from Beverly, Washington. Ferries were established at Richland, Hanford, Wahluke, White Bluffs, and Richmond. The towns and nearly all other structures were razed in the years after the U.S. government acquired the land for the Hanford Engineer Works in 1943 (Chatters 1989; Neitzel 2002).

Since 1987, the Hanford Cultural Resources Laboratory (HCRL) has recorded 655 historic archaeological sites associated with the pre-Hanford (Euro-American) era, the Manhattan Project, and Cold War Era, including an assortment of farmsteads, corrals, dumps, and military sites. Of these, 56 sites contain prehistoric components as well. Archaeological resources from the pre-Hanford period are scattered over the entire Hanford Site and include numerous areas of gold mining features along the riverbanks of the Columbia and remains of homesteads, building foundations, agricultural equipment and fields, ranches, and irrigation features. Properties from this period include the Hanford Irrigation Ditch; former Hanford Townsite; Wahluke ferry landing; White Bluffs Townsite; Richmond ferry landing; Arrowsmith Townsite; White Bluffs road; and the Chicago, Milwaukee, and St. Paul Railroad.

Areas of traditional cultural importance to pre-Hanford residents are also found on the Hanford Site. These areas include places and structures that are important to descendents of pre-1943 settlers in the former White Bluffs, Hanford, Allard, and Cold Creek areas.

4.7.3 Historic Built Environment

A number of buildings associated with the pre-Hanford Site era have been documented. They include the Hanford Irrigation and Power Company pumping plant at Coyote Rapids, the high school and the electrical substation at the Hanford Townsite, First Bank of White Bluffs, Bruggemann’s fruit warehouse, and the blacksmith cabin at the East White Bluffs ferry landing.

Historic built resources documented from the Manhattan Project and Cold War eras include buildings and structures found in the 100, 200, 300, 400, 600, 700, and former 1100 and 3000 Areas. The most important of these are the plutonium production and test reactors, chemical separation and plutonium finishing buildings, and fuel fabrication/manufacturing facilities. The first reactors, 100-B, 100-D, and 100-F, were constructed during the Manhattan Project. Plutonium for the first atomic explosion and the bomb that destroyed Nagasaki was produced at the Hanford Site. Additional reactors and processing facilities were constructed after World War II during the Cold War period. All reactor containment buildings still stand, although many ancillary structures have been removed, and the C, D, DR, F, and H reactors have been considerably modified.

Historic contexts were completed for the Manhattan Project and Cold War eras as part of a National Register Multiple Property Documentation Form prepared for the Hanford Site to assist with the evaluation of National Register of Historic Places (National Register) eligibility of buildings and structures sitewide (Bard 1997). Additionally, historical narratives and individual building documentations have been compiled in the *History of the Plutonium Production Facilities at the Hanford Site Historic District, 1943-1990*, published in 2002 (DOE-RL 2002). At the site, 528 Manhattan Project and Cold War Era buildings/structures and complexes have been determined to be eligible for the National Register as contributing properties within the designated Hanford Site Manhattan Project and Cold War Era Historic District. Of that number, 190 were recommended for individual documentation (DOE-RL 1998).

4.7.4 200 Areas

Much of the 200 East and West Areas has been disturbed by construction of facilities associated with the chemical separations process as part of the Manhattan Project and Cold War Era. Other facilities have been constructed as part of ongoing cleanup efforts for the Hanford Site. Comprehensive efforts were made in 1986 and 1989 to inventory the undisturbed portions of the 200 East and West Areas for cultural resources. The 1989 survey was "an intensive pedestrian survey of all undisturbed portions of the 200 East Area and a stratified random survey [of the undisturbed portions] of the 200 West Area" (Chatters and Cadoret 1990). No cultural resources are known to exist within currently active borrow areas (DOE 2001).

The 1989 survey located two historic-archaeological sites (can and glass scatters), four isolated historic artifacts, one isolated cryptocrystalline flake, and an extensive linear feature (that is, the White Bluffs Road). These were the only materials older than 50 years discovered during the field survey. The most significant archaeological resource located in the 200 Areas is the extensive linear feature known as the White Bluffs Road, a portion of which passes diagonally southwest to northeast through the 200 West Area. This road, in its entirety, was determined eligible for listing in the National Register. Within the 200 West Area, two intact segments of the road are considered contributing elements: 1) the southwest segment from the perimeter fence to approximately 19th Street at Dayton Avenue, and 2) the extreme northeast segment above T Plant Complex to the perimeter fence. A 100-m (328-ft) easement has been created to protect these segments of the road from uncontrolled disturbance. The remaining portions of the road within the 200 West Area have been determined to be non-contributing. Such non-contributing segments of the White Bluffs Road are those that do not add to the historic significance of the road, but retain evidence of its contiguous bearing. Originally used as a Native American trail, it played a role in Euro-American immigration, development, agriculture, and Hanford Site operations. In 1996, an inventory was completed of the remainder of the undisturbed ground; an area totaling 2.2 km^2 (0.85 mi^2). Although six isolated finds and two historic debris scatters were located, none were considered to be eligible for the National Register. A survey of the White Bluffs Road in 2000 recorded an additional 54 historic isolated finds and 2 prehistoric isolated finds, as well as six can dump features (Neitzel 2002a).

Although other areas of undisturbed land in the 200 East and 200 West Areas have been surveyed as part of cultural resource reviews of proposed projects, no new significant cultural resources have been located. Reviews include the 1989 permit application for the LLBGs (218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, 218-W-6) (Hanford Cultural Resources Case [HCRC] # 89-200-008; see Table K.1). Previous borrowing and burying activities at the grounds had extensively disturbed the majority of the LLBGs. However, portions of 218-E-12B, 218-W-5 and 218-W-6 were undisturbed. These areas were surveyed and reviewed by the HCRL in the summer of 1988 as part of HCRC# 88-200-038 (see Table K.1) and clearance for the project was granted. The ETF location was reviewed for the presence or absence of cultural resources in 1990 (HCRC# 89-200-023; see Table K.1). The WRAP Facility location was reviewed in 1993 (HCRC# 93-200-074; see Table K.2) and the CWC was reviewed in 1995 (HCRC# 95-200-104; see Table K.1). No significant resources were identified. Over the past 15 years, 50 cultural resource reviews were conducted on the LLBGs for grouting, geologic testing, subsidence repair and maintenance, removal of contaminated soils, retrieval of vented drums, culvert installation, drilling to install high-integrity containers, and trench construction.

Chemical separations facilities (processing plants and their ancillary and support services) were located in the 200 Areas. Irradiated fuel elements were dissolved and desired materials such as plutonium were separated out. Historic property inventory forms have been completed for 72 buildings and structures in the 200 Area. Of that number, 58 have been determined to be eligible for the National Register as contributing properties within the Historic District recommended for mitigation. Included are the 234-5Z Plutonium Finishing Plant, 236-Z Plutonium Reclamation Facility, 242-Z Water Treatment Facility, 231-Z Plutonium Metallurgical Laboratory, 225-B Encapsulation Building, 221-T Canyon (T Plant) Building, 202-A Purex Building, 222-S Redox Plant, 212-N Lag Storage Facility, 282-E Pumphouse and Reservoir Building, 283-E Water Filtration Plant, and 284-W Power House and Steam Plant. The 232-Z Waste Incinerator Facility and the 233-S Plutonium Concentration Building, determined eligible for the National Register, have been documented to Historic American Engineering Record (HAER) standards (DOE-RL 1998).

Completed in December 1944, T Plant (221-T) was the world's first large-scale plutonium (chemical) separation facility. T Plant, like the other chemical separation buildings at Hanford, is a massive, concrete, canyon-like structure measuring 800 feet long, 65 feet wide, and 80 feet high. Because of its role as the primary chemical separations plant at the Hanford Site from 1944 until the opening of the REDOX Plant in 1952, T Plant was found to be eligible for inclusion in the National Register as a contributing property within the Historic District and recommended for individual documentation (mitigation). Mitigation of T Plant has been completed and consisted of a HAER documentation of the facility and a walkthrough/assessment of the building contents. DOE entered into the Programmatic Agreement for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site (DOE-RL 1996) with the Advisory Council on Historic Preservation and the Washington State Historic Preservation Office. One stipulation of the agreement requires DOE to undertake an assessment of the contents of the historic buildings and structures prior to any deactivation, decommissioning, or decontamination activities. The purpose of these assessments is to locate any artifacts that may have interpretive and or educational value as exhibits within local, state, or national museums. Industrial artifacts at T Plant and other historic facilities in the 200 Area were identified and tagged for future exhibit purposes.

4.8 Socioeconomic Activity

Activity on the Hanford Site plays a dominant role in the socioeconomic activity of the Tri-Cities and other parts of Benton and Franklin counties. The agricultural community also has a significant effect on the local economy. Any major changes in the Hanford mission could potentially affect the Tri-Cities and other areas of Benton and Franklin counties.

4.8.1 Local Economy

Three major sectors have been the principal driving forces of the economy in the Tri-Cities since the early 1970s: 1) DOE and its contractors operating the Hanford Site; 2) Energy Northwest (formerly the Washington Public Power Supply System) in its construction and operation of nuclear power plants; and 3) the agricultural community, including a substantial food-processing component. With the exception of a minor amount of agricultural commodities sold to local-area consumers, the goods and services produced by these sectors are exported outside the Tri-Cities. In addition to the direct employment and payrolls, these major sectors also support a sizable number of jobs in the local economy through their procurement of equipment, supplies, and business services.

In addition to these three major employment sectors, three other components can be readily identified as contributors to the economic base of the Tri-Cities: payrolls from the five major non-Hanford employers in the region, tourism, and pension benefits from former employees.

4.8.1.1 Employment and Income

DOE Hanford Site Employment. During FY 2001, the DOE Office of River Protection (ORP) and its prime contractors CH2M Hill Hanford Group, Inc. and Bechtel National, Inc.; DOE-RL and its prime contractors Fluor Hanford, Inc. (and its principal subcontractors); PNNL; Bechtel Hanford, Inc.; and the Hanford Environmental Health Foundation employed an average of 10,700 employees. Fiscal year 2001 year-end employment at Hanford was 10,670, down slightly from 10,870 in FY 2000. In FY 1999, average employment was 10,290, compared to an average employment of 11,940 in 1996. The drop between FY 1996 and FY 1999 reflects employment declines and reorganization of the DOE contractors under the Project Hanford Management Contract (PHMC), which was created in 1996. Under the PHMC, almost 2200 employees of the former management and operations contractor were moved into six "enterprise companies" and were no longer counted as official Hanford employees. The number of employees at Hanford is down considerably from a peak of 19,200 in FY 1994, but still represents 12 percent of the 89,100 total jobs in the economy.

Based on employee residence records as of April 2002, 92 percent of the direct employees of Hanford live in Benton and Franklin counties. Approximately 73 percent of Hanford employees reside in Richland, Pasco, or Kennewick. More than 36 percent are Richland residents, 9 percent are Pasco residents, and 28 percent live in Kennewick. Residents of other areas of Benton and Franklin counties, including West Richland, Benton City, and Prosser, account for about 18 percent of total Hanford Site employment (Neitzel 2002a).

Energy Northwest. Although activity related to commercial nuclear power plant construction ceased with the completion of the WNP-2 reactor in 1983 (now named Columbia Generating Station), Energy Northwest continues to be a major employer in the Tri-Cities area. Headquarters personnel based in Richland oversee the operation of the Columbia Generating Station. Decommissioning of mothballed nuclear power plants (WNP-1 and WNP-4), which never were completed, began in 1995. In FY 1999, Energy Northwest employed around 29 people at the two plants (one-third of the 90 people who were employed in 1994 as a result of decommissioning activities). As part of an effort to reduce electricity production costs, Energy Northwest headquarters decreased the size of its workforce from over 1900 in 1994 to 1016 at the end of 1999. As part of a refueling and maintenance project, as of April 2002 employment was 1208 personnel.

Agriculture. In 2000, agricultural production and services in the bi-county area generated about 10,260 wage and salary jobs, or about 12 percent of the area's total employment, as represented by the employees covered by unemployment insurance (LMEA 2001a). Seasonal farm workers are not included in that total but are estimated by the U.S. Department of Labor (DOL) for the agricultural areas in the state of Washington. In 2001, there was an average of 5148 seasonal farm workers per month in Benton, Franklin, and Walla Walla counties, ranging from 1153 workers during the winter pruning season to 11,329 workers at the peak of harvest. An estimated average of 4391 seasonal workers were classified as local (ranging from 1131 to 10,054); an average of 15 were classified as intrastate (ranging from 0 to 146), and an average of 748 were classified as interstate (ranging from 0 to 1612). The weighted seasonal wage for 2001 ranged from $6.20/hr to $7.58/hr, with an average wage of $6.88/hr (DOL 2001).

According to the U.S. Department of Commerce's Regional Economic Information System (REIS), about 2640 people were classified as farm proprietors in 2000. Farm proprietors' income, according to this same source, was estimated to be $53.2 million (DOC 2001).

The area farms and ranches generate a sizable number of jobs in supporting activities, such as agricultural services (for example, application of pesticides and fertilizers and irrigation system development) and wholesale trade (farm supply and equipment sales, and fruit packing). Although formally classified as a manufacturing activity, food processing is a natural extension of the farm sector. More than 20 food processors in Benton and Franklin counties produce such items as potato products, canned fruits and vegetables, wine, and animal feed.

Other Major Employers. In 2001, the five largest non-Hanford Site and non-government employers employed approximately 5035 people in Benton and Franklin counties. These companies include (1) Lamb Weston, which employed 1800; (2) Iowa Beef Processing Inc., which employed 1450; (3) Framatome ANP, Richland Inc. (formerly Siemens Power Corporation), which employed 750; (4) Boise Cascade Corporation Paper and Corrugated Container Divisions, which employed 685, and (5) Burlington Northern Santa Fe Railroad, which employed 350. Boise Cascade and Iowa Beef are located in western Walla Walla County, but most of their workforce resides in Benton and Franklin counties. Four of the largest agriculture growers and processors in the area: Broetje Orchards, J.R. Simplot Company, Twin City Foods, Inc., and AgriNorthwest, employed approximately 2000 people in 2001; however, a large portion of the workers were seasonal (TRIDEC 2002).

Employment and Income Figures. In 2001, nonagricultural employment rose 4 percent. There was an average of 78,500 nonagricultural jobs in the Tri-Cities in 2001, up approximately 3000 from year 2000. Gains in employment ranged from 100 workers in the manufacturing sector to ,700 in services, as every sector added workers except finance, insurance, and real estate, which stayed the same (LMEA 2001b).

In 2000, the total personal income for Benton County was $3.7 billion and for Franklin County was $932 million, compared to the Washington State total of $184.5 billion. Per capita income in 2000 was $25,624 for Benton County, $18,813 for Franklin County, and $31,230 for Washington State (DOC 2001). The preliminary estimate of median household income in 2001 for Benton County is $48,893; Franklin County is estimated at $40,976, and for Washington is estimated at $48,835 (OFM 2001a).

4.8.1.2 Tourism

A significant rise in the number of visitors to the Tri-Cites over the last several years has resulted in tourism playing an increasing role in helping to diversify and stabilize the area economy. The Tri-Cities Visitors and Convention Bureau reported that 97,770 people attended conventions and sporting events, spending an estimated $32.3 million in the Mid-Columbia in 2001. The number of people attending convention and group events has more than doubled since 1995 and more than tripled since 1991.

The importance of tourism is evidenced by the amount of money spent on local goods and services. Overall tourism expenditures in the Tri-Cities were roughly $220 million in 2000, up from $204.7 million in 1999. Travel-generated employment in Benton and Franklin counties was about 4120 with an estimated $56.4 million in payroll, up from an estimated 4090 employed and a $44.7 million payroll in 1999. In addition, tourism generated $3.4 million in local taxes and $15.1 million in state taxes in 2000 (OTED 2002).

4.8.1.3 Retirees

Although Benton and Franklin counties have a relatively young population (approximately 53 percent under the age of 35), 19,523 people over the age of 65 resided in Benton and Franklin counties in 2002. The portion of the total population 65 years and older in Benton and Franklin counties accounts for 9.8 percent of the total population, which is below the 11.2 percent for the state of Washington (OFM 2003). This segment of the population supports the local economy on the basis of income received from government transfer payments and pensions, private pension benefits, and prior individual savings.

4.8.2 Environmental Justice

Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations” (59 FR 7629), directs federal agencies in the Executive Branch to consider environmental justice so that their programs will not have “…disproportionately high and adverse human health or environmental effects…” on minority and low-income populations. Executive Order 12898 further directed federal agencies to consider effects to “populations with differential patterns of subsistence consumption of fish and wildlife.” The Executive Branch agencies also were directed to develop plans for complying with the order. The Council on Environmental Quality (CEQ) provided additional guidance later for integrating environmental justice into the NEPA process in a December 1997 document, *Environmental Justice Guidance under the NEPA* (CEQ 1997).

Minority populations are defined as all nonwhite individuals, plus all individuals of Hispanic origin, as reported in the 2000 Census (Census 2001a). Low-income persons are defined as living in households that report an annual income less than the United States official poverty level, as reported by the Census Bureau. The poverty level varies by size and relationship of the members of the household. The year 2000 poverty level was $17,761 for a family of four (Census 2001a). Nationally, in 1999, 29.9 percent of all persons were minorities, and 11.8 percent of all persons lived in households that had incomes less than the poverty level (which was $17,029 for a family of four in that year) (Census 2000a, b). The year 2000 Census state and county area poverty estimates report that Washington had 11.6 percent of its population living in poverty in 1997, while Benton County and Franklin County had 10.3 percent and 19.2 percent, respectively (Census 2002).

The year 2000 census data indicate that a total population of approximately 482,300 people resided within an 80-km (50-mi) radius of the Hanford Site. Based on the 2000 census, the 80-km (50-mi) area surrounding the Hanford Site had a total minority population of about 178,500, about 37 percent of the total. The ethnic composition of the minority population is primarily White Hispanic (24 percent), self-designated “other” and multiple races (63 percent), and American Native (6 percent). Asians and Pacific Islanders (4 percent) and African American (3 percent) make up the remainder. The Hispanic population resides predominantly in Franklin, Yakima, Grant, and Adams counties. Native Americans within the 80-km (50-mi) area reside primarily on the Yakama Reservation, west of the Hanford Site, and upstream of the Site near the town of Beverly, Washington.

Figure 4.25 shows the location of Census block groups from the 2000 Census that had either a majority of residents who were members of a minority group (racial minority or Hispanic), or whose percentage of residents belonging to any minority group was at least 20 percentage points greater than the corresponding percentage of the state population (Census 2001b, c). Table 4.16 presents population estimates and percentages by race and Hispanic origin for Benton, Franklin, Grant, Adams, and Yakima counties, and the 80-km (50-mi) radius of the Hanford Site.

The 2000 low-income population was approximately 80,700 or 17 percent of the total population residing in the 80-km (50-mi) radius of the Hanford Site. The majority of these households were located to the southwest and north of the site (Yakima and Grant counties), and in the cities of Pasco and Kennewick.

Table 4.17 shows the estimated numbers and percentages of people living below the poverty level in the counties touched by the 80-km (50-mi) circle in Figure 4.26 for the year 2000. The low-income population of this larger area is dispersed throughout this region with the highest concentrations occurring in Franklin, Yakima, and Kittitas counties and the largest numbers in Benton, Yakima, and Grant counties.

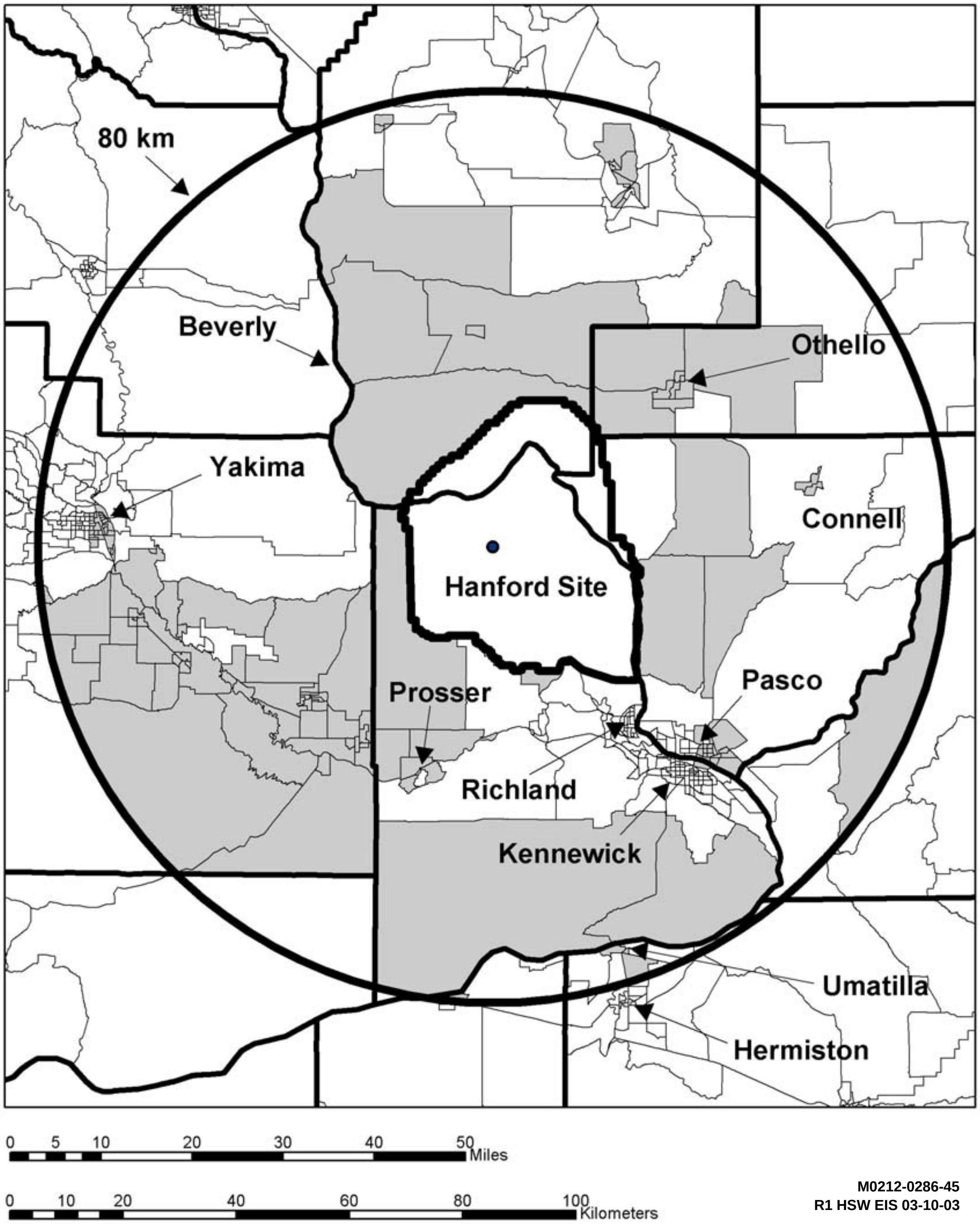


Figure 4.25. Location of Asian, Black, Hispanic, Native American, Pacific Islander, and Overall Minority Populations Near the Hanford Site. (Shading denotes block groups with potential environmental justice concerns).

Table 4.16. Population Estimates and Percentages by Race and Hispanic Origin within Selected Counties in Washington State and the 80-km (50 mi) Radius of Hanford as Determined by the 2000 Census (Census 2003)

Subject	WA State	Percent	Benton/Franklin/ Grant/Adams/ Yakima	Percent	Benton County	Franklin County	Grant County	Adams County	Yakima County	80 km (50 mi) Radius of Hanford[a]
Total Population	5,894,121	100	505,529	100	142,475	49,347	74,698	16,428	222,581	482,300
Single Race	5,680,602	96.4%	489,206	96.8%	138,646	47,302	72,451	15,977	214,830	482,280
White	4,821,823	81.8%	367,283	72.7%	122,879	30,553	57,174	10,672	146,005	347,047
Black or African American	190,267	3.2%	5,494	1.1%	1319	1230	742	46	2,157	5507
American Indian/Alaska Native	93,301	1.6%	12,468	2.5%	1165	362	863	112	9966	10,288
Asian	322,335	5.5%	6809	1.3%	3134	800	652	99	2124	6681
Native Hawaiian/Pacific Islander	23,953	0.4%	482	0.1%	163	57	53	6	203	479
Other Race	228,923	3.9%	96,670	19.1%	9986	14,300	12,967	5042	54,375	112,278
Two or More Races	213,519	3.6%	16,323	3.2%	3829	2045	2247	451	7751	20
Hispanic Origin (of any race)[b]	441,509	7.5%	150,951	29.9%	17,806	23,032	22,476	7732	79,905	149,588

(a) Includes a portion of Oregon

(b) Hispanic origin is not a racial category. It may be viewed as the ancestry, nationality group, lineage, or country of birth of the person or person's parents or ancestors before arrival in the United States. Persons of Hispanic origin may be of any race and are counted in the racial categories shown.

Table 4.17. Number and Percentages of Persons Defined as Low-Income Living in Counties Near the Hanford Site, in 1999, as Determined by the 2000 Census (Census 2002).

	Number(a)		Percent Below Poverty Level
	All Income Levels	Below Poverty Level	
Washington:			
Adams County	16,217	2951	18.2
Benton County	141,232	14,517	10.3
Chelan County	65,564	8147	12.4
Columbia	4008	507	12.6
Franklin	48,307	9280	19.2
Grant County	73,591	12,809	17.4
Kittitas County	31,177	6,122	19.6
Klickitat County	18,983	3236	17.0
Walla Walla County	50,245	7567	15.1
Yakima County	218,966	43,070	19.7
Oregon:			
Morrow County	10,919	1617	14.8
Umatilla County	67,329	8524	12.7
Union County	23,795	3281	13.8
Total	770,333	121,628	15.8

(a) All individuals for whom poverty status is determined.

The CEQ guidance recognizes that many minority and low-income populations derive part of their sustenance from subsistence hunting, fishing, and gathering activities (sometimes for species unlike those consumed by the majority population) or are dependent on water supplies or other resources that are atypical or used at different rates than other groups. These differential patterns of resource use are to be identified where practical and appropriate. There are Native Americans of various tribal affiliations that live in the greater Columbia Basin who rely on natural resources for subsistence.

There is some dependence on natural resources for dietary subsistence for the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, and the Yakama Nation (Harris and Harper 1997). The treaties of 1855 maintain the rights of these tribes to fish, hunt, erect fish-curing structures, gather food, and graze stock in their usual and accustomed places on open/unclaimed portions of the lands ceded to the government. The Wanapum, a non-treaty tribe, historically lived on what is now the Hanford Site and continue to live adjacent to the Site. They fish on the Columbia River and gather food resources near the Hanford Site. The Confederated Tribes of the Colville Reservation, established by an Executive Order in 1872, traditionally fished and gathered food resources in the Hanford area. They are also recognized as having cultural and religious ties to the Hanford Site.

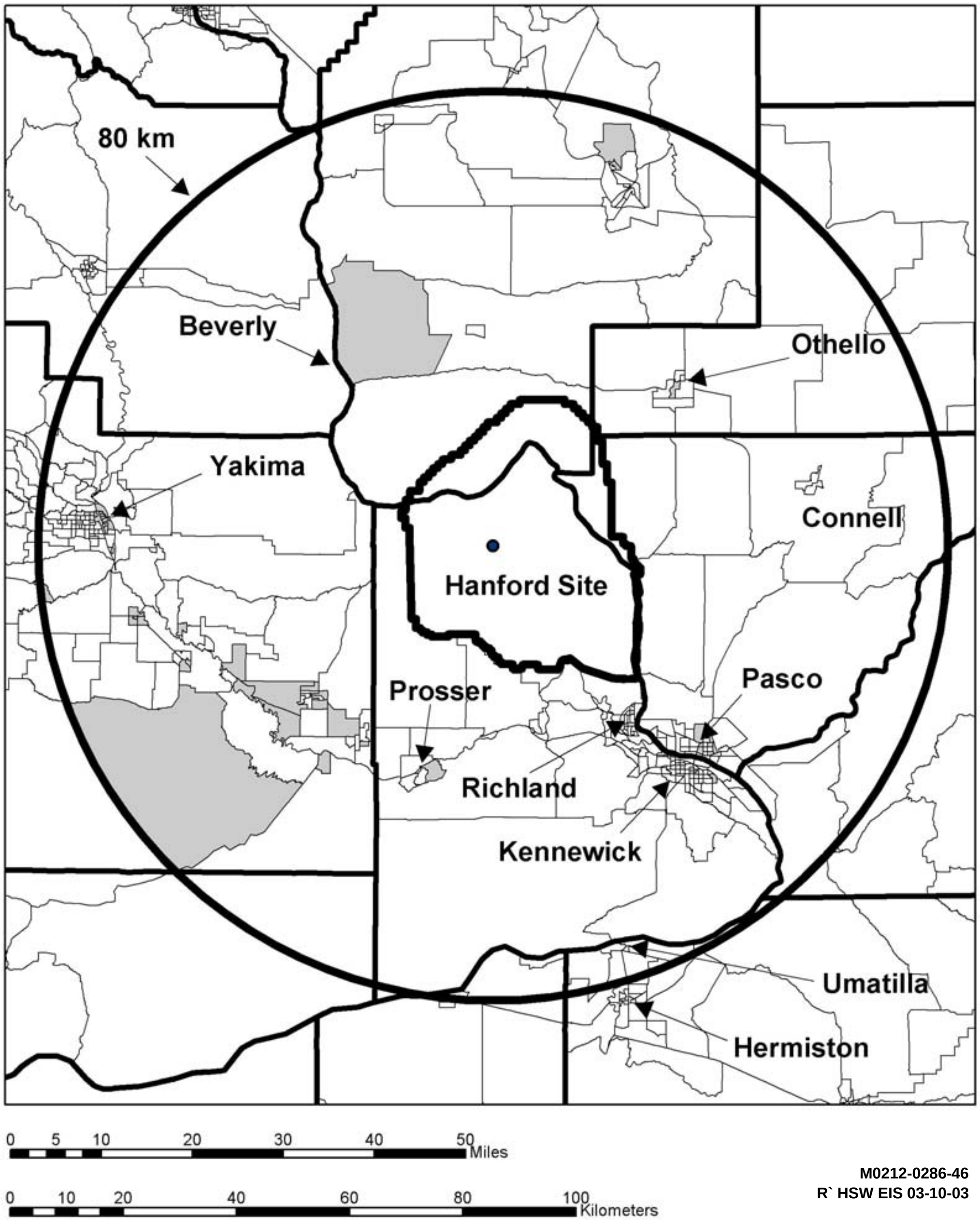


Figure 4.26. Location of Low-Income Populations Near the Hanford Site. (Shading denotes block groups with potential environmental justice concerns).

4.8.3 Demography

Census 2000 report population totals for Benton and Franklin counties were 142,475 and 49,347, respectively (Census 2001b). Benton and Franklin counties grew at a faster pace in the 1990s than

Washington State did as a whole. The population of Benton County grew 26.6 percent up from 112,560 in 1990. The population of Franklin County grew 31.7 percent, up from 37,473 in 1990 (Census 2001b).

Within each county, census figures indicate the distribution of the Tri-Cities population by city as follows: Richland 38,708; Pasco 32,066; and Kennewick 54,693. The combined populations of Benton City, Prosser, and West Richland totaled 15,847 in 2000. The unincorporated population of Benton County was 33,227. In Franklin County, incorporated areas other than Pasco had a total population of 3595. The unincorporated population of Franklin County was 13,886 (Census 2001b).

The 2000 population figures for Benton and Franklin counties indicate that Asians represent a lower proportion, and individuals of Hispanic origin represent a higher proportion of the racial distribution than those in the state of Washington. Countywide, Benton and Franklin counties exhibit varying racial distributions.

In 2000, Benton and Franklin counties accounted for 3.3 percent of Washington's population. The population demographics of Benton and Franklin counties are quite similar to those found within Washington. The population in Benton and Franklin counties under the age of 35 is 53.1 percent, compared to 49.4 percent for Washington State. In general, the population of Benton and Franklin counties is somewhat younger than that of Washington. The 0- to 14-year-old age group accounts for 25.6 percent of the total bi-county population as compared to 21.3 percent for Washington. In 2000, the 65-year-old and older age group constituted 9.8 percent of the population of Benton and Franklin counties, compared to 11.2 percent for Washington (Census 2001b).

4.8.4 Housing

In FY 2001, 2519 houses were sold in the Tri-Cities at an average price of $134,570, compared to 2195 houses sold at an average price of $128,928 in 2000 (TCAR 2001). In FY 2001, 869 single-family houses were built, up 14 percent from the 760 that were built in 2000, but down from a peak of 1117 in 1994 (WCRER 2001a).

As of April 1, 2001, there were estimated to be 73,410 housing units in Benton and Franklin counties, which is 26.4 percent more than the 58,541 in 1990 (OFM 2001c). The number of apartments has increased from 8225 in 1990 to 10,238 in 2001. The vacancy rate of apartments in Benton and Franklin counties in September 2001 was 2.0 percent, and the average rent was $576. These figures are down from the 4.3 percent vacancy rate and up from the $530 average rent in 2000 (WCRER 2001b).

4.8.5 Local and Regional Transportation

The Tri-Cities serves as a regional transportation and distribution center with major air, land, and river connections. The Burlington Northern Santa Fe and Union Pacific railroad companies provide direct rail service. Union Pacific operates the largest fleet of refrigerated rail cars in the United States and is essential to food processors that ship frozen food from this area. Amtrak provides passenger rail service with a station in Pasco.

Docking facilities at the Ports of Benton, Kennewick, and Pasco are important aspects of the regional infrastructure. These facilities are located on the 525-km (326-mi) long commercial waterway that includes the Snake and Columbia Rivers and extends from the ports of Lewiston-Clarkston in Idaho to the deep-water ports of Portland, Oregon, and Vancouver, Washington. The average shipping time from the Tri-Cities to these deep-water ports by barge is 36 hours.

Daily air passenger and freight services connect the area with most major cities through the Tri-Cities Airport, located in Pasco. This modern commercial airport links the Tri-Cities to major hubs and provides access to destinations anywhere in the world. Delta Airlines, United Express, and Horizon Air offer 33 flights into and out of the Tri-Cities daily connecting to domestic and international flights through Salt Lake City, Seattle, Denver, Spokane, and Portland. A total of 206,188 passengers, used the Tri-Cities Airport in 2001, which was down slightly from 2000 when the airport set a record of 209,434 passengers and was the sixth year in a row of passenger increases. Projections indicate the terminal can serve almost 300,000 passengers annually. The Tri-Cities region has three general aviation airports that serve private aircraft. Air freight shippers that service the region include Airborne from the Richland airport, United Parcel Service from the Kennewick airport, and Federal Express from the Tri-Cities Airport in Pasco.

Mass transit in the area is provided by the Ben Franklin Transit system. The system covers more than 286 km^2 (110 mi^2) and provides frequent service to most local communities. The Ben Franklin transit system consists of 54 buses, 31 Dial-a-Ride para-transit vehicles, and 75 Van Pool vans. Two local taxi companies provide radio-dispatched taxicab service 24 hours a day: A-1 Tri-Cities Cab and AMR Transportation. Intercity bus transportation is available.

The regional transportation network in the Hanford vicinity includes the areas in Benton and Franklin counties from which most of the commuter traffic associated with the Site originates. Interstate (I) highways that serve the area are I-82 and I-182. I-82 is 8 km (5 mi) south-southwest of the Hanford Site. I-182, a 24-km (15-mi) long urban connector route, located 8 km (5 mi) south-southeast of the site, provides an east-west corridor linking I-82 to the Tri-Cities area. I-90, located north of the site, is the major link to Seattle and Spokane and extends to the East Coast. I-82 serves as a primary link between Hanford and I-90, as well as I-84. I-84, located south of the Hanford Site in Oregon, is a major corridor leading to Portland, Oregon. SR 224, also south of the site, serves as a 16-km (10-mi) link between I-82 and SR 240. SR 24 enters the Site from the west, continues eastward across the northernmost portion of the site, and intersects SR 17 approximately 24 km (15 mi) east of the site boundary. SR 17 is a north-south route that links I-90 to the Tri-Cities and joins U.S. Route 395, continuing south through the Tri-Cities. U.S. Route 395 north also provides direct access to I-90. SR 240 and 24 traverse the Hanford Site and are maintained by Washington State.

A DOE-maintained road network within the Hanford Site consists of 607 km (377 mi) of asphalt-paved road, and provides access to the various work centers (Figure 4.27). Primary access roads on the Hanford Site are Routes 1, 2, 3, 4, 6, 10, and 11A. The 200 East Area is accessed primarily by Route 4 South from the east and from Route 4 North off Route 11A from the north and from Route 11A for vehicles entering the site at the Yakima Barricade. A new access road was opened in late 1994 to provide access directly to the 200 Areas from SR 240. Public access to the 200 Areas and interior locations of the

Hanford Site has been restricted by guarded gates at the Wye Barricade (at the intersection of Routes 10 and 4), the Yakima Barricade (at the intersection of SR 240 and Route 11A), and Rattlesnake Barricade south of the 200 West Area. None of the previously listed roadways have experienced any substantial congestion except Route 4. Onsite road usage is being assessed to determine whether roads could be closed to reduce the cost of infrastructure and maintenance.

Access to the Hanford Site is via three main routes, Hanford Route 4S from Stevens Drive or George Washington Way in the City of Richland, Route 10 from SR 240 near its intersection with SR 225, or via Route 11A from SR 240 near its intersection with SR 240. Another route, through the Rattlesnake Barricade, is located 35 km (22 mi) northwest of Stevens Drive and is for passenger vehicle access only. The estimated total number of commuters to this area is 3100. Approximately 87 percent of the workers commuting to the 200 Areas are from the Tri-Cities, West Richland, Benton City, and Prosser (Perteet et al. 2001).

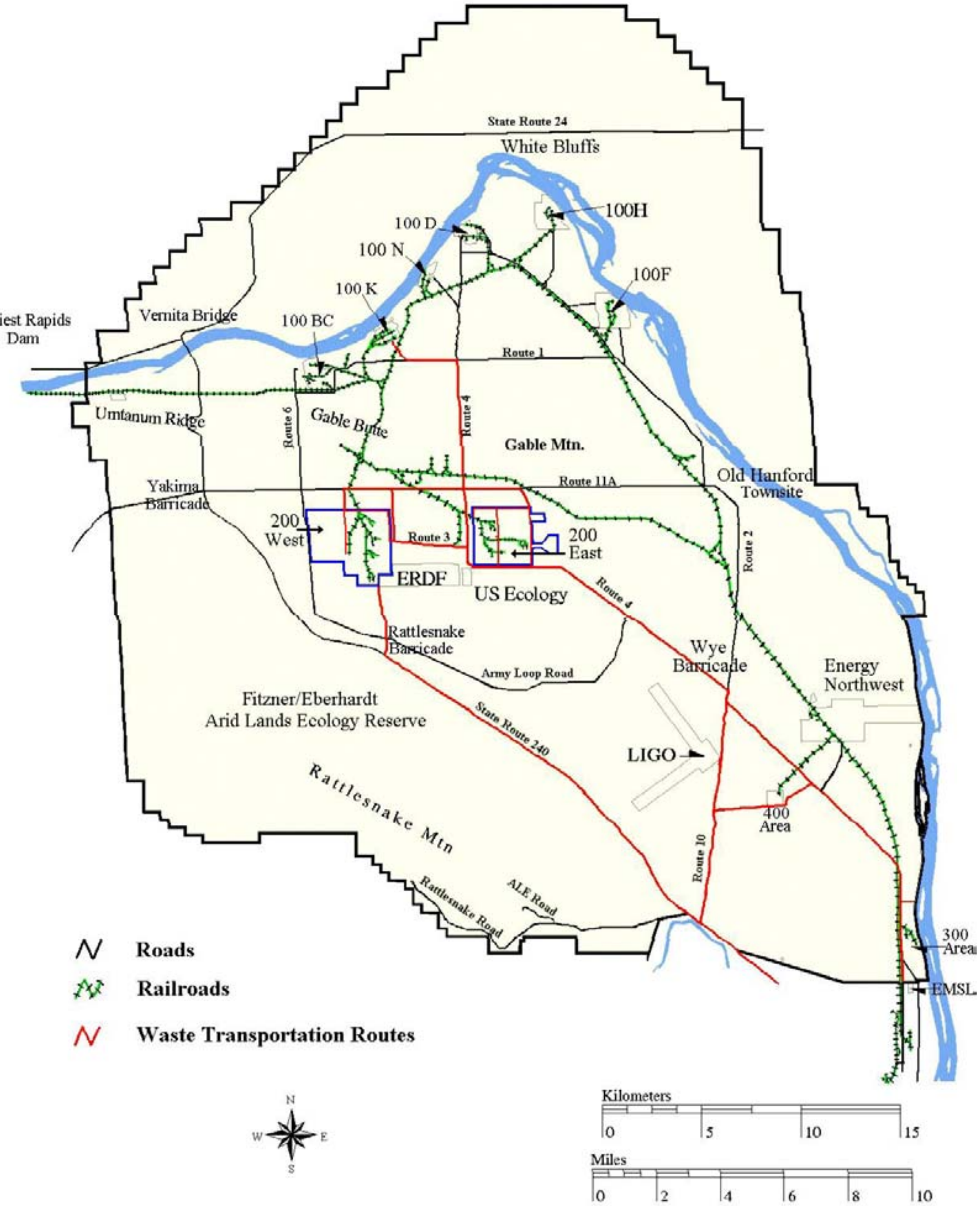
The portion of SR 240 most affected by 200 Area commuters is between U.S. 395 and Stevens Drive. Portions of this roadway currently operate below the minimum level of service established by the Regional Transportation Planning Organization. Peak annual average daily traffic (AADT) on the section from Columbia Center Boulevard to I-182 is 54,000 (Perteet et al. 2001).

I-182 has peak traffic counts of 35,000 AADT in the vicinity of SR 240. I-182 also has current deficiencies at the interchanges with Queensgate Drive and 20th Avenue. Van Giesen transports most of the commuters from West Richland and Benton City to SR 240. The intersection of SR 224 and SR 240 is the only section of SR 224 with current level of service (LOS) deficiencies. LOS is a qualitative measure of the roadway ability to accommodate vehicular traffic, ranging from free-flow conditions (LOS A) to extreme congestion (LOS F). LOS D is considered the lower end of acceptable LOS (Perteet et al. 2001).

Stevens Drive has peak traffic counts of 8300 AADT at Horn Rapids Road and 22,000 AADT just north of its intersection with SR 240. Currently this roadway experiences LOS deficiencies. George Washington Way is the principal north-south arterial through Richland. AADT at the entrance of the Hanford Site on George Washington Way is 1800. Counts north of McMurray are 18,000 AADT and on George Washington Way just north of I-182 are 43,000 AADT. George Washington Way has LOS deficiencies between I-182 and Swift Boulevard (Perteet et al. 2001).

Private vehicles account for 91 percent of the person trips to the Hanford Site. The remaining person trips are by forms of high-occupancy vehicles (mostly Ben-Franklin Vanpools). Of the 91 percent of private vehicles only 3 percent are by carpool with the remaining 88 percent being single occupancy vehicles. The Draft Regional Transportation Plan identifies 11,468 employees working at Hanford. Based on 88 percent of the trips carrying a single person to Hanford, 10,092 single occupancy trips are made daily or an AADT of 10,184 (Perteet et al. 2001).

The Hanford Site rail system originally consisted of approximately 210 km (130 mi) of track. It connected to the Union Pacific commercial track at the Richland Junction (at Columbia Center in Kennewick) and to a now-abandoned commercial right-of-way (Chicago, Milwaukee, St. Paul, and



ALE – (Fitzner Eberhardt) Arid Lands Ecology
EMSL – Environmental and Molecular Sciences Laboratory
ERDF – Environmental Restoration Disposal Facility
LIGO – Laser Inteferometer Gravitational Wave Observatory
mtn. – mountain

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Figure 4.27. Transportation Routes on the Hanford Site

Pacific railroads) near Vernita Bridge in the northwest section of the site. Prior to 1990, annual railcar movements numbered about 1400 sitewide, transporting materials including coal, fuel, hazardous process chemicals, and radioactive materials and equipment (DOE and Ecology 1996). In October 1998, 26 km (16 mi) of track from Columbia Center to Horn Rapids Road were transferred to the Port of Benton and are currently operated by the Tri-City Railroad. The Port of Benton has been granted the right to operate portions of the railroad on the Hanford Site.

4.8.6 Educational Services

The majority of primary and secondary education in the Tri-Cities area is served by the Richland, Pasco, Kennewick, and Benton City School Districts. The total 2001 fall enrollment for all districts in Benton and Franklin counties was 40,590 students, an increase of 2.2 percent from the 2000 total of 39,702 students. The 2000 totals include 9622 from the Richland School District, up from 9464 in 2000; 9227 students from the Pasco School District, up from 8850 in 2000; 13,993 students from the Kennewick School District, up from 13,629 in 2000; and 1664 from the Kiona-Benton School District, down from 1673 in 2000 (OSPI 2002).

Several private elementary and secondary schools are located in the Tri-Cities, including Bethlehem Lutheran (K-8) and St. Josephs (K-8) in Kennewick, Christ the King (K-8) and Liberty Christian (K-12) in Richland, Faith Christian (K-12), Country Haven Academy (9-12), St. Patrick's (K-8), Tri-City Junior Academy (K-10), and Tri-Cities Prep Catholic High School in Pasco (9-12). Fall 2001 enrollment at these schools totaled 2350 students, an increase of 1.6 percent from the 2000 total of 2312 (OSPI 2002). Home schooling is prevalent in the Tri-Cities, with students totaling 544. Richland School District reports 205 students are home schooled within their jurisdiction, Pasco School District reports 113, and Kennewick School District has 226 students home schooled (Neitzel 2002b).

Post-secondary education in the Tri-Cities area is provided by Columbia Basin College (CBC), City University, and Washington State University, Tri-Cities branch campus (WSU-TC). The 2001 fall/winter enrollment was approximately 7750 at CBC, 100 at City University, and 1083 at WSU-TC. Many of the programs offered by these three institutions are geared toward the vocational and technical needs of the area. In the 2000-01 academic year, CBC offered 25 Associate in Applied Science (AAS) degree programs. City University offers two associate degree programs, four undergraduate, and three graduate programs, plus access to several more programs through Distance Learning. WSU-TC offers 14 undergraduate and 16 graduate programs, as well as access to graduate programs via satellite (Neitzel 2002a).

4.8.7 Health Care and Human Services

The Tri-Cities area has three major hospitals and five minor emergency centers, as well as a cancer treatment center. All three hospitals offer general medical services and each includes a 24-hour emergency room, basic surgical services, intensive care, and neonatal care.

The Tri-Cities offers a broad range of social services. State human service offices in the Tri-Cities include the Job Service Center within the Employment Security Department; food stamp offices; the

Developmental Disabilities Division; financial and medical assistance; the Child Protective Service; emergency medical service; a senior companion program; and vocational rehabilitation.

The Tri-Cities is also served by a large number of private agencies and voluntary human service organizations. United Way incorporates 21 participating agencies offering 38 programs. These member agencies had a cumulative budget total of $27 million in 2000. In addition, 572 organizations received funds as part of the United Way Benton-Franklin County donor designation program.

4.8.8 Police and Fire Protection

The Benton and Franklin County sheriff departments, local municipal police departments (Pasco, Kennewick, Richland, West Richland), and the Washington State Patrol Division in Kennewick provide local police protection.

Fire protection in the Tri-Cities area is provided by fire departments in Kennewick, Richland, and Pasco, a volunteer fire department in West Richland, and three rural fire departments in Benton County.

The Hanford Site Fire Department has fire stations onsite, and the Benton County Sheriff Department provides onsite law enforcement. Site security is provided onsite by the Hanford Patrol.

4.8.9 Utilities

The principal sources of water in the Tri-Cities and the Hanford Site are the Columbia River and groundwater. The water systems of Richland, Pasco, and Kennewick drew a large portion of the 51.5 billion L (13.6 billion gal) used in 2000 from the Columbia River. Each city operates its own supply and treatment system. The Richland water supply system derives about 82 percent of its water directly from the Columbia River, while the remainder is split between a well field in North Richland (that is recharged from the river) and groundwater wells. The city of Richland's total usage in 2001 was 25.2 billion L (6.7 billion gal). The Pasco system also draws from the Columbia River for its water needs. In 2001, Pasco consumed 11.8 billion L (3.1 billion gal). The Kennewick system uses two wells and the Columbia River for its supply. These wells serve as the sole source of water between November and March and can provide approximately 40 percent of the total maximum supply of 30 billion L (8 billion gal). Total 2001 usage in Kennewick was 13.2 billion L (3.5 billion gal) (Neitzel 2002a).

The Benton County Public Utility District, Benton Rural Electric Association, Franklin County Public Utility District, and City of Richland Energy Services Department provide the Tri-Cities with electricity. Almost all of the power these utilities provide in the local area is purchased from the Bonneville Power Administration (BPA) that also provides power to the Hanford Site. Natural gas, provided by the Cascade Natural Gas Corporation, serves approximately 11,000 customers in the Tri-Cities, as well as the 300 Area of the Hanford Site.

4.8.10 Aesthetic and Scenic Resources

Broad basins and plateaus interspersed with ridges characterize the Hanford Site landscape. The wide vistas composing much of the area are interrupted by numerous large industrial facilities (for example, reactors and processing facilities). However, DOE and its predecessors have disturbed only about 6 percent of the site. The remainder lies undeveloped and includes natural areas and abandoned agricultural lands that remain undisturbed because of restricted public access. The Hanford Reach National Monument was established in part because of these aesthetic and scenic resources.

The Columbia River flows through the northern portion of the Hanford Site before turning south and forming the eastern site boundary. The White Bluffs, steep whitish-brown cliffs adjacent to the Columbia River, comprise a striking natural feature of the landscape. Rattlesnake Mountain, rising to 1092 m (3581 ft) above mean sea level forms the southeastern boundary of the Hanford Site. Gable Mountain and Gable Butte are the highest landforms within the Hanford Site. Large rolling hills are located to the west and north.

SR 240 provides public access through the southwestern portion of the Hanford Site. Views along this highway include the open lands of the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE) in the foreground to the west, with the prominent peak of Rattlesnake Mountain and the extended ridgelines of the Rattlesnake Hills in the background. To the east, the views include relatively flat terrain with the structures of the 200 East and 200 West Areas visible in the central area with Gable Butte and Gable Mountain in the background. From the highway, the Saddle Mountains can be seen in the distance to the north and steam plumes from the Energy Northwest reactor cooling towers are often visible in the distance to the east. The views along SR 240 are expansive due to the flat terrain and the predominantly short, treeless, vegetation cover.

Hanford Site facilities can also be seen from elevated locations, such as Gable Mountain, Gable Butte, Rattlesnake Mountain, and other parts of the Rattlesnake Hills along the western perimeter. Facilities are visible from the Columbia River as well. Because of the vast expanse, terrain, and distances involved, only portions of the site are visible from any one point.

The acquisition of spiritual guidance and assistance through personal vision quests is deeply rooted in the religious practices of the indigenous people of the Columbia Basin. High spots were selected because they afforded extensive views of the natural landscape and seclusion for quiet meditation. These practices, and the areas where they took place, are critical in maintaining the continuing cultural identity of the Native American community, and, as such, are eligible for inclusion in the National Register. The high points of the Hanford Site, including Gable Mountain, Rattlesnake Mountain, and Wahluke Slope, are representative of locations where vision quests were conducted. The physical landscape visible from each location is a means to determine areas and resources of concern.

4.9 Noise

Noise is technically defined as sound waves that are unwanted and perceived as a nuisance by humans. Sound waves are characterized by frequency, measured in Hertz (Hz), and sound pressure

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The acquisition of spiritual guidance and assistance through personal vision quests is deeply rooted in the religious practices of the indigenous people of the Columbia Basin. High spots were selected because they afforded extensive views of the natural landscape and seclusion for quiet meditation. These practices, and the areas where they took place, are critical in maintaining the continuing cultural identity of the Native American community, and, as such, are eligible for inclusion in the National Register. The high points of the Hanford Site, including Gable Mountain, Rattlesnake Mountain, and Wahluke Slope, are representative of locations where vision quests were conducted. The physical landscape visible from each location is a means to determine areas and resources of concern.

4.9 Noise

Noise is technically defined as sound waves that are unwanted and perceived as a nuisance by humans. Sound waves are characterized by frequency, measured in Hertz (Hz), and sound pressure expressed as decibels (dB). Most humans have a perceptible hearing range of 31 to 20,000 Hz. A decibel is a standard unit of sound pressure. The threshold of audibility for most humans ranges from about 60 dB at a frequency of 31 Hz to less than about 1 dB between 900 and 8000 Hz. (For regulatory purposes, noise levels for perceptible frequencies are weighted to provide an A-weighted sound level [dBA] that correlates highly with individual community response to noise.) Sound pressure levels outside the range of human hearing are not considered noise in a regulatory sense, even though wildlife may be able to hear at these frequencies.

Noise levels are often reported as the equivalent sound level (L_{eq}). The L_{eq} is expressed in dBA over a specified period of time, usually 1 or 24 hour(s). The L_{eq} is the equivalent steady sound level that, if continuous during a specified time period, would contain the same total energy as the actual time-varying sound over the monitored or modeled time period.

Environmental noise measurements were made on the Hanford Site in 1981 during site characterization for the Skagit/Hanford Nuclear Power Plant Site (NRC 1982). Measurements were also made at five locations during 1987 when the Hanford Site was considered for a geologic waste repository (BWIP) for spent commercial nuclear fuel and other high-level nuclear waste. Additionally, noise levels as a result of field activities, such as well drilling and sampling, were measured. Baseline offsite noise measurements attributable to automobile traffic were also determined.

During site characterization for the Skagit/Hanford Nuclear Power Plant (NRC 1982), 15 sites were monitored and noise levels were found to range from 30 to 60.5 dBA (L_{eq}). The values for isolated areas ranged from 30 to 38.8 dBA. Measurements taken around the sites where Energy Northwest was constructing nuclear power plants (WNP-1, WNP-2, and WNP-4) ranged from 50.6 to 64 dBA. Measurements taken along the Columbia River near the intake structures for WNP-2 were 47.7 and 52.1 dBA, compared with more remote river noise levels of 45.9 dBA (measured about 4.8-km [3 mi] upstream of the intake structures). Community noise levels in north Richland (Horn Rapids Road and SR 240) were 60.5 dBA.

Background noise levels were determined at five locations within the Hanford Site for studies supporting the BWIP. Noise levels are expressed as L_{eqs} for 24 hr (L_{eq-24}). On the dates tested, the average noise level for the five sites was 38.9 dBA. Wind was identified as the primary contributor to background noise levels, with winds exceeding 19 km/hr (12 mi/hr) significantly affecting noise levels. Background noise levels in undeveloped areas at Hanford can best be described as a mean L_{eq-24} of 24 to 36 dBA. Periods of high wind that normally occur in the spring would elevate background noise levels.

Baseline noise levels as a result of automobile traffic were determined for two locations: SR 24, leading from the Hanford Site west to Yakima, and SR 240, south of the site and west of Richland where the route handles maximum traffic volume (DOE 1991). Traffic volumes were predicted based on an operational workforce and a construction workforce. Peak (rush hour) and off-peak hours were modeled. Noise levels were expressed in L_{eq} for 1-hr periods in dBA at a receptor located 15 m (49 ft) from the road edge. Baseline noise levels during the construction phase were 62 dBA for SR 24 and 70.2 dBA for SR 240. Levels based on the operational phase ranged from 62 to 65.7 dBA for SR 24 and 70.2 to

74.1 dBA for SR 240. Adverse community responses would not be expected at increases of 5 dBA over background noise levels.

In the interest of protecting Hanford workers and complying with Occupational Safety and Health Administration (OSHA) standards for noise in the workplace, that Hanford Environmental Health Foundation (HEHF) has monitored noise levels resulting from several routine operations performed at Hanford. Occupational sources of noise propagated in the field include well sampling, well drilling, water wagon operation, trucks, compressors, and generators. Noise levels from these activities ranged from 74.8 to 125 dBA (Neitzel 2002a) and have the potential for disturbing sensitive wildlife.

4.10 Occupational Safety

Total occupational work hours at the Hanford Site for the 5-year period, 1997-2001, were 106,836,082 hours, or about 56,230 worker-years (DOE 2002). The DOE records occupational injuries and illnesses in four categories pertinent to NEPA analysis. Total recordable cases (TRCs) are work-related deaths, illnesses, or injuries resulting in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid. Lost workday cases (LWCs) represent the number of cases recorded resulting in days away from work or days of restricted work activity, or both, for affected employees. Lost workdays (LWDs) are the total number of workdays (consecutive or not), after the day of injury or onset of illness, during which employees were away from work or limited to restricted work activity because of an occupational injury or illness. Fatalities are the number of occupationally related deaths. Information on occupational safety used in this section is updated quarterly and is available at URL: http://tis.eh.doe.gov/cairs.

Occupational injury and illness incidence rates for the Hanford Site Office of River Protection showed a steady decrease from 1997 through 2000 (Figure 4.28). Rates ranged from 3.0 cases per 200,000 worker hours (100 worker years) in 1997 to 1.7 cases in 2001. Occupational injury and illness incidence rates for Richland Operations declined from 1997 to 2000, increasing slightly during 2001. In 1997 there were 3.1 cases per 200,000 worker hours. Rates decreased to 2.0 cases in 2000 and increased slightly in 2001 to 2.1 cases per 200,000 worker hours. Occupational injury and illness incidence rates for the DOE complex also demonstrate annual decreases, ranging from 3.5 cases per 200,000 worker hours during 1997 to 2.3 cases in 2001 (DOE 2002).

Over the 5-year period from 1997 to 2001, rates on the Hanford Site averaged 2.4 cases per 200,000 worker hours, whereas the incidence rate for the entire DOE complex averaged slightly higher, at 2.8 cases per 200,000 worker hours (DOE 2002). The Hanford Site and DOE-wide average TRC rates were well below the Bureau of Labor Statistics (BLS) rates for U.S. private industry of 6.7 cases per 200,000 worker hours during the same period (BLS 2002).

Table 4.18 shows occupational injury, illness, and fatality incidence rates reported for the private sector by the BLS (Department of Labor), and throughout the DOE complex, including DOE’s Richland Operations and Office of River Protection. During the 5-year period from 1997 to 2001, Hanford Site TRC and LWC rates were somewhat lower than those for DOE, whereas the private sector was consistently higher. Average LWD rates for Richland Operations for the 1997 to 2001 period were higher

74.1 dBA for SR 240. Adverse community responses would not be expected at increases of 5 dBA over background noise levels.

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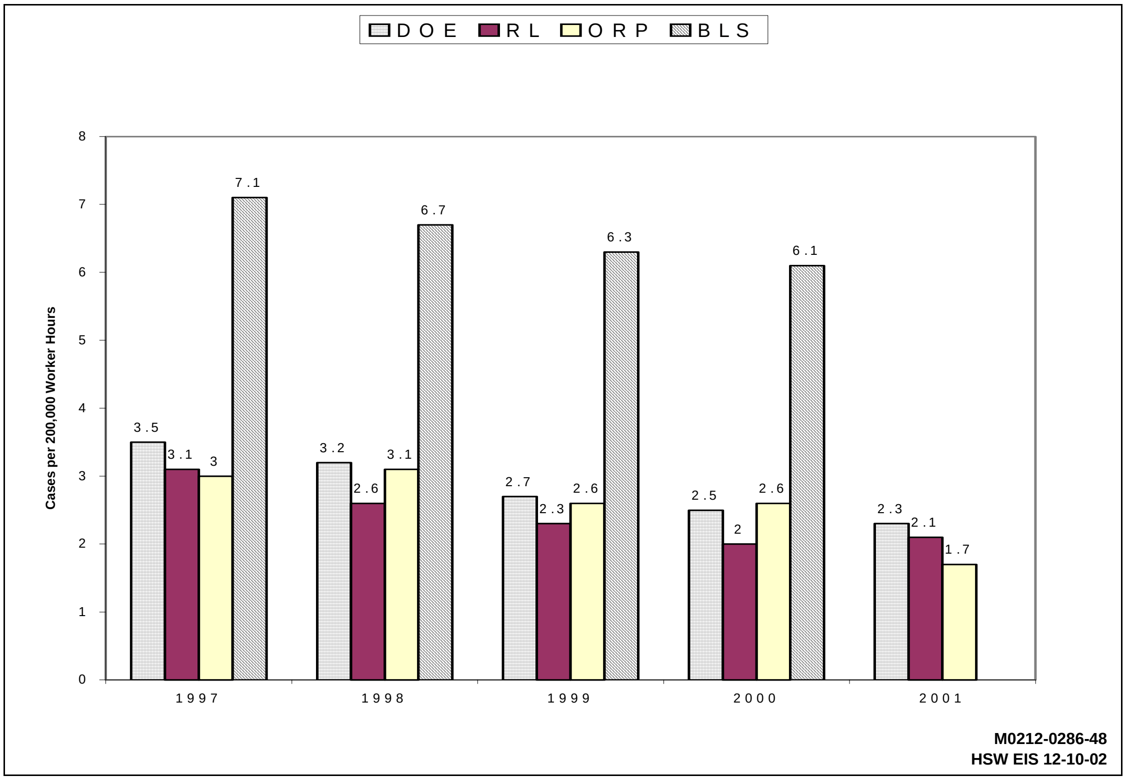

Figure 4.28. Occupational Injury and Illness Total Recordable Case Rates at the Hanford Site Compared to the DOE Complex and Private Industry (DOE 2002)

than Hanford's Office of River Protection and the entire DOE complex. There were no fatalities at the Hanford Site during the 1997 to 2001 period (DOE 2002).

4.11 Occupational Radiation Exposure at the Hanford Site

DOE's Office of Safety and Health reports occupational radiation exposure data for all monitored DOE employees, contractors, subcontractors, and members of the public associated with DOE facilities. The total number monitored for the 5-yr period, 1997-2001, at the Hanford Site was 53,888 individuals. Waste processing and management facility employees monitored for the same period was 7404, or approximately 14 percent of the site workforce (DOE 2003).

DOE has established dose limits in order to control radiation exposures. The primary DOE dose limit is 5000 mrem/yr (50 mSv/yr) to the whole body, expressed as the Total Effective Dose Equivalent (TEDE), which is the sum of dose due to radiation sources internal and external to the body.

Table 4.19. Radiation Exposure Data for the Hanford Site, 1997-2001 (DOE 2003)

Year	Total Number Monitored	Number with Meas. Dose	Percent with Dose >0	Total Collective Dose (TEDE)		Average Dose to Workers (mrem)	
				(Person-rem/yr)	(Person-mrem/yr)	All Monitored	All with Dose >0
Hanford Site							
2001	10,485	2218	21%	214	213,628	20	96
2000	10,048	1923	19%	219	219,032	22	114
1999	11,310	2013	18%	182	182,000	16	90
1998	10,441	1772	17%	181	180,927	17	102
1997	11,604	2058	18%	235	235,355	20	114
Cumulative Totals							
1997-2001	53,888	9984	19%	1031	1,030,942	19	103
Waste Processing/Management Facility							
2001	1216	294	24%	17	17,277	14	59
2000	938	234	25%	27	26,722	28	114
1999	1598	479	30%	64	64,258	40	134
1998	1609	419	26%	52	51,728	32	123
1997	2043	538	26%	50	50,033	24	93
Cumulative Totals							
1997-2001	7404	1964	27%	210	210,018	28	107

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5.0 Environmental Consequences

The results of analyses performed to assess potential environmental consequences, or impacts, of implementing any of the alternatives are presented in the following sections. For each category of potential environmental impacts considered, brief descriptions of the impact analysis method and the analysis results are given. Details of analytical methods, where applicable, are provided in appendixes, as noted within each section. Because the type and level of analysis typically needed for each environmental aspect of interest vary widely, the level of detail in the results presented in the following sections varies commensurate with the nature of the analysis and the potential for consequences associated with that environmental aspect.

In Section 3, Description and Comparison of Alternatives, various alternatives were described for storage, treatment, and disposal of low-level waste (LLW), mixed low-level waste (MLLW), transuranic (TRU) waste, and immobilized low-activity waste (ILAW, the low-activity fraction of tank waste). For purposes of analysis in this section, consequences associated with the alternative actions for each waste type have been combined to provide a consolidated analysis of waste management operations. In the following sections, these consolidated analyses, while retaining the designations corresponding to the various alternatives for each waste type described in Section 3, are analyzed by groups of alternatives. This approach facilitates presentation of impacts for all Hanford Solid Waste Program operations and also is necessary to evaluate facilities that are used to manage more than one type of waste. In these latter consolidated alternative groups, each of the waste types is considered, and the impacts either are analyzed directly or bounded by analysis of similar activities where appropriate.

Unless stated otherwise, waste volumes for which evaluations of environmental consequences of the alternatives were made include a Hanford Only volume, a Lower Bound waste volume consisting of the Lower Bound volumes for LLW and MLLW (some of which would be received from offsite generators),[a] the maximum forecast volume for TRU waste, and the ILAW volume as defined in Section 3. Similarly, evaluations were made for an Upper Bound waste volume consisting of the Upper Bound volumes for LLW and MLLW as might be received from offsite (in keeping with provisions of the Waste Management Programmatic Environmental Impact Statement [WM PEIS] [DOE 1997]), the maximum forecast volume for TRU waste, with additional offsite waste, and the Hanford Site ILAW volume, again as defined in Section 3.

The alternatives analyzed in detail by groups are described in the following paragraphs. The cumulative impacts are discussed in Section 5.14.

(a) The amount of the Lower Bound waste volume received from offsite generators would consist of 18 percent Category 1 LLW, 4 percent Category 3 LLW, and 0.2 percent MLLW.

Alternative Group A

Actions included in Alternative Group A are:

- modification of the T Plant Complex to treat some MLLW and for processing and certification of some TRU waste for shipment to the Waste Isolation Pilot Plant (WIPP)
- treatment of other MLLW
- treatment of some non-conforming LLW at commercial facilities, followed by return to the Hanford Site for disposal
- continued operation of the Waste Receiving and Processing Facility (WRAP) to process and certify some TRU waste for shipment to WIPP
- shipment of all TRU waste to WIPP following processing and certification
- disposal of LLW in 200 West Area low-level burial grounds (LLBGs) in unlined trenches that would be deeper and wider than those currently employed
- disposal of MLLW in 200 East Area LLBGs in lined trenches that would be deeper and wider than those currently employed
- disposal of melters in a lined trench in a new disposal facility near the Plutonium-Uranium Extraction (PUREX) Plant in the 200 East Area
- disposal of ILAW in multiple lined trenches in a new disposal facility near the PUREX Plant
- capping LLW trenches in the LLBGs with a modified Resource Conservation and Recovery Act (RCRA) Subtitle C cover
- capping MLLW trenches with a modified RCRA Subtitle C cover
- capping the melter trench with a modified RCRA Subtitle C cover
- capping the ILAW disposal facility with a modified RCRA Subtitle C cover.

Alternative Group B

Actions included in Alternative Group B are listed here. Actions that are the same as those in Alternative Group A are presented in *italics*.

- construction of a new waste processing facility in the 200 Areas to provide onsite capability to treat most MLLW and non-conforming LLW, and for processing and certification of TRU waste for shipment to WIPP (rather than modifying T Plant for that purpose)

- treatment of non-conforming LLW onsite

- treatment of a limited quantity of MLLW at commercial facilities, followed by return to the Hanford Site for disposal

- *continued operation of the WRAP to process and certify some TRU waste for shipment to WIPP*

- *shipment of all TRU waste to WIPP following processing and certification*

- disposal of LLW in 200 West Area LLBGs in unlined trenches of a design similar to those currently employed

- disposal of MLLW in 200 West Area LLBGs in lined trenches of a design similar to those currently employed until permitted lined trenches are full, then disposed of in 200 East Area LLBGs, again in trenches similar to those currently employed

- disposal of melters in the 200 East Area in a lined melter trench

- disposal of ILAW in multiple lined trenches in the 200 West Area

- capping LLW and MLLW trenches in the LLBGs with a modified RCRA Subtitle C cover

- capping the melter trench with a modified RCRA Subtitle C cover

- capping ILAW burial site with a modified RCRA Subtitle C cover.

Alternative Group C

Actions included in Alternative Group C are listed below. Actions that are the same as those in Alternative Group A are presented in *italics*.

- *modification of the T Plant Complex to provide the capability for treating some MLLW and for processing and certification of some TRU waste for shipment to WIPP*

- *treatment of other MLLW and some non-conforming LLW at commercial facilities, followed by return to the Hanford Site for disposal*

- *continued operation of the WRAP to process and certify some TRU waste for shipment to WIPP*

- *shipment of all TRU waste to WIPP following processing and certification*

- disposal of LLW in 200 West Area LLBGs in a single unlined expandable trench

- disposal of MLLW in 200 East Area LLBGs in a single lined expandable trench

- disposal of melters in a lined trench near the PUREX Plant in the 200 East Area

- disposal of ILAW in a single lined expandable trench near the PUREX Plant

- *capping LLW trenches in the LLBGs with a modified RCRA Subtitle C cover*

- *capping MLLW trenches with a modified RCRA Subtitle C cover*

- capping the melter trench with a modified RCRA Subtitle C cover

- *capping the ILAW burial site with a modified RCRA Subtitle C cover.*

Alternative Group D

Alternative Group D contains three subalternative groupings that depend on the location of disposal. These are denoted by subscripts.

Actions included in Alternative Group D are listed here. Actions that are the same as those in Alternative Group A are presented in *italics*.

- *modification of the T Plant Complex to provide the capability for treating some MLLW and for processing and certification of some TRU waste for shipment to WIPP*

- *treatment of other MLLW and some non-conforming LLW at commercial facilities, followed by return to the Hanford Site for disposal*

- *continued operation of the WRAP to process and certify some TRU waste for shipment to WIPP*

- *shipment of all TRU waste to WIPP following processing and certification*

- Alternative Group D_1—disposal of LLW, MLLW, melters, and ILAW in a lined modular facility in the 200 East Area near the PUREX Plant

- Alternative Group D_2—disposal of the wastes listed above in a lined modular facility in the 200 East Area LLBGs

- Alternative Group D_3—disposal of the wastes listed above in a lined modular facility at the Environmental Restoration Disposal Facility (ERDF)

- capping the lined modular facility with a modified RCRA Subtitle C cover.

Alternative Group E

Alternative Group E contains three subalternative groupings that depend on the location of disposal and waste type. These are denoted by subscripts.

Actions included in Alternative Group E are as listed below. Actions that are the same as those in Alternative Group A are presented in *italics*.

- *modification of the T Plant Complex to provide the capability for treating some MLLW and for processing and certification of some TRU waste for shipment to WIPP*

- *treatment of other MLLW and some non-conforming LLW at commercial facilities, followed by return to the Hanford Site for disposal*

- *continued operation of the WRAP to process and certify some TRU waste for shipment to WIPP*

- *shipment of all TRU waste to WIPP following processing and certification*

- Alternative Group E_1—disposal of LLW and MLLW in a lined modular facility in the 200 East Area LLBGs and disposal of melters and ILAW in a lined modular facility at the ERDF

- Alternative Group E_2—disposal of LLW and MLLW in a lined modular facility near the PUREX Plant and disposal of melters and ILAW at the ERDF

- Alternative Group E_3—disposal of LLW and MLLW in a lined modular facility at the ERDF and disposal of melters and ILAW in a lined modular facility near the PUREX Plant

- capping the lined modular facilities with a modified RCRA Subtitle C cover.

No Action Alternative

This analysis consists of the combined impacts associated with the No Action Alternative for LLW, MLLW, TRU waste, and ILAW as described in Section 3. The Hanford Only waste volume and the Lower Bound waste volume as defined in Section 3 were used for evaluation purposes. This No Action Alternative consists of continuing current solid waste management practices including implementing the Tank Waste Remediation System (TWRS) Record of Decision (ROD) (62 FR 8693). Actions evaluated as part of the No Action Alternative include those listed below. Actions that are the same as those in Alternative Group A are presented in *italics*.

- treatment of a limited quantity of MLLW at commercial facilities, followed by return to the Hanford Site

- disposal of LLW in the LLBGs in trenches of a design similar to those currently employed

- backfilling LLW trenches to grade with no cap

- disposal of MLLW in the two existing MLLW trenches until full

- capping the two MLLW trenches with a modified RCRA Subtitle C cover

- *processing and certification of some TRU waste at the WRAP for shipment to WIPP*

- *shipment of all TRU waste to WIPP following processing and certification*

- expansion of the Central Waste Complex (CWC) for storage of some non-conforming LLW, untreated MLLW, treated MLLW that exceeds the capacity of the two existing MLLW trenches, and TRU waste that cannot be certified for shipment to WIPP

- storage of melters on concrete pads at the CWC

- disposal of ILAW as glass cullet in vaults near the PUREX Plant according to the TWRS ROD (62 FR 8693).

Except where otherwise specified, all construction and operations engineering data that form the basis for environmental impact analysis of the alternatives are provided in the Technical Information Document prepared by Fluor Hanford (FH 2003).

A comparison of impacts among the alternatives appears in Section 3.4.

5.1 Land Use

Impacts on land use are considered in terms of commitment of land for a proposed use to the exclusion of other possible uses. Land occupied by LLBGs or other disposal facilities is considered to be permanently committed to the designated use.

In Alternative Groups A, B, C, D, and E, all LLW, MLLW, ILAW, and melters would be disposed of onsite. TRU waste would be shipped to WIPP for disposal. In the No Action Alternative, a substantial amount of the waste would remain in storage because of the lack of appropriate treatment capabilities to permit disposal.

Except for offsite commercial treatment of some MLLW, treatment, storage, and disposal activities associated with Alternative Groups A through E and the No Action Alternative would occur within or between the 200 East and 200 West Areas. The 200 Areas occupy about 16 km^2 (6 mi^2) on the Central Plateau. This area falls under the Industrial-Exclusive designation as defined in the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS) (DOE 1999). In addition, materials for capping the LLBGs at closure would be obtained from borrow pits in Area C located south of State Route 240 (SR 240) outside of, but adjacent to, the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE). The ALE boundary as adjusted in the HCP EIS is included within the Hanford Reach National Monument. Area C consists of about 926 ha (2287 ac) and was previously designated for Conservation (Mining) in the ROD for the HCP EIS (64 FR 61615). Excavation would occur over up to about 86 ha (210 ac) to provide capping materials for closure of the HSW disposal sites.

In Alternative Group A, use of land in the LLBGs for disposal of LLW and MLLW in trenches of deeper/wider design would range from 12 ha (30 ac) for the Hanford Only waste volume to 21 ha (52 ac) for the Upper Bound waste volume estimate. This use would be in addition to the 130 ha (321 ac) of land within the LLBGs already occupied by LLW and MLLW (and some retrievably stored TRU waste that would be removed). This additional land use would amount to increases of about 9 to 16 percent. Melters would be disposed of in a 6-ha (15-ac) single expandable lined trench near the PUREX Plant. ILAW would be disposed of near the PUREX Plant in a newly constructed facility occupying about 26 ha (62 ac). The total amount of land permanently used for disposal would range from 168 ha (410 ac) for the Hanford Only waste volume to 178 ha (440 ac) for the Upper Bound waste volume. No new support facilities would be built. However, from 69 to 73 ha (170 to 180 ac) would be temporarily used for excavation of capping materials.

In Alternative Group B, use of land in the LLBGs for disposal of LLW and MLLW in trenches of conventional design would range from 30 ha (74 ac) for the Hanford Only waste volume to 54 ha (130 ac) for the Upper Bound waste volume. This use would be in addition to the 130 ha (321 ac) of land within the LLBGs already occupied by LLW and MLLW (and some retrievably stored TRU waste that would be removed). This additional land use would amount to an increase of about 23 to 41 percent, respectively. ILAW would be disposed of in a newly constructed facility occupying about 26 ha (62 ac) in the CWC expansion area. The total amount of land permanently used for disposal would range from 187 to 210 ha (460 to 520 ac) for the Hanford Only waste volume to the Upper Bound waste volume. A new facility for processing waste would be built and would occupy about 4 ha. From 77 to 86 ha (190 to 210 ac) would be temporarily used for excavation of capping materials.

In Alternative Group C, use of land in the LLBGs for disposal of LLW and MLLW in single expandable trenches by waste type would range from 12 ha (30 ac) for the Hanford Only waste volume to 21 ha (52 ac) for the Upper Bound waste volume (essentially the same as for Alternative Group A). ILAW would be disposed of in a single expandable trench occupying about 8 ha (20 ac) near the PUREX Plant. The total amount of land permanently used for disposal would range from 151 to 160 ha (370 to 400 ac) for the Hanford Only waste volume to the Upper Bound waste volume. No new treatment facilities would be built. However, from 62 to 66 ha (150 to 160 ac) would be temporarily used for excavation of capping materials.

In Alternative Group D_1, there would be no use of land in the LLBGs for disposal of LLW and MLLW. LLW, MLLW, ILAW, and melters would be disposed of in a lined modular facility to be built near the PUREX Plant. This facility would occupy from 19 ha (47 ac) for the Hanford Only waste volume to 25 ha (62 ac) for the Upper Bound waste volume estimate. The total amount of land permanently used for disposal would range from 150 to 155 ha (370 to 380 ac) for the Hanford Only waste volume to the Upper Bound waste volume. No new treatment facilities would be built. However, from 62 to 64 ha (150 to 160 ac) would be temporarily used for excavation of capping materials.

In Alternative Group D_2, LLW, MLLW, ILAW, and melters would be disposed of in a lined modular facility to be built near the PUREX Plant in the 200 East Area. The amount of land used would be the same as for Alternative Group D_1. However, the location of the land would differ from that of Alternative Group D_1.

In Alternative Group D_3, LLW, MLLW, ILAW, and melters would be disposed of in a lined modular facility to be built at the ERDF. The amount of land used would be the same as that for Alternative Group D_1, but land located in a different place would be used.

In Alternative Group E_1, LLW and MLLW would be disposed of in a lined modular facility to be built in a 200 East Area LLBG. This facility would increase land use in the 200 East Area LLBGs ranging from 5 to 11 ha (12 to 27 ac) for the Hanford Only waste volume to the Upper Bound waste volume. This would represent an increase of from 4 to 8 percent. ILAW and melters would be disposed of in a lined modular facility at the ERDF and would occupy about 14 ha (35 ac). The total amount of land used would be the same as that for Alternative Group D_1.

In Alternative Group E_2, LLW and MLLW would be disposed of in a lined modular facility to be built near the PUREX Plant and would occupy the same amount of land as in Alternative Group E_1. ILAW and melters would be disposed of in a lined modular facility to be built at the ERDF. The size of the latter facility also would be the same as that in Alternative Group E_1.

In Alternative Group E_3, LLW and MLLW would be disposed of in a lined modular facility to be built at the ERDF and would occupy the same amount of land as in Alternative Group E_1. ILAW and melters would be disposed of in a lined modular facility to be built near the PUREX Plant. The size of the latter facility also would be the same as that in Alternative Group E_1.

In the No Action Alternative, LLW that had been certified for disposal would continue to be disposed of in trenches of current design. MLLW would be disposed of until trenches 31 and 34 in 218-W-5 are full and would thereafter be stored along with LLW that could not be certified for disposal in the CWC. ILAW would be disposed of in vaults occupying about 10 ha (25 ac) near the PUREX Plant. The increase in permanent land use would range from 27 to 29 ha (67 to 72 ac) for the Hanford Only waste volume and the Lower Bound waste volume (the Upper Bound waste volume would not be considered in this alternative), an increase of about 20 percent over the 130 ha (320 ac) currently occupied. In addition, about 66 ha (163 ac) would be used for storage of wastes for which treatment for disposal would not be available.

Details of land use (including new construction) associated with the HSW EIS alternatives are provided in Table 5.1 for disposal sites and in Table 5.2 for support facilities.

At most, a total of about 210 ha (440 ac), or 4 percent, of the 5000 ha (13,000 ac) of land designated as Industrial-Exclusive in the ROD for the HCP EIS (64 FR 61615) would be permanently committed to disposal of LLW, MLLW, ILAW, and melters within the scope of activities evaluated in this EIS.

Table 5.1. Land Use – Areas Used for Disposal, ha[(a)]

Low Level Burial Ground (LLBG) or Other Disposal Facility	Area Previously Designated for Disposal of HSW	Area Currently Occupied	Alternative Group A LLW & MLLW (Deeper/Wider Trench Design); Melter Trench and ILAW near PUREX			Alternative Group B LLW & MLLW (Conventional Trench Design); Melter Trench in 200 East Area; ILAW in 200 West Area (near CWC)			Alternative Group C Single Expandable Trenches, LLW in 200 West Area; MLLW in 200 East Area; Melter Trench and ILAW near PUREX			Alternative Group D_1 Lined Modular Facility near PUREX			Alternative Group D_2 Lined Modular Facility in 200 East LLBGs		
			Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume
Disposal – Low Level Burial Grounds (LLBGs)																	
218-W-3A[(b)]	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
218-W-3AE	20	12.2	12.2	12.2	12.2	20	20	20	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
218-W-4B[(b)]	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
218-W-4C[(b)]	20	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
218-W-5	37.2	26	29.4	30.4	35	33	35	37.2	29.4	30.4	35	26	26	26	26	26	26
218-W-5 Exp.[(c)]	202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
218-W-6	16	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
200 West Area Subtotal	319.1	66.8	70.2	71.2	75.8	81.6	83.6	92.8	70.2	71.2	75.8	66.8	66.8	66.8	66.8	66.8	66.8
218-E-10	36.1	22.7	22.7	22.7	22.7	22.7	23.2	25.6	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7
218-E-12B[(b,d)]	70.1	41	43.6	43.6	47.4	56.3	56.3	65.7	43.6	43.6	47.4	41	41	41	60.0	60.6	65.5
200 East Area Subtotal	106.2	63.7	66.3	66.3	70.1	79	79.5	91.3	66.3	66.3	70.1	63.7	63.7	63.7	82.7	83.3	88.2
LLBG Subtotal	425.3	130.5	136.5	137.5	145.9	160.6	163.1	184.1	136.5	137.5	145.9	130.5	130.5	130.5	149.7	150.2	155
Increase in LLBG Land Use			**6.0**	**7.0**	**15.4**	**30.1**	**32.6**	**53.6**	**6.0**	**7.0**	**15.4**	**0**	**0**	**0**	**19.2**	**19.7**	**24.5**

(a) To obtain areas in acres, multiply hectares (ha) by 2.47. Actual assignment of disposal areas to a particular LLBG would depend on operational efficiency.

(b) Area contains some retrievably stored TRU waste.

(c) 218-W-5 Exp. is a contingency expansion of the 218-W-5 Burial Ground for operational flexibility.

(d) Trench 94 in 218-E-12B consisting of about 7.4 ha (18 ac) is for disposal of decommissioned U.S. Naval reactor compartments and is included in the area designated. A like area is also included for future expansion of reactor compartment disposal (a total of 20.4 ha). The disposal of these reactor compartments was addressed in other NEPA documents (Navy 1984, 1996).

Table 5.1. (contd)

Low Level Burial Ground (LLBG) or Other Disposal Facility	Area Previously Designated for Disposal of HSW	Area Currently Occupied	Alternative Group A LLW & MLLW (Deeper/Wider Trench Design); Melter Trench and ILAW near PUREX			Alternative Group B LLW & MLLW (Conventional Trench Design); Melter Trench in 200 East Area; ILAW in 200 West Area (near CWC)			Alternative Group C Single Expandable Trenches, LLW in 200 West Area; MLLW in 200 East Area; Melter Trench and ILAW near PUREX			Alternative Group D_1 Lined Modular Facility near PUREX			Alternative Group D_2 Lined Modular Facility in 200 East LLBGs		
			Hanford Only Volume	**Lower Bound Volume**	**Upper Bound Volume**	**Hanford Only Volume**	**Lower Bound Volume**	**Upper Bound Volume**	**Hanford Only Volume**	**Lower Bound Volume**	**Upper Bound Volume**	**Hanford Only Volume**	**Lower Bound Volume**	**Upper Bound Volume**	**Hanford Only Volume**	**Lower Bound Volume**	**Upper Bound Volume**
Disposal – Other Areas																	
At ERDF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Near PUREX	41	0	32	32	32	0	0	0	14	14	14	19.2	19.7	24.5	0	0	0
CWC Expansion	30	0	0	0	0	26	26	26	0	0	0	0	0	0	0	0	0
Total Area Used for HSW Disposal		130.5	168.5	169.5	177.9	186.6	189.1	210.1	150.5	151.5	159.9	149.7	150.2	155	149.5	150.1	155.0
Total Increase in Land Use			**38.0**	**39.0**	**47.4**	**56.1**	**58.6**	**79.6**	**20.0**	**21.0**	**29.4**	**19.2**	**19.7**	**24.5**	**19.2**	**19.7**	**24.5**

Table 5.1. (contd)

Low Level Burial Ground (LLBG) or Other Disposal Facility	Area Previously Designated for Disposal of HSW	Area Currently Occupied	Alternative Group D_3 Lined Modular Facility at ERDF			Alternative Group E_1 Lined Modular Facilities LLW & MLLW in 200 East Area LLBGs, ILAW & Melters at ERDF			Alternative Group E_2 Lined Modular Facilities LLW & MLLW near PUREX, ILAW & Melters at ERDF			Alternative Group E_3 Lined Modular Facilities LLW&MLLW at ERDF, ILAW & Melters near PUREX			No Action Alternative. Non-Disposable Waste Stored in CWC; Melters Stored on Concrete Pads at CWC	
			Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume
Low Level Burial Grounds (LLBGs)																
218-W-3A(b)	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
218-W-3AE	20	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	20	20
218-W-4B(b)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
218-W-4C(b)	20	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
218-W-5	37.2	26	26	26	26	26	26	26	26	26	26	26	26	26	30.8	32.2
218-W-5 Exp.(c)	202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
218-W-6	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 West Area Subtotal	319.1	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	66.8	79.4	80.8
218-E-10	36.1	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	23.2	23.2
218-E-12B(b,d)	70.1	41	41	41	41	46.2	46.7	51.5	41	41	41	41	41	41	45	45
200 East Area Subtotal	106.2	63.7	63.7	63.7	63.7	68.9	69.4	74.2	63.7	63.7	63.7	63.7	63.7	63.7	68.2	68.2
LLBG Subtotal	425.3	130.5	130.5	130.5	130.5	135.7	136.2	141	130.5	130.5	130.5	130.5	130.5	130.5	147.6	149
Increase in LLBG Land Use			**0**	**0**	**0**	**5.2**	**5.7**	**10.5**	**0**	**0**	**0**	**0**	**0**	**0**	**17.1**	**18.5**

(b) Area contains some retrievably stored TRU waste.
(c) 218-W-5 Exp. is a contingency expansion of the 218-W-5 Burial Ground for operational flexibility.
(d) Trench 94 in 218-E-12B consisting of about 7.4 ha (18 ac) is for disposal of decommissioned U.S. Naval reactor compartments and is included in the area designated. A like area is also included for future expansion of reactor compartment disposal (a total of 20.4 ha). Disposal of these reactor compartments was addressed in other NEPA documents (Navy 1984, 1996).

Table 5.1. (contd)

Low Level Burial Ground (LLBG) or Other Disposal Facility	Area Previously Designated for Disposal of HSW	Area Currently Occupied	Alternative Group D_3 Lined Modular Facility at ERDF			Alternative Group E_1 Lined Modular Facilities LLW & MLLW in 200 East Area LLBGs, ILAW & Melters at ERDF			Alternative Group E_2 Lined Modular Facilities LLW & MLLW near PUREX, ILAW & Melters at ERDF			Alternative Group E_3 Lined Modular Facilities LLW&MLLW at ERDF, ILAW & Melters near PUREX			No Action Alternative Non-Disposable Waste Stored in CWC; Melters Stored on Concrete Pads at CWC	
			Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume
Other Disposal Areas																
At ERDF	0	0	19.2	19.7	24.5	14	14	14	14	14	14	5.0	5.6	10.5	0	0
Near PUREX	41	0	0	0	0	0	0	0	5.0	5.6	10.5	14	14	14	10	10
CWC Expansion	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Area Used for HSW Disposal			149.7	150.2	155	149.7	150.2	155	149.5	150.1	155	149.5	150.1	155	157.6	159
Total Increase in Land Used			**19.2**	**19.7**	**24.5**	**19.2**	**19.7**	**24.5**	**19.2**	**19.2**	**24.5**	**19.2**	**19.7**	**24.5**	**27.1**	**28.5**

Table 5.2. Land Use - Areas of HSW Treatment and Storage Facilities, ha[(a)]

Facility	Area Previously Designated for HSW Support Facility	Area Currently Occupied	Alternative Group A[(b)] LLW &MLLW (Deeper/Wider Trench Design); Melter Trench and ILAW near PUREX			Alternative Group B LLW &MLLW (Conventional Trench Design); Melter Trench in 200 East Area; ILAW in 200 West Area (near CWC)			Alternative Group C Single Expandable Trenches, LLW in 200 West Area; MLLW in 200 East Area; Melter Trench and ILAW near PUREX			Alternative Groups D&E Lined Modular Facilities			No Action Alternative[(c)] Non-Disposable Waste Stored in CWC; Melters Stored on Concrete Pads at CWC	
			Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume	Upper Bound Volume	Hanford Only Volume	Lower Bound Volume
CWC	86	50	50	50	50	50	50	50	50	50	50	50	50	50	86	86
CWC Expansion Area	30	0	0	0	0	0	0	0	0	0	0	0	0	0	23	30
WRAP	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
NWPF[(d)]	0	0	0	0	0	4	4	4	0	0	0	0	0	0	0	0
T Plant Complex	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
ETF[(e)]	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
LERF[(f)]	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Area C (Borrow Pit)	926	3	69.2	69.7	73.1	76.7	77.7	86.3	61.8	62.3	65.7	61.5	61.7	63.7	13.6	13.6
Total for Facilities	**1119**	**130**	**196**	**197**	**200**	**208**	**209**	**217**	**189**	**189**	**193**	**189**	**189**	**191**	**200**	**207**

(a) To obtain areas in acres, multiply hectares (ha) by 2.47.

(b) Treatment and Storage Facility requirements would be the same for the following as for Alternative Group A (capping resource area same as for Alternative Group D_1):
- Alternative Group D_1: Disposal in a lined modular facility near PUREX Plant
- Alternative Group D_2: Disposal in a lined modular facility in 200 East Area LLBGs
- Alternative Group D_3: Disposal in a lined modular facility at ERDF
- Alternative Group E_1: Disposal in lined modular facilities: LLW and MLLW in 200 East Area LLBGs, ILAW and melters at ERDF
- Alternative Group E_2: Disposal in lined modular facilities: LLW and MLLW near PUREX, ILAW and melters at ERDF
- Alternative Group E_3: Disposal in lined modular facilities: LLW and MLLW at ERDF, ILAW and melters near PUREX

(c) Storage of waste in CWC in the No Action Alternative would continue after 2046.

(d) NWPF = New Waste Processing Facility

(e) ETF = 200 Area Effluent Treatment Facility

(f) LERF = Liquid Effluent Retention Facility

5.2 Air Quality

Air quality impacts covered in this section focus on four criteria pollutants[(a)]—nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter with aerodynamic diameters of 10 µm or smaller (PM_{10}). Hanford Solid Waste Program activities would emit criteria pollutants as a result of the operation of diesel-fired and propane-fueled equipment. Construction, earthmoving, and transportation activities would also result in fugitive dust emissions. Major program activities that would be substantial sources of criteria pollutants include:

- construction of waste-disposal trenches (for example, LLW, MLLW, ILAW)
- waste-disposal operations
- excavation of backfill and capping materials at the borrow pit
- transportation of backfill and capping materials from the borrow pit to the disposal trenches
- backfill and capping activities at the disposal trenches
- leachate drying operations.

The air quality impacts to the public from these and related program activities are presented in this section, and additional supporting information is provided in Appendix E. The air quality impacts from criteria pollutants emitted during the transportation of waste materials are not included in this section, but are instead addressed in Section 5.8. The potential consequences to workers and the public of the releases from radiological and hazardous chemicals are addressed in Section 5.11.

In calculating air quality impacts for criteria pollutants, data on pollutant emissions was derived from the Hanford Solid Waste Technical Information Document (FH 2003). Detailed assessments of pollutant emissions were developed for each major program element. To compute maximum air quality impacts, emissions were combined from all activities that could potentially occur at the same time. Because only 22 percent of the LLW and essentially none of the MLLW would be from offsite sources, the air quality impacts for the Hanford Only waste volume under each Alternative Group were conservatively modeled as being equivalent to those for the Lower Bound waste volume under the same Alternative Group.

The approach used to estimate pollutant emission rates and emission schedules for all Hanford Solid Waste Program activities are addressed in detail in Appendix E.

The maximum air quality impacts that would result from the emission of criteria pollutants from Hanford Solid Waste Program activities were calculated using the Industrial Source Complex Short-Term (ISCST3) Dispersion Model (EPA 1995). The ISCST3 model has been approved by the U.S. Environmental Protection Agency (EPA) for the calculation of the maximum, time-averaged air concentrations at user-specified receptor locations. The model provides results for averaging periods of 1 hour, 3 hours, 8 hours, 24 hours, and 1 year to correspond to the time periods specified in national and

(a) The Clean Air Act authorizes the U.S. Environmental Protection Agency to set permissible levels of exposure for selected air pollutants using health-based criteria. These selected pollutants are called “criteria pollutants,” and their permissible exposure levels are defined in 40 CFR 50, “National Primary and Secondary Ambient Air Quality Standards.”

state ambient air quality standards. Four years of hourly Hanford Site meteorological data were used in modeling atmospheric dispersion. The ISCST3 model and the data used in model runs are discussed in more detail in Appendix E.

In modeling air quality impacts for the public, the following conservative assumptions were made to maximize impact estimates:

- Although Hanford Solid Waste Program activities would occur at numerous locations in and around the 200 Areas and Area C, program activities were conservatively modeled by collocating their emissions into three small area sources. These area sources were situated in the 200 West Area (near the southwestern edge of project activities), 200 East Area (near the northwestern edge of project activities), and Area C (at a site close to State Route [SR] 240). The location of each area source was set to correspond to the project work site in the associated major operating area that could generate the greatest air quality impacts to the public.

- When a project activity could potentially occur at more than one source location, the activity was conservatively assumed to occur at the location that would generate the greatest air quality impact. For example, the Lined Modular Facility proposed in Alternative Group D could be sited at locations in or near the 200 East or 200 West Areas, depending on the sub-alternative selected. After assessing impacts from both potential source locations, the 200 West source location was used in the air quality analysis because it generated the greatest air quality impacts.

- Even though the maximum air quality impacts to the public from the 200 West and 200 East source locations would occur at markedly different locations (as discussed later in this section), it was conservatively assumed that the maximum pollutant concentrations associated with these two source locations could be summed to compute total maximum air quality impacts for emissions from both 200 Area source locations.

- Chemical decay and deposition processes were not explicitly modeled for any criteria pollutant. Neglecting these removal mechanisms would increase estimates of maximum pollutant concentrations (especially in the case of particulate matter) at publicly accessible locations.

- Pollutant emission rates from diesel-fueled engines were only assumed to comply with current emissions standards. No credit was taken for the substantial reduction in the sulfur content of diesel fuel (from a 500-ppm to a 15-ppm limit) scheduled to be phased in beginning in June 2006 or a tightening of the emission standards for nitrogen dioxide and particulate matter scheduled to be phased in beginning in 2007 (EPA 2000).

As a result of these and other conservative assumptions, the estimates of short-term and long-term maximum air quality impacts presented in this section should be substantially greater than what would actually be experienced during program implementation.

To meet regulatory requirements, emissions from program activities must not result in air concentrations of criteria pollutants that exceed regulatory limits. The ISCST3 model predicted the locations of the maximum air quality impacts to the public from emissions at the 200 East Area, 200 West Area, and Area C source locations. These are provided in Table 5.3 for 200 East and 200 West and in Table 5.4 for Area C (borrow pit). The location of maximum impact varies based on the averaging period of exposure. The maximum shorter-term air quality impacts (for example, 1 hour and 3 hours) generally occur at or near the closest point of public access. The locations of the longer-term maximum air quality impacts (for example, 24 hours and annual) are heavily dependent on local, prevailing wind directions and other meteorological conditions. Dispersion factors are also provided in Tables 5.3 and 5.4 to provide relative estimates of the maximum impacts from a unit release (for example, one unit of mass emitted per second) of a generic pollutant.

Table 5.3. 200 East and 200 West Area Emissions: Location and Dispersion Factors Used to Determine Maximum Air Quality Impacts to the Public

Area	Averaging Time Period	Maximum Impact Location and Corresponding Public Access	Distance and Direction from Pollutant Release Location to Maximum Public Impact Location[(a)]	Dispersion Factor for Maximum Impact Location (s/m^3)[(b)]
200E	1 hr	SR 240	8.5 km – SW	8.4E-5
	3 hr	SR 240	9.0 km – SSW	3.3E-5
	8 hr	SR 240	9.0 km – SSW	2.2E-5
	24 hr	Hanford Site boundary	15.3 km – WNW	9.3E-6
	Annual	Hanford Site boundary	13.9 km – WNW	8.9E-8
200W	1 hr	SR 240	4.0 km – S	1.6E-4
	3 hr	SR 240	4.0 km – S	7.4E-5
	8 hr	SR 240	4.0 km – S	5.1E-5
	24 hr	Hanford Site boundary	8.5 km – WNW	1.6E-5
	Annual	Hanford Site boundary	11.5 km – W	1.5E-7

(a) Distance and direction determined by dispersion modeling. Pollutant transport direction is reported using 16 compass sectors—starting with N (North) and continuing clockwise with NNE, NE, ENE, E (East), ESE, SE, SSE, S (South), SSW, SW, WSW, W (West), WNW, NW, and NNW.

(b) Values computed by the ISCST3 model. To convert to a concentration estimate ($\mu g/m^3$), a dispersion factor (s/m^3) is multiplied by the estimated pollutant release rate ($\mu g/s$).

In the following sections, the results of the air quality analysis are presented for Alternative Groups A through E and the No Action Alternative. Separate results are provided for the maximum air quality impacts to the public from emissions in the 200 Areas and emissions in Area C.

A Clean Air Act General Conformity Review analysis is presented in Appendix E. Based on this analysis, it was concluded that a General Conformity Determination would not be needed.

Table 5.4. Area C (Borrow Pit) Emissions: Location and Dispersion Factors Used to Determine Maximum Air Quality Impacts to the Public

Averaging Time Period	Maximum Impact Location and Corresponding Public Access	Distance and Direction from Pollutant Release Location to Maximum Public Impact Location[(a)]	Dispersion Factors for Maximum Impact Location (s/m^3)[(b)]
1 hr	SR 240	<150 m NE	3.3E-3
3 hr	SR 240	<150 m NE	2.5E-3
8 hr	SR 240	<150 m NE	1.9E-3
24 hr	Hanford Site boundary	14.4 km WNW	1.0E-5
Annual	Hanford Site boundary	13.8 km WNW	9.2E-8

(a) Distance determined by dispersion modeling. Pollutant transport direction is reported using 16 compass sectors—starting with N (North) and continuing clockwise with NNE, NE, ENE, E (East), ESE, SE, SSE, S (South), SSW, SW, WSW, W (West), WNW, NW, and NNW.

(b) Values computed by the ISCST3 model. To convert to a concentration estimate ($\mu g/m^3$), the dispersion factor (s/m^3) is multiplied by the estimated pollutant release rate ($\mu g/s$).

5.2.1 Alternative Group A

Project activities that would generate air quality impacts under Alternative Group A include the use of diesel-fueled equipment to construct new trenches of deeper and wider design than current trenches, construction of the ILAW and melter trenches, backfilling of trenches, capping the LLBGs and the ILAW trench at closure, performing routine CWC and T Plant operations, modifying T Plant to achieve waste processing capability, and the excavation and transportation of materials from the borrow pit. In addition, propane-fueled pulse driers would be used to treat leachate from the MLLW trenches beginning in 2026. Fugitive dust emissions would be associated with many major construction, transportation, and operation activities.

For Alternative Group A (Hanford Only and Lower Bound waste volume), the largest air quality impacts would occur during two different periods of project operation. In 2006, ILAW trench construction and MLLW capping and backfill operations would be underway. The heavy use of construction equipment for short periods of time would produce the maximum 24-hour and shorter term average concentrations for SO_2 and CO. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hour and annual concentrations of PM_{10} and maximum annual concentrations of NO_2 and SO_2.

For Alternative Group A (Upper Bound waste volume), the largest air quality impacts would occur during three different periods of project operation. In 2006, the heavy use of construction equipment would produce the maximum concentrations over all averaging periods for CO, SO_2, and NO_2. In 2018, LLW and ILAW trench construction, coupled with MLLW melter capping and backfilling operations, would generate the maximum 24-hour PM_{10} concentrations. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum annual concentrations of PM_{10}.

Table 5.4. Area C (Borrow Pit) Emissions: Location and Dispersion Factors Used to Determine Maximum Air Quality Impacts to the Public

Averaging Time Period	Maximum Impact Location and Corresponding Public Access	Distance and Direction from Pollutant Release Location to Maximum Public Impact Location[a]	Dispersion Factors for Maximum Impact Location (s/m^3)[b]
1 hr	SR 240	<150 m NE	3.3E-3
3 hr	SR 240	<150 m NE	2.5E-3
8 hr	SR 240	<150 m NE	1.9E-3
24 hr	Hanford Site boundary	14.4 km WNW	1.0E-5
Annual	Hanford Site boundary	13.8 km WNW	9.2E-8

(a) Distance determined by dispersion modeling. Pollutant transport direction is reported using 16 compass sectors—starting with N (North) and continuing clockwise with NNE, NE, ENE, E (East), ESE, SE, SSE, S (South), SSW, SW, WSW, W (West), WNW, NW, and NNW.

(b) Values computed by the ISCST3 model. To convert to a concentration estimate ($\mu g/m^3$), the dispersion factor (s/m^3) is multiplied by the estimated pollutant release rate (μg/s).

5.2.1 Alternative Group A

Project activities that would generate air quality impacts under Alternative Group A include the use of diesel-fueled equipment to construct new trenches of deeper and wider design than current trenches, construction of the ILAW and melter trenches, backfilling of trenches, capping the LLBGs and the ILAW trench at closure, performing routine CWC and T Plant operations, modifying T Plant to achieve waste processing capability, and the excavation and transportation of materials from the borrow pit. In addition, propane-fueled pulse driers would be used to treat leachate from the MLLW trenches beginning in 2026. Fugitive dust emissions would be associated with many major construction, transportation, and operation activities.

For Alternative Group A (Hanford Only and Lower Bound waste volume), the largest air quality impacts would occur during two different periods of project operation. In 2006, ILAW trench construction and MLLW capping and backfill operations would be underway. The heavy use of construction equipment for short periods of time would produce the maximum 24-hour and shorter term average concentrations for SO_2 and CO. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hour and annual concentrations of PM_{10} and maximum annual concentrations of NO_2 and SO_2.

For Alternative Group A (Upper Bound waste volume), the largest air quality impacts would occur during three different periods of project operation. In 2006, the heavy use of construction equipment would produce the maximum concentrations over all averaging periods for CO, SO_2, and NO_2. In 2018, LLW and ILAW trench construction, coupled with MLLW melter capping and backfilling operations, would generate the maximum 24-hour PM_{10} concentrations. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum annual concentrations of PM_{10}.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative Group A are summarized in Table 5.5. Estimates of the maximum air quality impacts from Area C activities are presented in Table 5.6. The maximum air quality impacts from Area C activities are the same for all Alternative Groups. The impacts from the single activity undertaken in Area C are less than the maximum impacts from the multiple activities undertaken in Alternative Group A.

Table 5.5. Alternative Group A: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

Pollutant	Averaging Time	Ambient Air Quality Standard (μg/m^3)	Hanford & Lower Bound Volume		Upper Bound Volume	
			Maximum Air Quality Impacts (μg/m^3)	Percent of Standard	Maximum Air Quality Impacts (μg/m^3)	Percent of Standard
PM_{10}	24 hr	150	69	46	74	49
	Annual	50	0.61	1.2	0.62	1.2
SO_2	1 hr	1,000	81	8.1	98	9.8
	3 hr	1,300	38	2.9	45	3.5
	24 hr	260	2.7	1.0	3.5	1.3
	Annual	50	0.017	0.034	0.019	0.038
CO	1 hr	40,000	1500	3.8	1900	4.8
	8 hr	10,000	470	4.7	590	5.9
NO_2	Annual	100	0.84	0.84	0.80	0.80

Table 5.6. All Alternative Groups: Maximum Air Quality Impacts to the Public from Area C (Borrow Pit) Activities

Pollutant	Averaging Time	Ambient Air Quality Standard (μg/m^3)	Maximum Air Quality Impacts	
			Maximum Pollutant Concentration (μg/m^3)	Percent of Standard
PM_{10}	24 hr	150	21	14
	Annual	50	0.19	0.38
SO_2	1 hr	1,000	260	26
	3 hr	1,300	200	15
	24 hr	260	0.44	0.17
	Annual	50	0.0035	0.0070
CO	1 hr	40,000	6300	16
	8 hr	10,000	3600	36
NO_2	Annual	100	0.16	0.16

Even in the years with the largest potential air quality impacts, ambient air quality standards (see Table 4.5, Section 4.3.2) would not be exceeded under Alternative Group A. The largest potential impacts to the public from activities at Area C would result from SO_2 and CO emissions. Maximum air quality impacts to the public are conservatively estimated to be about 26 percent of the 1-hour SO_2 standard and 36 percent of the 8-hour CO standard. The largest potential impacts to the public from activities within the 200 Areas would involve the 24-hour PM_{10} standard. Using the series of conservative assumptions employed in the air-dispersion modeling, this maximum air quality impact would be about half of the 24-hour PM_{10} standard.

5.2.2 Alternative Group B

Project activities that would generate air quality impacts under Alternative Group B include the use of diesel-fueled equipment to construct additional trenches of current design and the ILAW and melter trenches, backfilling and capping activities in the LLBGs, construction of a new waste processing facility, and the excavation of materials at the borrow pit. In addition, propane would be used to fuel vehicles at the CWC and to operate pulse driers used to treat leachate from the MLLW trenches. Fugitive dust would be associated with all major construction and operation activities.

For Alternative Group B (Hanford Only and Lower Bound waste volumes), the largest air quality impacts would occur during two different periods of project operation. In 2011, ILAW trench construction, LLW trench construction, and MLLW capping and backfill operations would be underway. The heavy use of construction equipment for short periods of time would produce the maximum pollutant concentrations for CO, SO_2, and NO_2. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce maximum 24-h and annual concentrations of PM_{10} that would be slightly greater than in 2011.

For Alternative Group B (Upper Bound waste volume), the largest air quality impacts would occur during three different periods of project operation. In 2006, the heavy use of construction equipment would produce the maximum pollutant concentrations over the relevant 1-hour, 3-hours, 8-hours, and 24-hr averaging periods for CO and SO_2. In 2011, LLW and ILAW trench construction, coupled with MLLW melter capping and backfilling operations, would generate the maximum annual SO_2 and NO_2 concentrations. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hr and annual concentrations of PM_{10}.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative Group B are summarized in Table 5.7. Estimates of the maximum air quality impacts from Area C activities are the same for all Alternative Groups (see Table 5.6).

All air quality impacts to the public under Alternative Group B would be within ambient air quality standards (see Table 4.5, Section 4.3.2). The largest potential impact to the public from activities at Area C would result from SO_2 and CO emissions. The largest potential air quality impacts to the public from 200 Area emissions would involve the 24-hr PM_{10} air concentration. Even using the series of conservative assumptions employed in the dispersion modeling, the maximum air quality impact to the public for the Upper Bound waste volume would be about 60 percent of the applicable air quality standard. Maximum impacts for the Hanford Only and Lower Bound waste volumes would be less than 47 percent of the applicable standards.

5.2.3 Alternative Group C

Project activities that would generate air quality impacts under Alternative Group C include the use of diesel-fueled equipment to construct new expandable trenches for LLW and for MLLW, construction of the ILAW and Melter trenches, backfilling of trenches, capping the LLBGs and the ILAW trench at closure, performing routine CWC and T Plant operations, modifying T Plant for new waste processing

5.2.2 Alternative Group B

Project activities that would generate air quality impacts under Alternative Group B include the use of diesel-fueled equipment to construct additional trenches of current design and the ILAW and melter trenches, backfilling and capping activities in the LLBGs, construction of a new waste processing facility, and the excavation of materials at the borrow pit. In addition, propane would be used to fuel vehicles at the CWC and to operate pulse driers used to treat leachate from the MLLW trenches. Fugitive dust would be associated with all major construction and operation activities.

For Alternative Group B (Hanford Only and Lower Bound waste volumes), the largest air quality impacts would occur during two different periods of project operation. In 2011, ILAW trench construction, LLW trench construction, and MLLW capping and backfill operations would be underway. The heavy use of construction equipment for short periods of time would produce the maximum pollutant concentrations for CO, SO_2, and NO_2. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce maximum 24-h and annual concentrations of PM_{10} that would be slightly greater than in 2011.

For Alternative Group B (Upper Bound waste volume), the largest air quality impacts would occur during three different periods of project operation. In 2006, the heavy use of construction equipment would produce the maximum pollutant concentrations over the relevant 1-hour, 3-hours, 8-hours, and 24-hr averaging periods for CO and SO_2. In 2011, LLW and ILAW trench construction, coupled with MLLW melter capping and backfilling operations, would generate the maximum annual SO_2 and NO_2 concentrations. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hr and annual concentrations of PM_{10}.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative Group B are summarized in Table 5.7. Estimates of the maximum air quality impacts from Area C activities are the same for all Alternative Groups (see Table 5.6).

All air quality impacts to the public under Alternative Group B would be within ambient air quality standards (see Table 4.5, Section 4.3.2). The largest potential impact to the public from activities at Area C would result from SO_2 and CO emissions. The largest potential air quality impacts to the public from 200 Area emissions would involve the 24-hr PM_{10} air concentration. Even using the series of conservative assumptions employed in the dispersion modeling, the maximum air quality impact to the public for the Upper Bound waste volume would be about 60 percent of the applicable air quality standard. Maximum impacts for the Hanford Only and Lower Bound waste volumes would be less than 47 percent of the applicable standards.

5.2.3 Alternative Group C

Project activities that would generate air quality impacts under Alternative Group C include the use of diesel-fueled equipment to construct new expandable trenches for LLW and for MLLW, construction of the ILAW and Melter trenches, backfilling of trenches, capping the LLBGs and the ILAW trench at closure, performing routine CWC and T Plant operations, modifying T Plant for new waste processing

Table 5.7. Alternative Group B: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

			Hanford & Lower Bound Volume		Upper Bound Volume	
Pollutant	**Averaging Time**	**Ambient Air Quality Standard ($\mu g/m^3$)**	**Maximum Air Quality Impacts ($\mu g/m^3$)**	**Percent of Standard**	**Maximum Air Quality Impacts ($\mu g/m^3$)**	**Percent of Standard**
PM_{10}	24 hr	150	71	47	90	60
	Annual	50	0.62	1.2	0.65	1.3
SO_2	1 hr	1,000	130	13	180	18
	3 hr	1,300	61	4.7	85	6.5
	24 hr	260	4.7	1.8	6.4	2.5
	Annual	50	0.021	0.042	0.021	0.042
CO	1 hr	40,000	2500	6.3	3400	8.5
	8 hr	10,000	800	8.0	1100	11
NO_2	Annual	100	1.0	1.0	1.1	1.1

capability, and the excavation and transportation of materials from the borrow pit. In addition, propane engines would be used at the CWC and to operate pulse driers used to treat leachate from the MLLW trenches. Fugitive dust would be associated with all major construction and operation activities.

For Alternative Group C (Hanford Only and Lower Bound waste volumes), the largest air quality impacts would occur during three different periods of project operation. In 2007, the heavy use of construction equipment would produce the maximum pollutant concentrations over 1-hr and 3-hr averaging periods for SO_2. In 2018, ILAW trench construction and MLLW capping and backfill operations would be under way. This use of construction equipment for long periods of time would produce the maximum 24-hr and annual concentrations for SO_2 and the maximum 1-hr and 8-hr pollutant concentrations for CO. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hr and annual concentrations of PM_{10} and the maximum annual concentration of NO_2.

For Alternative Group C (Upper Bound waste volume), the largest air quality impacts would occur during four different periods of project operation. In 2007, the construction of ILAW, LLW, and MW trenches would produce the maximum concentrations over 1-hr and 3-hr averaging periods for SO_2 and an 8-hr averaging period for CO. In 2018, ILAW trench construction, coupled with MLLW melter capping and backfilling operations, would generate the maximum 24-hr and annual concentrations of SO_2, annual concentrations of NO_2, and 1-hr concentrations of CO. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hour and annual concentrations of PM_{10}.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative C are summarized in Table 5.8. Estimates of the maximum air quality impacts from Area C activities are the same for all Alternative Groups (see Table 5.6).

Table 5.8. Alternative Group C: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

			Hanford & Lower Bound Volume		Upper Bound Volume	
Pollutant	**Averaging Time**	**Ambient Air Quality Standard (μg/m^3)**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**
PM_{10}	24 hr	150	60	40	61	41
	Annual	50	0.53	1.1	0.54	1.1
SO_2	1 hr	1,000	79	7.9	80	8.0
	3 hr	1,300	36	2.8	37	2.8
	24 hr	260	2.9	1.1	2.9	1.1
	Annual	50	0.018	0.036	0.018	0.036
CO	1 hr	40,000	1500	3.8	1500	3.8
	8 hr	10,000	460	4.6	470	4.7
NO_2	Annual	100	0.79	0.79	0.78	0.78

All air quality impacts to the public from Alternative Group C would be within ambient air quality standards (see Table 4.5). The largest potential impacts to the public from activities at Area C would result from SO_2 and CO emissions. The largest potential air quality impacts to the public from activities in the 200 Areas would involve the 24-hour PM_{10} concentration. Even using the series of conservative assumptions employed in the dispersion modeling, this maximum air quality impact would be about 40 percent of the applicable air quality standard.

5.2.4 Alternative Groups D_1, D_2, and D_3

Project activities that would generate air quality impacts under Alternative Group D_1, D_2, and D_3 (collectively referred to as Alternative D) include the use of diesel-fueled equipment to construct a lined modular facility to hold the LLW, MLLW, ILAW and melters, backfilling and capping activities in the LLBGs, the modification of T Plant, and the excavation of materials at the borrow pit. In addition, propane would be used at the CWC and to operate pulse driers used to treat leachate from the MLLW trenches. Fugitive dust would be associated with all major construction and operation activities. Alternative Groups D_1, D_2, and D_3 postulate different locations for the Lined Modular Facility. In conducting air quality modeling, a conservative 200 West Area source location was assumed in all cases for the lined modular facility. As a result, the air quality estimates for D_1, D_2, and D_3 are equivalent.

For Alternative Group D (Hanford Only, Lower Bound, and Upper Bound waste volumes), the largest air quality impacts would occur during two different periods of project operation. In 2006, the lined modular facility construction and capping of an existing MLLW trench would be under way. The heavy use of construction equipment for short periods of time would produce the maximum average pollutant concentrations for CO and SO_2. After disposal operations cease, the lined modular facility capping operations would be in full swing. This sustained activity would produce the maximum 24-hour and annual concentrations of PM_{10} and the maximum annual concentrations of NO_2.

Table 5.8. Alternative Group C: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

			Hanford & Lower Bound Volume		Upper Bound Volume	
Pollutant	**Averaging Time**	**Ambient Air Quality Standard (μg/m^3)**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**
PM_{10}	24 hr	150	60	40	61	41
	Annual	50	0.53	1.1	0.54	1.1
SO_2	1 hr	1,000	79	7.9	80	8.0
	3 hr	1,300	36	2.8	37	2.8
	24 hr	260	2.9	1.1	2.9	1.1
	Annual	50	0.018	0.036	0.018	0.036
CO	1 hr	40,000	1500	3.8	1500	3.8
	8 hr	10,000	460	4.6	470	4.7
NO_2	Annual	100	0.79	0.79	0.78	0.78

All air quality impacts to the public from Alternative Group C would be within ambient air quality standards (see Table 4.5). The largest potential impacts to the public from activities at Area C would result from SO_2 and CO emissions. The largest potential air quality impacts to the public from activities in the 200 Areas would involve the 24-hour PM_{10} concentration. Even using the series of conservative assumptions employed in the dispersion modeling, this maximum air quality impact would be about 40 percent of the applicable air quality standard.

5.2.4 Alternative Groups D_1, D_2, and D_3

Project activities that would generate air quality impacts under Alternative Group D_1, D_2, and D_3 (collectively referred to as Alternative D) include the use of diesel-fueled equipment to construct a lined modular facility to hold the LLW, MLLW, ILAW and melters, backfilling and capping activities in the LLBGs, the modification of T Plant, and the excavation of materials at the borrow pit. In addition, propane would be used at the CWC and to operate pulse driers used to treat leachate from the MLLW trenches. Fugitive dust would be associated with all major construction and operation activities. Alternative Groups D_1, D_2, and D_3 postulate different locations for the Lined Modular Facility. In conducting air quality modeling, a conservative 200 West Area source location was assumed in all cases for the lined modular facility. As a result, the air quality estimates for D_1, D_2, and D_3 are equivalent.

For Alternative Group D (Hanford Only, Lower Bound, and Upper Bound waste volumes), the largest air quality impacts would occur during two different periods of project operation. In 2006, the lined modular facility construction and capping of an existing MLLW trench would be under way. The heavy use of construction equipment for short periods of time would produce the maximum average pollutant concentrations for CO and SO_2. After disposal operations cease, the lined modular facility capping operations would be in full swing. This sustained activity would produce the maximum 24-hour and annual concentrations of PM_{10} and the maximum annual concentrations of NO_2.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative D are summarized in Table 5.9. Estimates of the maximum air quality impacts from Area C activities are the same for all Alternative Groups (see Table 5.6).

Table 5.9. Alternative D: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

			Hanford & Lower Bound Volume		Upper Bound Volume	
Pollutant	**Averaging Time**	**Ambient Air Quality Standard (μg/m³)**	**Maximum Air Quality Impacts (μg/m³)**	**Percent of Standard**	**Maximum Air Quality Impacts (μg/m³)**	**Percent of Standard**
PM_{10}	24 hr	150	61	41	62	41
	Annual	50	0.53	1.1	0.54	1.1
SO_2	1 hr	1,000	84	8.4	84	8.4
	3 hr	1,300	38	2.9	38	2.9
	24 hr	260	3.1	1.2	3.1	1.2
	Annual	50	0.019	0.038	0.019	0.038
CO	1 hr	40,000	1590	4.0	1590	4.0
	8 hr	10,000	500	5.0	500	5.0
NO_2	Annual	100	0.91	0.91	0.98	0.98

All air quality impacts from Alternative D would be within ambient air quality standards. The largest potential impacts to the public from Area C activities would result from SO_2 and CO emissions. The largest potential air quality impacts to the public from activities in the 200 Areas would involve the 24-hour PM_{10} air concentration. Using the series of conservative assumptions employed in the dispersion modeling, this maximum air quality impact would be about 41 percent of the applicable air quality standard.

5.2.5 Alternative Groups E_1, E_2, and E_3

Project activities that would generate air quality impacts under Alternative Groups E_1, E_2, and E_3 (collectively referred to as Alternative E) include the use of diesel-fueled equipment to construct a lined modular facility for LLW and MLLW, construction of the ILAW and melter trenches, backfilling and capping activities in the LLBGs, modification of T Plant, and the excavation of materials at the borrow pit. In addition, propane engines would be used at the CWC and to operate pulse driers used to treat leachate from the MLLW trenches. Fugitive dust would be associated with all major construction and operation activities. Alternative Groups E_1, E_2, and E_3 postulate different locations for the lined modular facility. In conducting air quality modeling, a conservative 200 West Area source location was assumed in all cases for the lined modular facility. As a result, the air quality estimates for E_1, E_2, and E_3 are equivalent.

For Alternative Group E (Hanford Only, Lower Bound, and Upper Bound waste volumes), the largest air quality impacts would occur during three different periods of project operation. In 2006, the heavy use of construction equipment for concurrent construction of LLW, MLLW, and ILAW trenches and the

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative D are summarized in Table 5.9. Estimates of the maximum air quality impacts from Area C activities are the same for all Alternative Groups (see Table 5.6).

Table 5.9. Alternative D: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

			Hanford & Lower Bound Volume		**Upper Bound Volume**	
Pollutant	**Averaging Time**	**Ambient Air Quality Standard (μg/m³)**	**Maximum Air Quality Impacts (μg/m³)**	**Percent of Standard**	**Maximum Air Quality Impacts (μg/m³)**	**Percent of Standard**
PM_{10}	24 hr	150	61	41	62	41
	Annual	50	0.53	1.1	0.54	1.1
SO_2	1 hr	1,000	84	8.4	84	8.4
	3 hr	1,300	38	2.9	38	2.9
	24 hr	260	3.1	1.2	3.1	1.2
	Annual	50	0.019	0.038	0.019	0.038
CO	1 hr	40,000	1590	4.0	1590	4.0
	8 hr	10,000	500	5.0	500	5.0
NO_2	Annual	100	0.91	0.91	0.98	0.98

All air quality impacts from Alternative D would be within ambient air quality standards. The largest potential impacts to the public from Area C activities would result from SO_2 and CO emissions. The largest potential air quality impacts to the public from activities in the 200 Areas would involve the 24-hour PM_{10} air concentration. Using the series of conservative assumptions employed in the dispersion modeling, this maximum air quality impact would be about 41 percent of the applicable air quality standard.

5.2.5 Alternative Groups E_1, E_2, and E_3

Project activities that would generate air quality impacts under Alternative Groups E_1, E_2, and E_3 (collectively referred to as Alternative E) include the use of diesel-fueled equipment to construct a lined modular facility for LLW and MLLW, construction of the ILAW and melter trenches, backfilling and capping activities in the LLBGs, modification of T Plant, and the excavation of materials at the borrow pit. In addition, propane engines would be used at the CWC and to operate pulse driers used to treat leachate from the MLLW trenches. Fugitive dust would be associated with all major construction and operation activities. Alternative Groups E_1, E_2, and E_3 postulate different locations for the lined modular facility. In conducting air quality modeling, a conservative 200 West Area source location was assumed in all cases for the lined modular facility. As a result, the air quality estimates for E_1, E_2, and E_3 are equivalent.

For Alternative Group E (Hanford Only, Lower Bound, and Upper Bound waste volumes), the largest air quality impacts would occur during three different periods of project operation. In 2006, the heavy use of construction equipment for concurrent construction of LLW, MLLW, and ILAW trenches and the capping of an existing MLLW trench would produce the maximum 24-hour and annual concentrations of SO_2. In 2007, trench-construction activities would be underway, which would produce the maximum 1- and 8-hour concentrations of CO and the maximum 1- and 3-hour concentrations of SO_2. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hour and annual concentrations of PM_{10} and annual concentrations of NO_2.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative E are summarized in Table 5.10. Estimates of the maximum air quality impacts to the public from Area C activities are the same for all Alternative Groups (see Table 5.6).

Table 5.10. Alternative E: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

			Hanford & Lower Bound Volume		**Upper Bound Volume**	
Pollutant	**Averaging Time**	**Ambient Air Quality Standard (μg/m^3)**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**
PM_{10}	24 hr	150	60	40	62	41
	Annual	50	0.53	1.1	0.54	1.1
SO_2	1 hr	1,000	93	9.3	95	9.5
	3 hr	1,300	42	3.2	42	3.2
	24 hr	260	3.1	1.2	3.2	1.2
	Annual	50	0.019	0.038	0.020	0.040
CO	1 hr	40,000	1700	4.3	1700	~~4.4~~4.3
	8 hr	10,000	530	5.3	530	5.3
NO_2	Annual	100	0.84	0.84	0.97	0.97

All air quality impacts from Alternative E would be within ambient air quality standards (see Table 4.5). The largest potential impacts to the public from activities at Area C would result from SO_2 and CO emissions. The largest potential air quality impact to the public from activities in the 200 Areas would involve the 24-hour PM_{10} air concentration. Using the series of conservative assumptions employed in the dispersion modeling, this maximum air quality impact would be about 41 percent of the applicable air quality standard.

5.2.6 No Action Alternative

Project activities that would generate air quality impacts under the No Action Alternative include the use of diesel-fueled equipment during construction of additional trenches of current design, construction of the ILAW trench and 66 CWC buildings, backfilling the LLW and MLLW trenches, capping two existing MLLW trenches, and excavation of materials at the borrow pits. A propane-fueled pulse drier would be used to treat MLLW trench leachate, beginning in 2026. Fugitive dust would be associated with all major construction and operation activities.

capping of an existing MLLW trench would produce the maximum 24-hour and annual concentrations of SO_2. In 2007, trench-construction activities would be underway, which would produce the maximum 1- and 8-hour concentrations of CO and the maximum 1- and 3-hour concentrations of SO_2. After disposal operations cease, LLBG and ILAW capping operations would be in full swing. This sustained activity would produce the maximum 24-hour and annual concentrations of PM_{10} and annual concentrations of NO_2.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under Alternative E are summarized in Table 5.10. Estimates of the maximum air quality impacts to the public from Area C activities are the same for all Alternative Groups (see Table 5.6).

Table 5.10. Alternative E: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

			Hanford & Lower Bound Volume		**Upper Bound Volume**	
Pollutant	**Averaging Time**	**Ambient Air Quality Standard (μg/m^3)**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**	**Maximum Air Quality Impacts (μg/m^3)**	**Percent of Standard**
PM_{10}	24 hr	150	60	40	62	41
	Annual	50	0.53	1.1	0.54	1.1
SO_2	1 hr	1,000	93	9.3	95	9.5
	3 hr	1,300	42	3.2	42	3.2
	24 hr	260	3.1	1.2	3.2	1.2
	Annual	50	0.019	0.038	0.020	0.040
CO	1 hr	40,000	1700	4.3	1700	~~4.4~~4.3
	8 hr	10,000	530	5.3	530	5.3
NO_2	Annual	100	0.84	0.84	0.97	0.97

All air quality impacts from Alternative E would be within ambient air quality standards (see Table 4.5). The largest potential impacts to the public from activities at Area C would result from SO_2 and CO emissions. The largest potential air quality impact to the public from activities in the 200 Areas would involve the 24-hour PM_{10} air concentration. Using the series of conservative assumptions employed in the dispersion modeling, this maximum air quality impact would be about 41 percent of the applicable air quality standard.

5.2.6 No Action Alternative

Project activities that would generate air quality impacts under the No Action Alternative include the use of diesel-fueled equipment during construction of additional trenches of current design, construction of the ILAW trench and 66 CWC buildings, backfilling the LLW and MLLW trenches, capping two existing MLLW trenches, and excavation of materials at the borrow pits. A propane-fueled pulse drier would be used to treat MLLW trench leachate, beginning in 2026. Fugitive dust would be associated with all major construction and operation activities.

For the No Action Alternative (Hanford Only and Lower Bound waste volumes), the largest air quality impacts would occur during two different periods of project operation. In 2007, the heavy use of construction equipment to construct LLW trenches and CWC buildings, the capping of existing MLLW trenches, and propane use at CWC would produce the maximum 24-hour and annual concentrations of PM_{10}. In 2034, ILAW vault and final LLW trench construction would be underway, and propane for CWC and pulse drier operations would be at their peak. These activities would produce the maximum concentrations of SO_2 over all averaging periods, the maximum annual concentrations of NO_2, and the maximum 1- and 8-hour concentrations of CO.

Estimates of the maximum air quality impacts to the public from activities in the 200 Areas under the No Action Alternative are presented in Table 5.11. Estimates of the maximum air quality impacts to the public from Area C activities are the same for all Alternative Groups (see Table 5.6).

Table 5.11. No Action Alternative: Maximum Air Quality Impacts to the Public from Activities in the 200 Areas

Pollutant	Averaging Time	Ambient Air Quality Standard (μg/m^3)	Maximum Air Quality Impacts	
			Maximum Pollutant Concentration (μg/m^3)	Percent of Standard
PM_{10}	24 hr	150	57	38
	Annual	50	0.37	0.74
SO_2	1 hr	1000	86	8.6
	3 hr	1300	35	2.7
	24 hr	260	3.4	1.3
	Annual	50	0.019	0.038
CO	1 hr	40,000	1600	4.0
	8 hr	10,000	460	4.6
NO_2	Annual	100	0.93	0.93

All air quality impacts from the No Action Alternative would be within ambient air quality standards (see Table 4.5). The largest potential impacts to the public from Area C activities would result from SO_2 and CO emissions. The largest potential air quality impact from emissions in the 200 Areas would involve the 24-hour PM_{10} air concentration. Using the series of conservative assumptions employed in the dispersion modeling, this maximum air quality impact would be about 38 percent of the applicable air quality standard.

5.2.7 Comparison of Alternative Groups

Table 5.12 presents a summary comparison, across all Alternative Groups, of maximum ambient air quality impacts to the public from activities in the 200 Areas. The greatest air quality impacts are experienced under Alternative B – Upper Bound. Depending on the pollutant and averaging period, the lowest air quality impacts are experienced under Alternative A – Hanford Only and Lower Bound, Alternative C – Hanford Only and Lower Bound, Alternative C – Upper Bound, and the No Action Alternative.

estimated health and safety impacts would be about 200 total recordable cases, 84 lost workday cases, and about 2900 lost work days.

5.11.1.3 Alternative Group B

Alternative Group B is similar to Alternative Group A except that use of commercial treatment facilities would be minimized with construction of a new waste processing facility, instead of modifying the T Plant Complex. New LLW and MLLW trenches would be constructed using the current design instead of the wider, deeper trench designs. Alternative Group B would involve the same waste processing and the same waste management approaches. The alternative includes the establishment of necessary facilities for storage, inspection, treatment, and final disposal or shipment offsite for all included waste streams. In addition, Alternative Group B includes the same sources, waste streams, and volumes of waste as Alternative Group A.

As in Alternative Group A, all of the wastes would be removed from storage and treated as necessary for disposal in the HSW disposal facilities or sent to the WIPP. After about 10 years, wastes would only be held in storage for short periods of time to allow for characterization and evaluation prior to treatment or disposal. Under Alternative Group B, the analyses use the Hanford Only, Upper, and Lower Bound of forecasted disposal waste volumes for LLW and MLLW.

5.11.1.3.1 Construction

New construction activities are anticipated for HSW disposal facilities and the new waste processing facility. The primary impacts from construction activities would be to air quality and injuries to construction workers. No impacts to construction workers are expected from radiation and chemicals because new construction activities would be performed away from areas of known contamination. Impacts to non-involved workers (from other onsite activities) are expected to bound potential air quality impacts to construction workers. Impacts from industrial accidents during construction are discussed in Section 5.11.1.2.3.

The construction activities may involve emission of criteria pollutants from the use of combustion engines and earthmoving activities. The potential impacts from these activities are described in Section 5.2 and are summarized here. Impacts are measured by comparison of air concentrations at the point of maximum potential public exposure. The analysis indicated that emissions of criteria pollutants (including sulfur dioxide, carbon monoxide, nitrogen dioxide, and PM_{10}) from construction activities would result in air concentrations below the regulatory limits. As a consequence, no health impacts would be expected from these emissions.

5.11.1.3.2 Normal Operations

Potential impacts to public health from normal operations include air quality impacts from atmospheric releases of radionuclides and chemicals from waste operations. Long-term impacts from releases to groundwater from LLBGs are discussed in Sections 5.11.2 and 5.3.

Alternative Group B involves operations that may result in routine releases of radionuclides and chemicals to the atmosphere. These operations include waste package verification, treatment, and packaging at WRAP; processing of materials and equipment at modified T Plant Complex; treatment and processing of waste in the new waste processing facility; and treatment of leachate from MLLW trenches using pulse driers. Annual releases have been estimated for each year of operation for the facilities involved in this alternative. Details of the release calculations are described in Appendix F.

5.11.1.3.2.1 Health Impacts from Routine Radionuclide Releases

The expected doses and health impacts to non-involved workers and the public from routine atmospheric releases of radionuclides are presented in Table 5.47 for the Hanford Only waste volume, Table 5.15 for the Lower Bound waste volume, and in Table 5.49 for the Upper Bound waste volume. The tables present the maximum annual dose to the non-involved workers and the MEI, and the collective dose to the public along with the probability of developing an LCF for the individual and the number of LCFs expected for the public. Given that the cancer risk estimates and doses are small in comparison to regulatory limits,[a] no adverse health impacts would be expected from radionuclide releases.

5.11.1.3.2.2 Health Impacts from Chemical Releases

Releases of chemicals to the atmosphere could occur for the same processes involving release of radionuclides when wastes with hazardous chemicals are involved. The potential health impacts from chemical releases to the atmosphere are presented in Table 5.50 for all waste volumes. The results for the Hanford Only waste volume are the same as those for the Lower Bound waste volume because the processing volumes for mixed waste streams are nearly identical for both (only mixed wastes contain chemicals that may be released to the atmosphere). Because all the peak hazard quotients are less than 1, and because the cancer risk estimates are small, no adverse health impacts would be expected from chemical releases.

5.11.1.3.2.3 Worker Occupational Radiation Exposure

The radiation dose received by workers involved with waste operations is estimated using historical exposure data for the facilities involved in the alternative as provided the Technical Information Document (FH 2003). The potential radiation exposure to workers for Alternative Group B are summarized in Table 5.51 for the Hanford Only waste volume, in Table 5.52 for the Lower Bound waste volume, and in Table 5.53 for the Upper Bound waste volume. All estimated radiation doses to workers are well below regulatory limits.[b]

(a) The maximum annual radiation dose presented in this section may be compared to the regulatory limit of 10 mrem/year (WAC 246-247; 40 CFR 61; DOE 1993).

(b) The annual limit for occupational exposures is 5000 mrem/year (10 CFR 835).

Table 5.47. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group B, Hanford Only Waste Volume

Exposed Group	Exposure Scenario[(a)]	Facility	Lifetime Dose[(b)] (mrem)	Prob. of LCFs[(c)]	Maximum Annual Dose	
					Year	mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.2E-03	7E-10	2004	1.3E-04
		T Plant Complex	4.8E-01	3E-07	2003	3.9E-02
		NWPF[(d)]	2.8E-02	2E-08	2015	2.0E-03
		Leachate Treatment[(e, f)]	6.9E-08	4E-14	2026	4.9E-09
MEI Offsite	Resident Gardener	WRAP	9.9E-05	6E-11	2004	1.1E-05
		T Plant Complex	1.0E-03	6E-10	2003	7.9E-05
		NWPF	9.7E-04	6E-10	2015	6.7E-05
		Leachate Treatment	2.2E-10	1E-16	2027	1.2E-11
		Total	2.1E-03	1E-09	2003	1.6E-04
			(person-rem)	**Number of LCFs[(h)]**	**Year**	**(person-rem)**
Population[(g)]	Population within 80 km (50 mi)	WRAP	9.1E-03	0 (5E-06)	2004	7.4E-04
		T Plant Complex	9.2E-02	0 (6E-05)	2003	5.5E-03
		NWPF	8.8E-02	0 (5E-05)	2015	4.7E-03
		Leachate Treatment	2.0E-08	0 (1E-11)	2026	8.2E-10
		Total	1.9E-01	0 (1E-04)	2003	1.1E-02

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) NWPF = new waste processing facility.
(e) Leachate treatment is a pulse drier operation.
(f) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(g) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(h) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.48. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group B, Lower Bound Waste Volume

Exposed Group	Exposure Scenario[a]	Facility	Lifetime Dose[b] (mrem)	Prob. of LCFs[c]	Maximum Annual Dose Year	Maximum Annual Dose mrem
Worker Onsite (non-involved)	Industrial	WRAP	1.4E-03	9E-10	2004	1.6E-04
		T Plant Complex	5.8E-01	3E-07	2003	4.8E-02
		NWPF[d]	2.8E-02	2E-08	2015	2.0E-03
		Leachate Treatment[e, f]	5.0E-07	3E-13	2026	2.8E-08
MEI Offsite	Resident Gardener	WRAP	1.2E-04	7E-11	2004	1.3E-05
		T Plant Complex	1.2E-03	7E-10	2003	9.5E-05
		NWPF	9.7E-04	6E-10	2015	6.7E-05
		Leachate Treatment	2.6E-10	2E-16	2027	1.4E-11
		Total	2.3E-03	1E-09	2003	1.8E-04
			(person-rem)	**Number of LCFs[h]**	**Year**	**(person-rem)**
Population[g]	Population within 80 km (50 mi)	WRAP	1.1E-02	0 (6E-06)	2004	8.8E-04
		T Plant Complex	1.1E-01	0 (7E-05)	2003	6.7E-03
		NWPF	8.8E-02	0 (5E-05)	2015	4.7E-03
		Leachate Treatment	2.3E-08	0 (1E-11)	2026	9.6E-10
		Total	2.1E-01	0 (1E-04)	2003	1.3E-02

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) NWPF = new waste processing facility.
(e) Leachate treatment is a pulse drier operation.
(f) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(g) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(h) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.49. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Radionuclides – Alternative Group B, Upper Bound Waste Volume

Exposed Group	Exposure Scenario[(a)]	Facility	Lifetime Dose[(b)] (mrem)	Prob. of LCFs[(c)]	Maximum Annual Dose Year	Maximum Annual Dose mrem
Worker Onsite (non-involved)	Industrial	WRAP	2.2E-03	1E-09	2004	1.9E-04
		T Plant Complex	8.9E-01	5E-07	2006	7.2E-02
		NWPF[(d)]	2.8E-02	2E-08	2015	2.0E-03
		Leachate Treatment[(e, f)]	8.4E-07	5E-13	2026	4.7E-08
MEI Offsite	Resident Gardener	WRAP	2.1E-04	1E-10	2004	1.6E-05
		T Plant Complex	2.0E-03	1E-09	2006	1.5E-04
		NWPF	9.7E-04	6E-10	2015	6.7E-05
		Leachate Treatment	4.3E-10	3E-16	2026	2.3E-11
		Total	3.2E-03	2E-09	2006	2.3E-04
			Dose (person-rem)	**Number of LCFs[(h)]**	**Year**	**Dose (person-rem)**
Population[(g)]	Population within 80 km (50 mi)	WRAP	2.0E-02	0 (1E-05)	2004	1.1E-03
		T Plant Complex	1.8E-01	0 (1E-04)	2006	1.0E-02
		NWPF	8.8E-02	0 (5E-05)	2015	4.7E-03
		Leachate Treatment	3.9E-08	0 (2E-11)	2026	1.9E-09
		Total	2.9E-01	0 (2E-04)	2006	1.6E-02

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The lifetime dose is the radiation dose received from intake during the exposure period and up to 50 years after exposure due to radionuclides deposited in the body during the exposure period.
(c) LCF = latent cancer fatality.
(d) NWPF = new waste processing facility.
(e) Leachate treatment is a pulse drier operation.
(f) If LLW trenches were to be lined, the doses from leachate collection and treatment might be as much as three times the leachate treatment values shown in this table.
(g) The population lifetime impacts are based on exposure for the same exposure pathways impacting the resident gardener MEI.
(h) The value in parentheses is the calculated value based on the population dose and the appropriate health effects conversion factor. The actual number of LCFs must be a whole number (deaths).

Table 5.50. Non-Involved Worker and Public Health Impacts from Routine Atmospheric Releases of Chemicals – Alternative Group B, All Waste Volumes

Volume	Exposed Group	Exposure Scenario[a]	Facility	Risk of Cancer Incidence[b]	Peak Annual Hazard Quotient[c]
Hanford Only and Lower Bound	Worker Onsite (non-involved)	Industrial	WRAP	1.2E-09	8.9E-05
			T Plant Complex	3.2E-08	2.3E-03
			NWPF[d]	1.7E-07	9.1E-03
	MEI Offsite	Gardener	WRAP	5.6E-11	3.4E-06
			T Plant Complex	3.3E-11	2.0E-06
			NWPF	6.9E-09	3.7E-04
			Total	7.0E-09	3.8E-04
	Population	Population within 80 km (50 mi)	WRAP	0 (5E-06)[e]	NA[f, g]
			T Plant Complex	0 (3E-06)[e]	NA
			NWPD	0 (6E-04)[e]	NA
			Total	0 (6E-04)[e]	NA
Upper Bound	Worker Onsite (non-involved)	Industrial	WRAP	5.3E-09	6.9E-04
			T Plant Complex	1.8E-07	2.4E-02
			NWPF	1.7E-07	9.1E-03
	MEI Offsite	Gardener	WRAP	2.3E-10	2.5E-05
			T Plant Complex	1.7E-10	2.0E-05
			NWPF	6.9E-09	3.7E-04
			Total	7.3E-09	4.2E-04
	Population	Population within 80 km (50 mi)	WRAP	0 (2E-05)[e]	NA[f, g]
			T Plant Complex	0 (2E-05)[e]	NA
			NWPF	0 (6E-04)[e]	NA
			Total	0 (7E-04)[e]	NA

(a) The exposure duration for the industrial scenario is 20 years and for the resident gardener, 30 years. The exposure scenarios are described in Appendix F.
(b) The individual risk of cancer incidence is evaluated for the exposure duration defined for the given exposure scenario starting in the year that provides the highest total impact.
(c) Hazard quotients are reported for the year of highest exposure.
(d) NWPF = new waste processing facility.
(e) Population risk from cancer is expressed as the inferred number of fatal and non-fatal cancers in the exposed population over the lifetime of the population from intakes during the remediation period. The actual value must be a whole number (cancers).
(f) Hazard quotients are designed as a measure of impacts on an individual and are not meaningful for population exposures.
(g) NA = not applicable.

5.11.1.3.3 Accidents

Continuing waste management operations under Alternative Group B would involve a continuing potential for accidental release that would be very similar to those discussed for Alternative Group A in four Hanford facilities: the CWC for waste storage, the WRAP for waste treatment, the modified T Plant Complex for waste treatment, and the HSW disposal facilities for waste disposal. Alternative Group B also adds a new treatment facility, the new waste processing facility, for which potential health impacts from accidents were evaluated. Health and safety impacts from industrial accidents would differ only slightly from Alternative Group A from construction activities for the new waste processing facility and LLBGs under Alternative Group B.

Anticipated health impacts to all workers from industrial accidents during construction and operations would be 640 to 660 total recordable cases, 260 to 270 lost workday cases, and 9000 to 9300 lost workdays. A total of about 20,800 to 21,400 worker-years would be required to complete all activities. Of these worker-years about 2800 to 3400 are site support and waste generator-paid workers that do not appear in the direct facility worker and impact estimates in the following sections. About 94 to 97 percent of these health impacts are from operations.

5.11.1.3.3.1 Storage – CWC

Potential radiological, non-radiological, and industrial accidents and impacts for the CWC would be the same as for Alternative Group A (see Section 5.11.1.1.3.1).

5.11.1.3.3.2 Treatment – WRAP

Potential radiological, non-radiological, and industrial accidents and impacts for the WRAP would be the same as for Alternative Group A (see Section 5.11.1.1.3.2).

5.11.1.3.3.3 Treatment – T Plant Complex

Potential radiological, non-radiological, and industrial accidents and impacts for continuing the existing T Plant activities are described under Alternative Group A (see Section 5.11.1.1.3.3).

Table 5.51. Occupational Radiation Exposure – Alternative Group B, Hanford Only Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCFs[c]
LLW and MLLW Trenches	2002-2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.1	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	20	13	1.9	0 (1E-03)
T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (4E-03)
New Waste Processing Facility	2013-2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	7.6	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026-2077	Operator	2.8	54	8.0	0 (5E-03)
Total					772	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

Table 5.52. Occupational Radiation Exposure – Alternative Group B, Lower Bound Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[(a)]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCFs[(c)]
LLW and MLLW Trenches	2002-2046	Operator	14	54	34	0 (2E-02)
		RCT[(b)]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[(d)]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.1	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	20	13	1.9	0 (1E-03)
T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (4E-03)
New Waste Processing Facility	2013-2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[(e)]	2002-2019	Operator	15	34	9.2	0 (6E-03)
		RCT	12	35	7.6	0 (5E-03)
	2020-2026	Operator	5	34	1.2	0 (7E-04)
		RCT	3	35	0.7	0 (4E-04)
	2027-2044	Operator	1	34	0.6	0 (4E-04)
		RCT	1	35	0.6	0 (4E-04)
Pulse Driers	2026-2077	Operator	3.3	54	9.4	0 (6E-03)
Total					773	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

Table 5.53. Occupational Radiation Exposure – Alternative Group B, Upper Bound Waste Volume

Facility	Operating Period	Worker Category	Workers (FTE)[a]	Average Dose Rate (mrem/yr)	Workforce Dose (person-rem)	Workforce LCFs[c]
LLW and MLLW Trenches	2002-2046	Operator	14	54	34	0 (2E-02)
		RCT[b]	4	45	8.5	0 (5E-03)
		Other	66	35	104	0 (6E-02)
ILAW	2008-2028	Workers	70	300[d]	443	0 (3E-01)
	2032-2046	Workers	20	14	4.1	0 (2E-03)
CWC	2002-2046	Operator	12	54	29	0 (2E-02)
		RCT	4	45	8.6	0 (5E-03)
		Other	55	17	42	0 (3E-02)
WRAP	2002-2032	Operator	13	18	7.3	0 (4E-03)
		RCT	9	36	10	0 (6E-03)
		Other	29	13	12	0 (7E-03)
	2033-2039	Operator	9	18	1.2	0 (7E-04)
		RCT	6	36	1.6	0 (1E-03)
		Other	21	13	1.9	0 (1E-03)
T Plant Complex	2002-2032	Operator	20	9	5.6	0 (3E-03)
		RCT	18	13	7.3	0 (4E-03)
		Other	38	7	8.2	0 (5E-03)
	2033-2046	Operator	14	9	1.7	0 (1E-03)
		RCT	13	13	2.3	0 (1E-03)
		Other	27	7	2.6	0 (2E-03)
New Waste Processing Facility	2013-2031	Operator	10	13	2.6	0 (2E-03)
		RCT	10	13	2.4	0 (1E-03)
		Other	20	13	4.9	0 (3E-03)
Generator Staff[e]	2002-2019	Operator	20	34	12	0 (7E-03)
		RCT	13	35	8.2	0 (5E-03)
	2020-2026	Operator	7	34	1.7	0 (1E-03)
		RCT	5	35	1.2	0 (7E-04)
	2027-2044	Operator	3	34	1.8	0 (1E-03)
		RCT	2	35	1.3	0 (8E-04)
Pulse Driers	2026 – 2077	Operator	5.6	54	16	0 (9E-03)
Total					786	0 (5E-01)

(a) The number of workers is the average necessary for the facility during the indicated period.
(b) RCT = radiation control technician.
(c) LCF = latent cancer fatality. Workforce LCFs are the inferred number of cancer deaths in the exposed workforce, which must be a whole number (deaths). The value in parentheses is the calculated value based on the workforce dose and the appropriate health effects conversion factor.
(d) The dose rates for placement of ILAW into disposal facilities are higher than for other solid waste management operations because the material emits more radiation.
(e) Staff in the solid waste support services group that work as needed in various solid waste facilities.

5.11.1.3.3.4 Treatment – New Waste Processing Facility

The DOE would construct a new waste processing treatment facility in the 200 West Area to augment existing capabilities for treatment of contact-handled (CH) MLLW. DOE would provide onsite treatment for CH MLLW at this facility in addition to non-standard, remote-handled (RH) MLLW and TRU waste.

Radiological Consequences. Radiological consequences of accidents would be the same as those described for the modified T Plant Complex described under Alternative Group A (see Section 5.11.1.1.3.3).

Non-Radiological (Chemical) Consequences. Non-radiological consequences for the new waste processing facility have not been evaluated in detail. However, potential non-radiological impacts from accidents in the WRAP and the modified T Plant Complex are expected to be representative for potential impacts from the new waste processing facility. Potential impacts from accidents in the CWC and LLBGs would likely be bounding for accidents in the new waste processing facility.

Industrial Accidents-Construction. Direct employment for the new waste processing facility construction would total 278 worker-years. The estimated health and safety impacts would be 23 total recordable cases, 8 lost workday cases, and 150 lost workdays.

Industrial Accidents-Operations. Alternative Group B direct operations staffing in the new waste processing facility would be the same as described for the modified T Plant Complex under Alternative Group A (see Section 5.11.1.1.3.3).

5.11.1.3.3.5 Disposal – HSW Disposal Facilities

Potential radiological and non-radiological (chemical) accidents and impacts for the HSW disposal facilities under Alternative Group B would be the same as for Alternative Group A. Industrial accidents are discussed below.

Industrial Accidents-Construction. Slightly more impacts would be expected for LLBG construction under Alternative Group B than Alternative Group A and would require 54 to 83 worker-years. The estimated health and safety impacts would be 4 to 6 total recordable cases, 1 to 2 lost workday cases, and 24 to 41 lost workdays.

Industrial Accidents-Operations. Industrial accidents from LLBG operations would be the same as Alternative Group A (see Section 5.11.1.1.3.4).

ILAW Industrial Accidents. Industrial accidents form ILAW trench construction, operations, and closure would be the same as Alternative Group A (see Section 5.11.1.1.3.4).

5.11.1.4 Alternative Group C

Alternative Group C is similar to Alternative Group A except for the disposal location of some of the

5.13 Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629), directs federal agencies in the Executive Branch to consider environmental justice so that their programs will not have "…disproportionately high and adverse human health or environmental effects…" on minority and low-income populations. Executive Order 12898 further directed federal agencies to consider effects to "populations with differential patterns of subsistence consumption of fish and wildlife." The Executive Branch agencies also were directed to develop plans for carrying out the order. The CEQ provided additional guidance later for integrating environmental justice into the National Environmental Policy Act process in a December 1997 document, *Environmental Justice Guidance Under the National Environmental Policy Act* (CEQ 1997).

Environmental justice is concerned with assessment of disproportionate distribution of adverse impacts of an action among minority and low-income populations that is significantly greater than that experienced by the rest of the population. Adverse impacts are defined as negative changes to the existing conditions in the natural environment (for example, land, air, water, wildlife, vegetation) or in the human environment (for example, employment, health, land use). The distribution of minority and low-income groups in the Hanford environs is shown graphically in Section 4.8.

Based on the 2000 census (Census 2000), the 80-km (50-mi) radius area surrounding the Hanford Site had a total population of 482,300 and a minority population of 178,500. The ethnic composition of the minority population is primarily White Hispanic (24 percent), self-designated "other and multiple" races (63 percent), Native American (6 percent), and two or more races (9 percent). Asians and Pacific Islanders (4 percent) and African American (3 percent) make up the rest. The Hispanic population resides predominantly in Franklin, Yakima, Grant, and Adams counties. Native Americans within the 80-km (50-mi) area reside primarily on the Yakama Reservation and upstream of the Hanford Site near the town of Beverly, Washington.

The 2000 low-income population was approximately 80,700, or 17 percent of the total population residing in the 80-km (50-mi) radius of the Hanford Site. The majority of these households were located to the southwest and northwest of the site (Yakima and Grant counties) and in the cities of Pasco and Kennewick.

Native Americans of various tribal affiliations who live in the greater Columbia Basin rely in part on natural resources for subsistence. According to Harris and Harper (1997), the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, and the Yakama Nation depend on natural resources for dietary subsistence. For example, the treaty of 1855 with the Yakama Nation (Treaty with the Yakama 1855) secured to the Yakamas "…the right of taking fish at all usual and accustomed places, in common with the citizens of the Territory [now the state of Washington] and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed lands." The Wanapum historically lived along the Columbia River and continue to live upstream of the Hanford Site. They fish on the Columbia River and gather food resources near the Hanford Site. The Confederated Tribes of the Colville Reservation traditionally fished and gathered food resources in the Hanford area. They also are recognized as having cultural and religious ties to the Hanford Site.

The pathways through which the environmental impacts are associated with each of the alternatives and how they might disproportionately impact minority or low-income groups were reviewed for each of the associated sections of Section 5. The only aspect that exhibited the potential for disproportionate impacts dealt with implications of cultural resources on the Hanford Site with respect to Native Americans. However, these would be common to all of the alternative groupings. Native American affiliations near the Hanford Site include such places as Gable and Rattlesnake mountains and Gable Butte in their creation beliefs and cultural heritage. Thus, disproportionate adverse impacts from implementing any of the alternatives on minority or low-income populations would be limited to those that might be associated with restricted use of Native American traditional cultural places on the Hanford Site. Additional information on cultural resources is presented in Section 5.7. Other impacts related to aesthetic and scenic resources are addressed in Section 5.12.

5.14 Cumulative Impacts

This section includes discussions of past, current, and reasonably foreseeable future actions in the Hanford area. Current and future activities include preparation for and disposal of tank waste, CERCLA remediation projects, decontamination and decommissioning of the Hanford production reactors and other facilities, operation of a commercial LLW disposal site by U.S. Ecology, Inc., and operation of the Columbia Generating Station by Energy Northwest.

Potential cumulative impacts associated with implementing the various HSW EIS alternative groups are summarized in this section for storage, treatment, and disposal of the range of waste volumes evaluated. For most resource and potential impact areas, the combined effects from the alternative groups for the Hanford Only, Lower and Upper Bound volumes, or for the No Action Alternative for the Hanford Only and Lower Bound waste volume, when added to these other activities, are small.

The CEQ on assessment of cumulative impacts.

In 40 CFR 1508.7, the Council on Environmental Quality (CEQ) defines cumulative impact as:

"…the impact on the environment from the incremental impact of the action when added to other past, present, and reasonably future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time)."

In CEQ 1997, the CEQ states:

"The continuing challenge of cumulative effects analysis is to focus on important cumulative issues…."

5.14.1 Land Use

Consistent with past NEPA actions, land within the 200 Areas has already been committed for industrial-exclusive use, including waste disposal (HCP EIS) (DOE 1999). Radionuclides are present in the soil from past discharges, disposal actions, or tank leaks. Because of their chemical characteristics and very long half-lives (for example, cesium-135 with a half-life of 2.3 million years), some radionuclides are held in the soil indefinitely.

Waste previously disposed of in the solid waste disposal facilities currently occupies 130.5 ha (322 ac) of the Hanford Site. As discussed in Section 5.1, additions to the commitment of land area for waste disposal would range from about 19.2 ha (47 ac) for the Hanford Only waste volume as disposed of in any of the configurations of Alternative Groups D or E to 79.6 ha (197 ac) for the Upper Bound waste volume estimate as disposed of in Alternative Group B (see Section 5.1). Waste management activities through 2046 (Upper Bound waste volume) would be expected to require up to a total of 427 ha (1050 ac) for waste storage, treatment, and disposal facilities and for capping materials. Of this total, 210 ha (519 ac) would be permanently committed for disposal of wastes in Alternative Group B (largest requirements). This amount would represent about 4.2 percent of the 5000-ha (12,350-ac) within the area previously designated for long-term waste management activities in the HCP EIS (DOE 1999).

5.14.2 Air Quality

As discussed in Section 5.2, air quality standards at the Hanford Site boundary would not be approached or exceeded as a result of implementing any of the options described here or in combination with other reasonably foreseeable actions at the Hanford Site (see Section 5.2). This is due in large part to the current and projected:

- low density and intensity of pollutant emitting activities on the Hanford Site and in neighboring areas of south-central Washington
- relatively low population density in the region (minimizing the contribution of urban impacts on the region's air quality)
- substantial distances between the project activities and the Hanford Site boundary
- atmospheric dispersion conditions at Hanford that are generally favorable and meteorological conditions that could lead to a severe atmospheric stagnation event are of low-to-moderate frequency (and typically of short duration).

Quantification of cumulative non-radiological impacts for criteria pollutants was based on data presented in the TWRS EIS and is shown in Table 5.142 (DOE and Ecology 1996). The maximum impacts from activities evaluated in this HSW EIS are presented in Table 5.143 for comparison.

Table 5.142. Cumulative Air Quality Impacts for Criteria Pollutants

Sources	Maximum Average Concentration (g/m^3)			
	Particulate (PM-10)	**Nitrogen Oxides (NO_X)**	**Sulfur Oxides (SO_X)**	**Carbon Monoxide (CO)**
Hanford Site Baseline	3	3	19	3
Hanford Remedial Action	43	40	5	26
Environmental Restoration Disposal Facility	33	Negligible	Negligible	Negligible
Tank Waste Remediation System Alternative	98	2.2	27	2500
Total	177	45	51	2529
Standard 1	150 (24 hour)	100 (Annual)	365 (24 hour)	10,000 (8 hour)
Notes: 1 Washington State standards				

Table 5.143. Largest Criteria-Pollutant Impacts for HSW Operations Among the Alternative Groups and the No Action Alternative

Alternative	Hanford Only and Lower Bound Waste Volumes				Upper Bound Waste Volume			
	24-hr PM_{10}	1-hr SO_2	8-hr CO	Annual NO_2	24-hr PM_{10}	1-hr SO_2	8-hr CO	Annual NO_2
Alternative Group A, $\mu g/m^3$	69	81	470	0.84	74	98	590	0.8
Alternative Group B, $\mu g/m^3$	71	130	800	1.0	90	180	110	1.1
Alternative Group C, $\mu g/m^3$	60	79	460	0.79	61	80	470	0.78
Alternative Group D, $\mu g/m^3$	61	84	500	0.91	62	84	500	0.98
Alternative Group E, $\mu g/m^3$	60	93	530	0.84	62	95	530	0.97
No Action Alternative, $\mu g/m^3$	57	86	460	0.93	Not applicable			

(a) Standards are: 24-Hour PM_{10} = 150 $\mu g/m^3$, 1-Hour SO_2 = 1,000 $\mu g/m^3$, 8-Hour CO = 10,000 $\mu g/m^3$.
Annual NO_2 = 100 $\mu g/m^3$

It should be noted that the values presented in Tables 5.142 and 5.143 are maximums that would occur at different times and locations and may not be additive.

5.14.3 Ecological, Cultural, Aesthetic, and Scenic Resources

Cumulative impacts as they pertain to ecological, cultural, aesthetic, and scenic resources in general on the Hanford Site can be found in the HCP EIS, which is incorporated by reference (DOE 1999). There, it was concluded that the potential for cumulative impacts to biological resources could best be evaluated by determining the amount of BRMaP Level III and Level IV resources that could be affected.

This EIS does not change any land use designated by the HCP EIS ROD (64 FR 61615). The HCP EIS took a long-term look at the resources that would be required for the major reasonably foreseeable projects. Capping of the Central Plateau and complete conversion of the Industrial-Exclusive to industrial areas were two of the impacts assumed at that time. The HCP EIS contains the distribution of BRMaP Levels II, III, and IV resources for the DOE Preferred Alternative, before the 24 Command Fire. BRMaP mitigation would have been required for those areas that were designated Level III or Level IV. Assuming that the pre-fire condition represents the edaphic potential of the burned areas, the HCP EIS identified 16,833 ha (41,595 ac) in Conservation (Mining) and 3,115 ha (7, 697 ac) in Industrial-Exclusive as BRMaP Level III resources, out of a site resource base of 66,744 ha (164,927 ac). These areas contain no BRMaP Level IV resources. In the HCP EIS, Conservation (Mining) was chosen for 30 percent of the site, while Preservation was chosen for 53 percent of the site.

Field surveys conducted during 2002 for each of the areas in which any of the HSW EIS alternative groups might be implemented identified the near PUREX disposal facility site (up to 24.5 ha [60 ac]) as mature shrub-steppe habitat that could qualify under BRMaP Level III and require mitigation. Isolated element occurrences in Area C might also qualify as Level III or Level IV, but would need to be re-examined nearer the time of planned disturbance (see Section 5.5).

The activities described in this EIS would take place in areas that are, and will be for the foreseeable future, dedicated to industrial type uses. However, the presence of the Hanford Reach Monument with its relatively low-density use and the portions of the Hanford Site designated for preservation/conservation would result in large areas remaining in a natural state.

Surveys of areas to be used in implementing each of the alternative groups did not disclose the presence of cultural resources (see Section 5.7). However, changes to the viewshed of the Hanford 200 Areas would occur as a result of activities evaluated in this EIS as well as other programs at Hanford. As facilities are closed and barriers are placed on waste disposal facilities, the visual appearance of waste disposal facilities would likely become more similar to the to pre-Hanford Site condition. Future uses of the Central Plateau are likely to include structures and activities consistent with its designation for Industrial-Exclusive use in the HCP EIS (DOE 1999). However, most areas of the viewshed on the Hanford Site are expected to remain in a near natural state due to designation of approximately 80,000 ha (200,000 ac) of the site as a National Monument (65 FR 114) and of many other major areas of the site for preservation/conservation (DOE 1999).

5.14.4 Geologic Resources

Geologic resources consisting of sand, gravel, silt/loam, basalt would be required in construction of modified RCRA Subtitle C barriers for any of the alternative groups and for the Hanford barrier to cover immobilized low-activity waste (ILAW) as disposed of in the No Action Alternative. The quantities of these resource expected to be required were presented in Section 5.10. The resources would be obtained from Area C identified in the HCP EIS (DOE 1999) as Conservation (mining). In areal extent, the requirements would at most (Alternative Group B) amount to about 10 percent of Area C designated for borrow-pit materials.

This EIS does not change any land use designated by the HCP EIS ROD (64 FR 61615). The HCP EIS took a long-term look at the resources that would be required for the major reasonably foreseeable projects. Capping of the 200 Area Plateau and complete conversion of the Industrial-Exclusive to industrial areas were two of the impacts assumed at that time. Appendix D of the HCP EIS discussed using 36.1 million cubic meters (47.3 million cubic yards) of fine textured soils and developing a basalt source that could yield 15.3 million cubic meters (20 million cubic yards) of basalt riprap. A maximum of 90 ha (222 ac) of area C would be used for geologic resource development, out of the 44,183 ha (109,179 ac) reserved by the HCP EIS for Conservation (Mining). In the HCP EIS, Conservation (Mining) was chosen for 30 percent of the site, while Preservation was chosen for 53 percent of the site.

5.14.5 Socioeconomics

If a number of the projects being considered for Hanford were undertaken simultaneously, the activity levels and the workers needed to support the activities could temporarily strain community infrastructure. The impact of any of the HSW alternative groups or the No Action Alternative would each be small (300 to 500 workers out of 15,000 workers at the Hanford Site, see Section 5.6). The current projected baseline for Hanford shows declining budgets and employment beginning in about 2012. If this baseline is maintained and other considerations remain equal, most existing components of community infrastructure would be adequate to accommodate population growth of about 2000 residents associated with any of the HSW alternative groups in the long run. However, between 2003 and 2007, a projected 7000 new residents are expected move into the area to support construction of the Hanford tank waste treatment plant. These new arrivals and any early arrival of the up to about 2000 new residents related to the Hanford solid waste program in the Tri-Cities area could challenge the capacities of the local real estate markets, the transportation network, and the primary and secondary education facilities.

In addition, other projects are expected to be underway at Hanford in the near term, such as operations at the Hazardous Materials Management and Emergency Response (HAMMER) facility, cleanup of several older reactors and other buildings, and actions to remediate the K Basins, the vadose zone, and the groundwater on the site. These additional projects could increase Hanford employment by a few hundred workers during the period 2003 to 2010 and, therefore, might also affect the socioeconomic context against which the effects of any LLW, MLLW, and TRU waste-related activity under the proposed action would need to be judged (see Section 5.6).

While the increases in workers (300 to 500) mentioned above would be in addition to the existing Hanford work force of about 15,000, that work force is anticipated to temporarily increase (from activities other than associated with HSW) and then to generally decline after about 2005 and to continue to decline throughout the period of analysis (see Figure 5.1). Overall employment may even decline at a faster rate than presently forecast depending on the success of accelerated site cleanup. However, the impact of implementing any of the HSW alternative groups would be a small addition to cumulative socioeconomic impacts.

5.14.6 Public Health

Although large amounts of various chemicals have been used during Hanford operations over the years, the breadth and depth of documented, quantitative information regarding these chemicals is very limited when compared to the amount of information available about radioactive materials. However, as shown in Section 5.11, hazards from releases of chemicals to the atmosphere have been calculated to be very small for all HSW alternative groups and would not be expected to add measurably to cumulative impacts regardless of their magnitude.

As was shown in Section, 4.5.3.2, Figure 4.19, a number of chemicals, principally from past liquid discharges to the ground, are found in the groundwater at Hanford. Again, there is only fragmentary data on the source quantities and transport to groundwater of these chemicals. In one case, however, it was estimated that the inventory of nitrate in groundwater beneath the 200 Areas exceeded 90,000 tonnes (100,000 tons) (ERDA 1975). The inventory of nitrate in HSW is on the order of 6.2 tonnes (6.8 tons), which, if taken as an indication of incremental impact of all chemicals in HSW, would suggest that those chemicals would not add substantially to the cumulative impacts of existing chemicals in groundwater.

Cumulative impacts for the atmospheric, surface water, and groundwater pathways, which could lead to potential radiological impacts on the public, are presented in the following subsections (also see Section 5.11).

5.14.6.1 Atmospheric Pathway

A summary of cumulative radiological impacts on public health due to radiological air emissions from past, current, and reasonably foreseeable future activities at Hanford is provided in Table 5.144. Examples of past activities include operation of the fuel fabrication plants, reactors, the PUREX Plant and other fuel processing facilities, the Plutonium Finishing Plant, and research facilities. Current activities include site cleanup, waste disposal, and tank-waste stabilization, and reasonably foreseeable future activities include continuation of site cleanup, waste disposal, and immobilization of both high-level waste and low-activity waste, and related activities.

Table 5.144. Cumulative Population Health Effects in the Hanford Environs from Atmospheric Pathways due to Hanford Activities[(a)]

Source of Impacts	Dose person-rem	Latent Cancer Fatalities[(b)]
Past Hanford Operations (DOE 1995)	100,000	60
Ongoing and Proposed Operations		
Hanford Operations (1997–2046) (Poston et al. 2001)[(c)]	15	0
Columbia Generating Station (30 yr) (DOE 1996a)	21	0
HSW EIS—Atmospheric Releases		
Alternative Groups A, C, D & E–Range[(d)]	0.15 – 0.24	0
Alternative Group B–Range[(d)]	0.19 – 0.29	0
No Action Alternative–Range[(e)]	0.10 – 0.12	0
Reasonably Foreseeable Operations		
Plutonium Finishing Plant Stabilization (DOE 1996b)	140[(f)]	0
K Basin Fuel Treatment and Storage (DOE 1996a)	120[(f)]	0
TWRS Phased Implementation Alternative (DOE and Ecology 1996)	400[(f)]	0
Cumulative Total	100,696.3[(g)]	60
Perspective		
Cumulative Natural Background Dose–100 yr, 1946-2046	12,000,000	7,200

(a) Assumes constant population of about 380,000.
(b) Six inferred LCFs per 10,000 person-rem Values less than 0.5 were rounded to zero.
(c) Assumed to continue at the 2000 population dose rate.
(d) Range based on Hanford Only Waste Volume and Upper Bound Waste Volume.
(e) Range based on Hanford Only Waste Volume and Lower Bound Waste Volume.
(f) Value based on previous NEPA analyses.
(g) For the solid waste program, this number includes only the value of 0.3 person-rem from Alternative Groups A, B, C, D, or E—Upper Bound waste volume activities.

The cumulative population dose since startup of Hanford operations was estimated to be 100,000 person-rem (DOE 1995). The number of inferred latent cancer fatalities (LCFs) since Hanford startup inferred from such a population dose would amount to about 60, essentially all of which would be attributed to dose received in the 1945 to 1952 time period.

For perspective, since startup of the Hanford Site, the population of interest (assuming an average population within 80 km [50 mi] of 380,000 and an individual dose of 0.3 rem/yr [(NCRP 1987]) would have received about 6 million person-rem from naturally occurring radiation sources (that is, natural background), from which 3600 LCFs could be inferred.

If the entire Hanford Sitewide contribution to population dose from all exposure pathways were to remain at calendar-year 2000 levels through the period ending in 2046 (Poston et al. 2001), the estimated collective population dose would be about 36 person-rem. No LCFs would be expected from such a population dose.

This estimated level was based on a 0.3 person-rem/yr population dose from DOE facilities at Hanford, and a 0.7 person-rem/yr population dose from Energy Northwest's Columbia Generating Station for 30 years of operation (DOE 1996b). The largest contribution from solid waste management alternative groups to the total population dose of 36 person-rem would be about 0.3 person-rem (see Section 5.11).

Depending on the options selected, vitrification of the Hanford tank wastes could contribute up to about 400 person-rem to the cumulative, collective population dose (DOE and Ecology 1996). The cumulative, collective population dose for the Plutonium Finishing Plant could increase to another 140 person-rem depending on the option ultimately selected (DOE 1996b). Similarly, remediation of K Basins could add another 120 person-rem depending on options selected (DOE 1996b). No other activities are foreseen that would add substantially to these doses, and the total dose from these activities through the period ending in 2046 would not be expected to result in any LCFs.

Again for perspective, the doses to the local population from naturally occurring radioactive sources would result in about an additional 6 million person-rem for the 50-year period ending in 2046, from which another 3600 LCFs would be inferred. Thus, over about 100 years from the start of the Hanford operations to the year 2046, about 7200 LCFs might have resulted from naturally occurring sources. To this number of LCFs resulting from natural sources would be the inference that Hanford operations might have added about 60 LCFs as a result of airborne releases of radioactive material mainly during the 1945 to 1952 time period.

5.14.6.2 Surface Water Pathway

Past impacts associated with the water pathway were principally associated with contamination of Columbia River water that was used as once-through coolant for the eight Hanford production reactors. Various elements present in the incoming water were made radioactive during their passage through one or more of these reactors.[a] In addition, some of the corrosion products that formed in the plants' piping were made radioactive and entered the water. Fuel element failures (slug ruptures) also exposed the fuel to cooling water and added contaminants to the water. On an average annual basis, the principal radionuclides contributing to potential dose were phosphorous-32, chromium-51, zinc-65, arsenic-76, and neptunium-239. Contamination also occurred as a result of adding water-conditioning agents, with hexavalent chromium as the principal contaminant.

An estimate of collective population dose to the nearest downstream users of the Columbia River (Richland, Pasco, and Kennewick, Washington) from 1944 to present would amount to about 3000 person-rem, most of which occurred before 1971 at which time the last reactor that used once-through cooling was shut down. This estimate was based on the dose to people who drank water supplied by municipal water plants and estimates of the populations for Richland (after startup of its water treatment plant in late 1963), Pasco, and Kennewick, and included a nominal amount of time for people who engaged in boating and swimming in the Columbia River.[b] From 1971 to present, the collective population dose was estimated to be less than 400 person-rem. From a collective dose of 3000 person-rem, two LCFs could be inferred. The collective population drinking water dose for 2001 from the surface water pathway was determined to be 0.0024 person-rem (Poston 2001). If that annual dose were to continue over 10,000 years, the total from all future Hanford activities might amount to 27 person-rem. The addition of radionuclides from the disposal of HSW over that period was less than or equal to 0.3 person-rem at the Tri-Cities. Neither the current projection of drinking water dose nor that projected from disposal of HSW would add substantially to the past cumulative population dose derived from the Columbia River of 3400 person-rem.

The presence of contaminants in surface water as a result of inflow of groundwater, and a discussion of the cumulative impacts of contaminants in the groundwater itself are included in the next subsection.

5.14.6.3 Groundwater Pathway

Cumulative groundwater impacts are examined in the context of existing sources of contamination in the soil, vadose zone, and groundwater. The following contaminants have been consistently detectable in soil on the Hanford Site: strontium-90, cesium-137, uranium -238, plutonium isotopes (238, 239, 240), and americium-241. Contaminants in the vadose zone include cobalt-60, strontium-90, technetium-99,

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(a) A ninth reactor, N Reactor, did not use once-through cooling. Past discharges to nearby trenches is a source for seepage of some contaminants into the river.

(b) Before 1971, higher doses would have been experienced by those individuals making recreational use of the Columbia River, consuming food crops grown with irrigation water derived from the river, consuming fish and waterfowl inhabiting the river, and consuming seafood harvested from along the Washington and Oregon coast. Due to the number of pathways and uncertainties in numbers of individuals involved, this aspect has not been quantified on a collective basis for the 1944 to present time period. Estimates of maximum and average representative individual doses may be found in Farris et al. (1994). Doses from 1971 to present were estimated from the maximally exposed individual (MEI) doses taken from annual reports and, consequently, are substantially higher than would be expected for individuals with typical dietary habits (for example, the annual per capita dose for 1999 was reported as 0.0007 mrem, and the MEI dose was reported as 0.008 mrem, thus the MEI dose overestimates the per capita dose by a factor of about 10.)

cesium-137, europium isotopes (152, 154), uranium isotopes (234, 235, 238), and plutonium isotopes (239, 240). Contaminants in the vadose zone also include non-radioactive materials including metals, votatile organics, semivolatile organics, and inorganics (Poston et al. 2002).

Groundwater beneath the operational areas and in plumes leading from the Central Plateau to the Columbia River is contaminated with hazardous chemicals and radionuclides from past liquid waste disposal practices. The existing level of contamination in the groundwater would exceed Federal Drinking Water Standards if it were a source of drinking water as defined in the standards (Poston et al. 2002). Hazardous chemical contaminants that would exceed this benchmark include nitrate, carbon tetrachloride, trichloroethene, and chromium, and radiological contaminants that exceed the Standards include tritium, iodine-129, strontium-90, technetium-99, and uranium. Concentrations of these radionuclides and hazardous chemicals currently in groundwater are shown in Section 4.5.3.1, Figures 4.18 and 4.19, respectively.

Action alternatives analyzed in this EIS do not exceed the 4-mrem per year benchmark public drinking water dose (see Section 3.4.3). By the time the waste constituents from the action alternatives are predicted to reach groundwater (hundreds of years) the waste constituents would not superimpose on existing plumes and would not exceed the benchmark dose, because the existing groundwater contaminant plumes will have migrated out of the unconfined aquifer by then.

Radionuclides leached from wastes disposed of in HSW disposal facilities could eventually be transported through the vadose zone to groundwater. For this analysis, it was assumed that an individual drilled a well through the vadose zone to the groundwater and used the groundwater as a source of drinking water. As an indication of cumulative Hanford groundwater impacts, the annual dose to an individual drinking 2 liters of that water per day and taking into account all wastes intentionally or unintentionally disposed of on the Hanford Site since the beginning of operations and waste forecast to be disposed of through 2046 (Lower Bound waste volume)[a] was calculated for technetium-99 and uranium isotopes using the System Assessment Capability (SAC) (Kincaid et al. 2000) software and data. Technetium-99 and uranium were selected for analysis because they are representative of the more mobile contaminants evaluated elsewhere in this EIS.

A SAC analysis of hypothetical future impacts was conducted based on conservative assumptions (that is, loss of institutional controls and cessation of barrier maintenance). The SAC analysis of the initial assessment for 10,000 years completed for the HSW EIS was comprised of two simulations: a

(a) ILAW from treating tank waste was not included in the original SAC or initial assessment. Initially the SAC was tasked to address a 1000-year period; however, technetium-99 and iodine-129 would not release from the ILAW form to the water table within that time period. An approximation of the drinking water doses combining SAC and ILAW results for technetium-99 and uranium is shown as a function of time in Figures 5.14(1), 5.14(2), and 5.14(3). Melters and naval reactor compartments also were not included as sources of radioactive releases in the original SAC assessment. They, like ILAW, were assumed to not release any activity during the initial 1000-year, post-closure period. Both of these waste types are encased in substantial steel containment and contain substantially lower inventories of technetium-99 and uranium than ILAW; therefore, they would not contribute to groundwater contamination and were not simulated.

stochastic analysis[a] and a deterministic analysis.[b] First was the 25 realization stochastic analysis. Each realization represents a possible combination of the uncertain parameters. Using a cumulative performance measure, such as cumulative dose at a point of interest, a single realization can be identified as the median response for the stochastic problem. The second simulation conducted was a median-inputs case where each stochastic parameter is assigned its median value in a single or deterministic simulation. Results of the stochastic simulations with the median case highlighted are provided in Appendix L. The results for the median-inputs case are presented here and in Appendix L as representative of a best-estimate simulation. For additional information on the SAC calculation process, see Appendix L to this EIS and the initial assessment report (Bryce et al. 2002). The SAC is the next generation capability intended to update and improve the 1998 Composite Analysis completed by Kincaid et al. (1998). Using the dose predicted in the ILAW performance assessment (Mann et al. 2001) the influence of ILAW disposal has been added to that predicted in the initial assessment median-inputs case simulated with SAC. Thus, the cumulative impact shown below for selected points is achieved by superimposing the published ILAW impact on the simulated initial assessment results.

The cumulative impact for technetium-99 in all Hanford sources is provided in Figure 5.38. This is the annual dose resulting from a 2 L/d drinking water scenario for technetium-99 at a line of analysis approximately 1 km (0.6 mi) southeast of the 200 East Area.

This annual dose exhibits an initial peak prior to the year 2000 and a second peak of approximately 2 mrem/yr within 200 years. This second peak appears to be related to releases from past liquid discharge sites in the 200 East Area. Additional, but lower, peaks of approximately 0.3 mrem/yr appear in approximately years 4300 and 7500. Releases from HSW disposal facilities in the 200 West Area are responsible for the peak in approximately year 4300. Tank waste residuals releasing in the 200 East Area from a 1-percent residual volume and a salt cake waste are responsible for the last peak. The underlying long-term dose declines to 0.06 mrem/yr by 10,000 years post-closure. This dose is related to long-term releases from HSW and other miscellaneous waste, which, when combined, account for approximately 0.04 mrem/yr, and from ILAW, which accounts for approximately 0.02 mrem/yr.

Based on uncertainty in the groundwater conceptual model, the ILAW contribution to the cumulative result may be approximately four times larger or 0.08 mrem/yr. The resulting cumulative 2 L/d drinking water dose from technetium-99 would be approximately 0.12 mrem/yr at 10,000 years post-closure. Somewhat higher contributions than shown here from HSW and other sources, (that is, 0.04 mrem/yr) may also occur because of uncertainty in the groundwater conceptual model utilized in the SAC; however, groundwater model uncertainty as it relates to the HSW contributions is addressed in Section 5.3 and Appendix G. It should be noted that the ILAW release and associated dose impacts play a role in the last several thousand years only and do not substantially influence the peaks described above.

(b) Stochastic Analysis: Set of calculations performed using values randomly selected from a range of reasonable values for one or more parameters; in contrast, see deterministic analysis. In the HSW EIS, the median value was reported.

(c) Deterministic Analysis: A single calculation using only a single value for each of the model parameters. A deterministic system is governed by definite rules of system behavior leading to cause and effect relationships and predictability. Deterministic calculations do not account for uncertainty in the physical relationships or parameter values. See stochastic analysis.

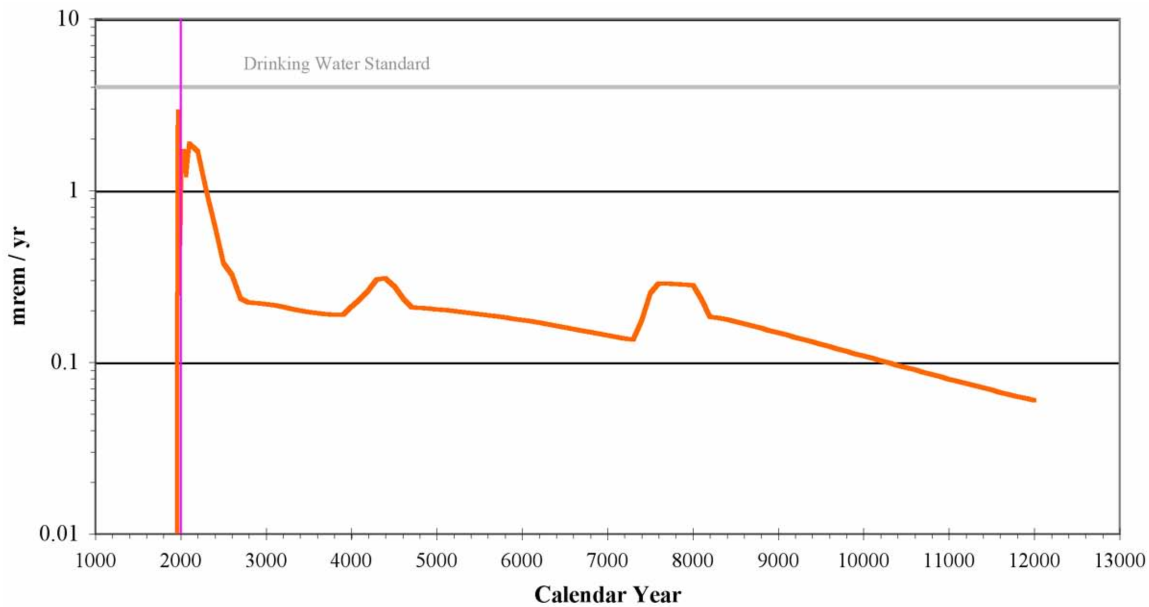

Figure 5.38. Annual Drinking Water Dose from Technetium-99 in Groundwater Southeast of the 200 East Area from All Hanford Sources

A plot of the cumulative drinking water dose for technetium-99 in all Hanford sources from Columbia River water at the City of Richland Pumping Station is provided in Figure 5.39. This location is down-river from all groundwater plumes of Hanford origin. While having a much more variable appearance caused by river discharge variability, the peaks seen in Figure 5.38 at the 200 East Area location are also present in Figure 5.39. However, the annual dose values are approximately five orders of magnitude lower than those predicted at the 200 East Area. The maximum estimated annual dose from technetium-99 over all 25 realizations of the stochastic analysis from the years 2000 through 9900 was determined to be less than 0.00008 mrem/yr, while the peak median dose was approximately 0.00004 mrem/yr.

Although groundwater simulations continued through the year 12,050 A.D. (10,000 years post closure; see Figure 5.38, the river simulations were terminated at the year 9900 A.D. due to the river model's software design constraints. Thus, river model forecasts are not available for the final 2000 years of the 10,000-year, post-closure period. However, as is apparent from the simulation results achieved, trends seen in the groundwater system near the Central Plateau appear somewhat later and at much reduced concentrations in the Columbia River at the City of Richland location.

Figure 5.40 shows the drinking water dose from uranium in Columbia River water at the City of Richland Pumping Station. The dose from Hanford-origin uranium also exhibits a temporal variability caused by variability in Columbia River discharge. However, the peaks are subdued and delayed for uranium, an element that is sorbed and migrates more slowly than groundwater and non-sorbed elements such as technetium. The maximum annual dose from uranium over all 25 realizations of the stochastic analysis from the year 2000 through the year 9900 was determined to be less than 0.002 mrem/yr, while the peak median dose was approximately 0.00005 mrem/yr.

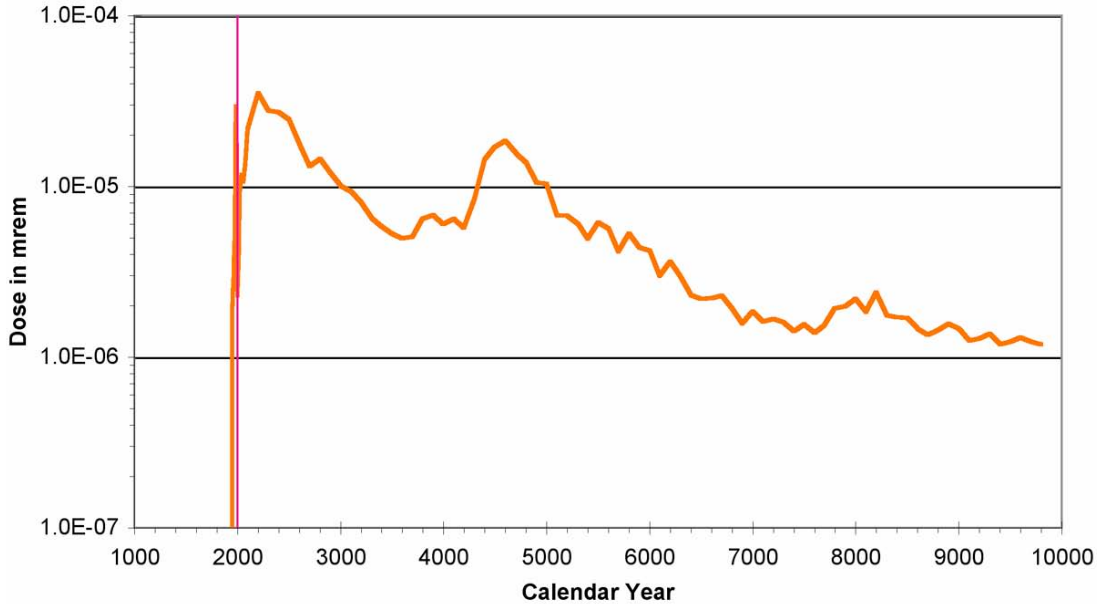

Figure 5.39. Annual Drinking Water Dose from Technetium-99 in the Columbia River at the City of Richland Pumping Station from All Hanford Sources

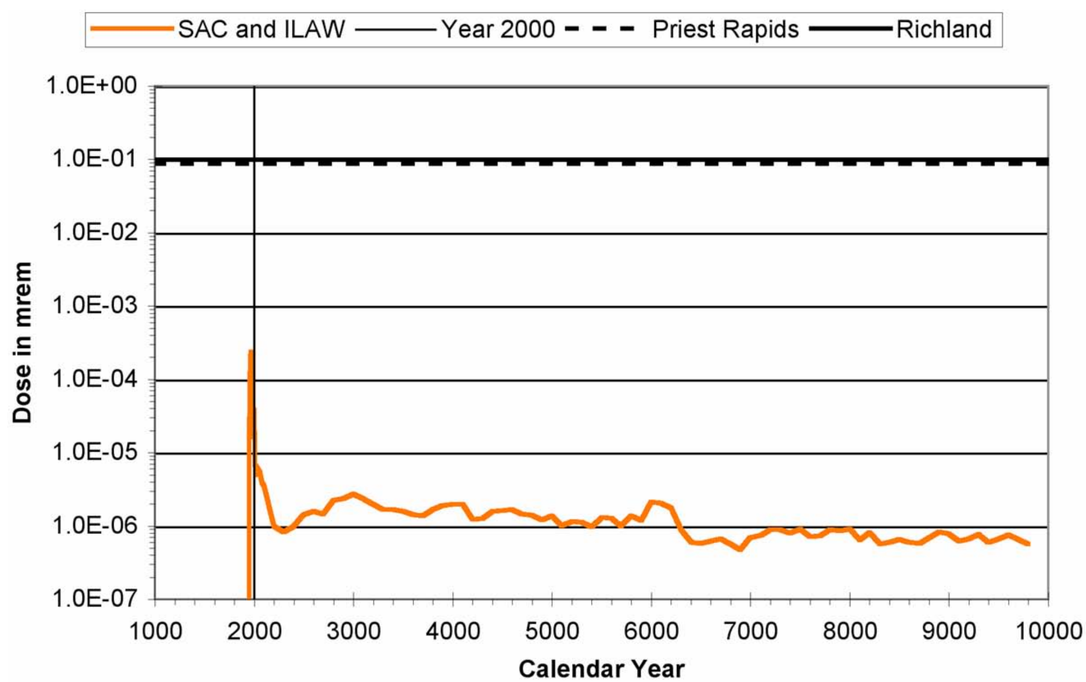

Figure 5.40. Annual Drinking Water Dose from Uranium in the Columbia River at the City of Richland Pumping Station from All Hanford Sources

The annual drinking water dose at Priest Rapids, upstream of Hanford, and at the Richland Pumping Station, downstream of Hanford, are shown for uranium (Figure 5.40 based on a five-year average concentration of uranium at those locations (Poston et al. 2002). The technetium-99 measurements were not suitable for a similar presentation (concentrations at Priest Rapids were higher than at the City of Richland Pumping Station). In Figure 5.40, an estimate of the annual drinking water dose based on 5-year average isotopic uranium concentrations at Priest Rapids Dam (upstream of the Hanford Reach of the Columbia River) that are assumed to continue at those levels indefinitely is shown near the top of the figure (0.090 mrem) as a black dashed line. A similar dose estimate based on average uranium concentrations (0.099 mrem) at the City of Richland Pumping Station is shown as a solid black line.

The stochastic capability of SAC was employed to evaluate the relative role in overall release of different waste types including solid waste, past liquid discharges, tank wastes, and facilities including canyon buildings. The variability in the stochastic results is due to variability in the inventory, release, and transport of technetium-99 and uranium. The human dose calculations use fixed inputs. These results include all waste releases (for example, releases from cribs, ponds, solid waste, past tank leaks, future tank losses, tank residuals, unplanned releases) that were considered in the initial assessment performed by Bryce et al. (2002) and exclude the influence of the ILAW, melter, and naval waste forms and inventories.

In the SAC simulation, cumulative releases to groundwater from HSW, excluding ILAW disposed of in the Central Plateau, ranged from approximately 300 to 450 Ci for technetium-99 over the 12,050-year analysis period. This compares with releases to groundwater ranging from approximately 1500 to 2300 Ci of technetium-99 for all Hanford wastes except ILAW. Thus, the contribution to technetium-99 releases to groundwater from HSW, excluding ILAW, would amount to at most 20 percent of the cumulative release from all Hanford sources. The ILAW cumulative release of technetium-99 for the base case (Mann et al. 2001) used in this analysis was approximately 86 curies by the end of the 10,000-year, post-closure period. Thus, the contribution from HSW, including ILAW, for technetium-99 would amount to, at most, 25 percent of the cumulative release.

For uranium, releases from HSW, excluding ILAW, to groundwater are much lower in the SAC simulation. No realizations showed any release of uranium to groundwater from these wastes in the 200 East Area, and only 5 of 25 realizations show any release of uranium to groundwater from these wastes in the 200 West Area. Thus, in an average (or median) sense, deposits of HSW, excluding ILAW, would release no uranium to groundwater over the 10,000-year period of analysis. This compares with a median release of approximately 84 Ci and a range of releases to groundwater from the 25 realizations of between approximately 10 and 300 Ci of uranium for all Hanford wastes except ILAW. Of the five stochastic realizations exhibiting non-zero uranium release from HSW, excluding ILAW, in the 200 West Area, the cumulative release ranged from 0 to approximately 90 Ci. Hence, the contribution of HSW, excluding ILAW, to overall uranium release to groundwater lies between 0 and 90 Ci, but the majority of the realizations showed no release. As a consequence, the contribution of HSW, excluding ILAW, to uranium releases to groundwater would amount to between 0 and 30 percent of the cumulative release from all Hanford sources except ILAW, and likely would be zero. The majority of the technetium-99 and uranium releases from wastes other than ILAW were predicted to occur from liquid discharge sites (cribs, ponds, trenches) used in the past and from unplanned releases on the plateau and from off-plateau waste sites.

The SAC and HSW EIS approach (see Appendix G) simulations of uranium migration and fate that appear in this EIS differ in the relative roles of technetium-99 and uranium at times nearing the end of the 10,000-year, post-closure period analyzed because distribution coefficients for uranium in the two analyses differ. The SAC produces results where technetium-99 is the dominant radionuclide throughout the post-closure analysis period. However, the HSW EIS approach, which is applied to generate comparative analyses of the 33 alternative groups, predicts that uranium becomes dominant towards the end of the post-closure analysis. The distribution coefficients of the linear sorption isotherm model were assigned a value of 0.6 ml/g in the HSW EIS approach and a value of 3 ml/g for the median-value SAC simulation. The value used in the HSW EIS approach is a more conservative, lower value that causes more rapid migration at higher contaminant levels. The value used in the SAC is a median value, somewhat higher than the conservative value that causes slower migration and lower contaminant concentrations. As a result, the SAC assessment predicts that the median response will be dominated by technetium-99 with uranium making more of a contribution in the latter portion of the 10,000-year, post-closure period. The HSW EIS simulation of alternative groups shows uranium dominating in the last few thousand years because its mobility is greater in that model. The range of K_d applied for uranium in the stochastic SAC model includes the nominal value used in the HSW EIS simulation, and some realizations of the stochastic model exhibit the greater uranium mobility and contribution to dose seen in the HSW EIS results. However, the focus and purpose of the SAC simulation is to provide the central tendency or median simulation result.

Leaching of radionuclides from wastes disposed of in HSW disposal facilities and their transport through the vadose zone, to groundwater, and then to the Columbia River also would lead in the long term to small additional collective doses to downstream populations. The collective dose from HSW was calculated to be only about 0.14 person-rem for the total population of the cities of Richland, Kennewick, and Pasco, Washington, and 0.39 person-rem for a hypothetical population of a city the size of Portland, Oregon, that might draw water from the Columbia River in the vicinity of Portland. No LCFs would be inferred from such population doses.

In addition to technetium-99 and uranium, iodine-129 is another contaminant of interest. There is uncertainty with respect to the total inventory of iodine-129 in spent fuel irradiated at Hanford and the amount currently in groundwater. The inventory data and information assembled for the initial assessment (Bryce et al. 2002) revealed that approximately 75 curies of iodine-129 were generated during the irradiation of nuclear fuel in Hanford reactors. Most of the spent fuel was processed in facilities on the Central Plateau; however, some remains in spent fuel that is being moved to a central location on the Central Plateau prior to shipment to a national repository. Some of the iodine-129 inventory is conservatively counted in individual waste site inventories. When summed, the inventories disposed of at waste sites, released to the environment (for example, at cribs, into the atmosphere, into the Columbia River), and stored for future disposal at offsite locations exceed 75 curies and are approximately 100 curies.

Iodine is found in all three phases; solid, liquid, and gas, and has been identified in each of these waste types. Accordingly, some iodine-129 is found in solid waste, some in liquid discharges, and some in atmospheric releases. There is considerable uncertainty in the amount of iodine-129 that appears in each. In prior inventory compilations and the initial assessment, it was assumed that most of the iodine-129 resides in single-shell and double-shell tanks in the Central Plateau. Furthermore, it was assumed that all of the iodine-129 would be captured in secondary waste streams from waste separation and solidification processes, and that these wastes would be treated and the iodine disposed of, primarily, in solid waste disposal facilities. Of the 100 curies estimated at the site at the time of site closure in the initial assessment and this cumulative impact analysis, approximately 66 curies reside in solid waste, 19 curies may have been released to the atmosphere, 7 curies reside in spent fuel, 5.5 curies reside in commercial low-level radioactive waste disposal, 4 curies were discharged to cribs and trenches, and 2 curies are associated with the past leaks, estimated future losses, and residuals of tanks. None of the 66 curies of iodine-129 associated with solid waste in the cumulative assessment is assigned to ILAW because the early assumption was that iodine was too volatile to remain in the solidified low-activity tank waste.

As a result of recent estimates of iodine retention in immobilized tank waste, about 22 curies of the iodine-129 in the tank waste was assumed, for impact modeling purposes in this EIS, to be disposed of as part of the ILAW waste form. The model assumes an additional 5 curies is contained in the solid waste to be disposed of (see Appendix B, Table B.19). Thus the groundwater modeling performed for the actions in this EIS assumes a total source term of 27 curies of iodine-129 in the combined ILAW and solid wastes.

A bounding case for cumulative impacts would occur if releases from HSW EIS curies were released exactly in phase, in space and in time, with the assumed "cumulative impact" curies. If such exact phasing occurred, it would be expected that groundwater concentrations would be three to four times those reported for the HSW EIS alternative groups. However, due to the low-release characteristics of the ILAW waste form, the likelihood that a substantial portion of the cumulative impacts inventory of iodine-129 would be disposed in a cement waste form, geographic distribution, and variations in lining and capping techniques, it would be unlikely that such exact phasing would occur.

5.14.6.4 Transportation

Transportation impacts associated with transporting radioactive wastes and materials including that to and from the Hanford Site have been addressed in other NEPA documents. Table 5.143, based on DOE 2002 and this EIS, provides cumulative impact information from those analyses and analyses preformed for the HSW EIS.

In addition, this EIS presents a discussion of transportation of wastes that are within the scope of this HSW EIS in the States of Oregon and Washington (see Section 5.8).

The information in Table 5.145 indicates that the cumulative transportation impacts associated with any of the HSW EIS alternative groups are small relative to transport of radioactive material in general. For perspective, it may be noted that about 4.4 million traffic fatalities from all causes would be expected nationwide during the period 1943 to 2047 (DOE 2002a).

Table 5.145. Cumulative Transportation Impacts

Category	Workers LCFs[a]	General Population, LCFs	Traffic Fatalities
Representative Past and Reasonably Foreseeable Actions (Excluding HSW) Involving Transport of Radioactive Materials			
Historical DOE Shipments	0 (0.20)	0 (0.14)	Not Listed[b]
Sodium-Bonded Spent Nuclear Fuel	0 (<0.001)	0 (<0.001)	0 (<0.001)
Surplus Plutonium Disposition	0 (0.036)	0 (0.040)	0 (0.053)
Waste Management PEIS	10	12	36
Waste Isolation Pilot Plant	0 (0.47)	4 (3.5)	5
Cruiser and Submarine Reactor Plant Disposal	0 (0.003)	0 (0.003)	0 (0.0095)
Spent Nuclear Fuel and High-Level Waste – Oregon & Washington	0 (<0.055)	0 (<0.021)	0 (0.049)
General Transport of Radio-pharmaceuticals, Commercial LLW, etc.	198	174	22
Transport of Hanford Solid Wastes			
Alternative Groups A, C, D, and E - Onsite and Treatment at ORR	0 (0.45)	0 (0.15)	1 (0.52)
Alternative Group B - Onsite and Nearby Treatment	0 (0.068)	0 (0.055)	0 (0.49)
No Action Alternative - Onsite	0 (0.075)	0 (0.047)	0 (0.055)
Incoming Offsite Shipments, WA and OR impacts (Upper Bound Volume)	0 (0.21)	0 (0.13)	0 (0.078)
Hanford TRU Waste Shipments to WIPP			
Alternative Groups A – E	0 (0.088)	1 (0.95)	2 (1.6)
No Action Alternative	0 (0.061)	1 (0.51)	1 (0.87)

(a) Assumes 6 latent cancer fatalities (LCFs) per 10,000 person-rem.
(b) The low worker and population doses suggest low mileage for which no traffic fatalities would be expected.

5.14.7 Worker Health and Safety

The cumulative Hanford worker dose, since the startup of activities at Hanford, is about 90,000 person-rem (DOE 1995), to which would be added approximately 1000 person-rem from spent fuel management (DOE 1996b), 8200 person-rem from tank waste remediation (DOE and Ecology 1996), 730 person-rem for Plutonium Finishing Plant stabilization (DOE 1996a), and 765 to 873 person-rem through the year 2046 from management of Hanford solid waste, ILAW, and WTP melters (Hanford Only waste volume for Alternative Group A to either the Hanford Only or Lower Bound volume for the No Action Alternative, [see Section 5.11]). Thus, for about 100 years of Hanford operations, approximately 40 LCFs would be inferred among workers, none of which would be attributable to HSW program activities. Because of DOE restrictions on worker dose and rigorous application of the ALARA principle, the cumulative collective worker dose associated with all future Hanford Site restoration activities would not be expected to add substantially to the collective worker dose to date.

5.15 Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources (NEPA; 42 USC 4321) that would likely result from implementing any of the Alternative Groups or the No Action Alternative are addressed in this section. An irreversibly committed or irretrievable resource is one that is irreplaceably consumed and is non-renewable, is in limited supply, or cannot be replenished.

Implementation of any of the alternatives would result in the irretrievable use of fossil fuels in construction activities, transport of materials and waste, and treatment processes. Bentonite clay, which is a limited resource, would also be committed. Although steel is not in limited supply, that used in drums and rebar would be essentially irretrievable. Land areas used for disposal facilities would also be irretrievably committed. In addition, after a few hundred years following disposal, the vadose zone surrounding disposal areas and groundwater beneath the Hanford Site to which contaminants travel would be irretrievably committed. Depending on concentrations at the time and the down-gradient location of interest (generally south-easterly to north-westerly from the 200 Areas towards the Columbia River), the slow entry of long-lived mobile radionuclides into groundwater might constitute a continuing (thousands of years) commitment of a water resource. Depending on the location and time of interest, concentrations of nuclides in groundwater might be such that it would be necessary to place some restrictions on groundwater usage. When the groundwater reaches the Columbia River and is diluted by the large flow of the river, the contamination levels will fall well below those for which restricted use would be necessary to comply with the National Primary Drinking Water Regulations (40 CFR 141).

The quantities of non-renewable resources that would be irreversibly or irretrievably committed are listed in Table 5.62.

Table 5.146. Irreversible and Irretrievable Resource Commitments by Alternative Group with ILAW

Resource	**Diesel**[b]	**Gasoline**	**Propane**	**Bentonite Clay**	**Steel**[c]	**Land**
Units[a]	**m^3**	**m^3**	**t**	**t**	**t**	**ha**
Alternative Group A						
Hanford Only	132,900	260	12,700	13,900	1,720	169
Lower Bound	132,900	260	12,700	13,900	1,870	170
Upper Bound	133,700	270	19,300	18,200	2,280	178
Alternative Group B						
Hanford Only	136,600	340	23,500	33,600	1,800	187
Lower Bound	136,700	340	23,500	33,600	1,950	189
Upper Bound	140,600	430	38,300	57,600	2,380	210
Alternative Group C						
Hanford Only	65,900	260	12,700	13,900	1,720	151
Lower Bound	65,900	260	12,700	13,900	1,870	152
Upper Bound	66,700	270	19,300	18,200	2,280	160
Alternative Group D						
Hanford Only	65,900	260	18,800	13,900	1,710	150-155
Lower Bound	65,900	260	20,300	13,900	1,870	150-155
Upper Bound	66,700	270	27,800	18,200	2,280	150-155
Alternative Group E						
Hanford Only	65,900	260	18,800	12,800	1,710	150-155
Lower Bound	65,900	260	20,300	13,900	1,870	150-155
Upper Bound	66,700	270	27,800	18,200	2,280	150-155
No Action Alternative						
Hanford Only	188,600	48	3,560	0	59,100	267[d]
Lower Bound	188,700	50	3,560	0	59,200	275[d]

(a) Conversion factors: 1 m^3 = about ≈ 260 gal; 1 m^3 = about 1.3 yd^3; and 1 t (tonne) = about 1.1 ton.
(b) Includes 120,100 m^3 for ILAW in Alternative Groups A and B, 53,100 m^3 for ILAW in Alternative Groups C, D, and E, and 183,400 m^3 for ILAW in the No Action Alternative.
(c) Includes 1000 t for ILAW in Alternative Groups A-E and 33,200 t for ILAW in the No Action Alternative.
(d) Includes land committed to storage of waste at CWC.

5.17 Unavoidable Adverse Impacts

This section summarizes the potential unavoidable adverse impacts associated with implementing the HSW EIS alternatives. Identified are those unavoidable adverse impacts that would remain after incorporating all mitigation measures that were included in the development of the EIS alternatives. Potentially adverse impacts for each of the alternatives are described in other portions of Section 5. In Section 5.18, additional practicable mitigation measures are identified that might further reduce the impacts described in this section.

In particular, unavoidable adverse impacts that would occur if Alternative Groups A, B, C, D, E, or the No Action Alternative were to be implemented are identified in the following sections.

5.17.1 Alternative Group A

Unavoidable adverse impacts associated with implementing Alternative Group A would include:

- commitment of from about 168.5 ha (410 ac) of land for disposal of the Hanford Only waste volume to about 177.9 ha (440 ac) for the Upper Bound waste volume of LLW, MLLW, ILAW, and melters

- small additions of pollutants to the atmosphere as a result of operating heavy equipment during modification of the T Plant Complex and construction of additional burial trenches, operation of facilities, trench backfilling, obtaining materials for constructing modified RCRA Subtitle C covers for disposal facilities and capping the sites, and from transportation of materials and wastes

- small increments in dose to workers and the public

- potential for 20 transport accidents and 1 non-radiological fatality as a result of transporting MLLW offsite for treatment

- potential for 1 radiological latent cancer fatality together with 18 transport accidents and 3 non-radiological fatalities from transport of TRU waste to WIPP (none of these fatalities was expected to occur in the states of Oregon or Washington)

- potential for two transport accidents in Oregon and one in Washington involving receipt of waste from offsite generators in the Lower Bound waste volume case and four transport accidents in Oregon and one in Washington in the Upper Bound waste volume case (no fatalities were predicted in either case)

- eventual migration of mobile radionuclides such as technetium-99, iodine-129, and uranium isotopes to groundwater and ultimately to the Columbia River, leading to contamination of groundwater and very small additional radiation doses to downstream populations.

5.17.2 Alternative Group B

Unavoidable adverse impacts associated with implementing Alternative Group B would be essentially the same as those for Alternative Group A, except for the following differences:

- commitment of from about 186.6 ha (460 ac) of land for disposal of the Hanford Only waste volume to 184 ha (454 ac) for the Upper Bound waste volume of LLW, MLLW, and ILAW
- small additions of pollutants to the atmosphere as a result of operating heavy equipment during construction of a new waste processing facility for treatment of some wastes
- potential for 1 transport accident but with no associated fatalities
- potential for 1 radiological latent cancer fatality together with 18 transport accidents and 2 non-radiological fatalities from transport of TRU waste to WIPP (none of these fatalities was expected to occur in the states of Oregon or Washington)
- potential for two transport accidents in Oregon and one in Washington involving receipt of waste from offsite generators in the Lower Bound waste volume case and four transport accidents in Oregon and one in Washington in the Upper Bound waste volume case (no fatalities were predicted in either case).

5.17.3 Alternative Group C

Unavoidable adverse impacts associated with implementing Alternative Group C would be essentially the same as those for Alternative Group A, except for the following difference:

- commitment of from about 150.5 ha (370 ac) of land for disposal of the Hanford Only waste volume to 159.9 ha (390 ac) for the Upper Bound waste volume of LLW, MLLW, and ILAW.

5.17.4 Alternative Groups D and E (All Subalternatives)

Unavoidable adverse impacts associated with implementing Alternative Groups D and E would be essentially the same as those for Alternative Group A, except for the following difference:

- commitment of from about 149.9 ha (370 ac) of land for disposal of the Hanford Only waste volume to 155 ha (329 ac) for the Upper Bound waste volume of LLW, MLLW, ILAW, and melters.

5.17.5 No Action Alternative

Unavoidable adverse impacts associated with implementing the No Action Alternative would include

- storage of certain MLLW and TRU wastes and melters requiring additional land disturbance of about 66 ha (163 ac)

- consumption of resources and localized minor degradation of air quality associated with construction of 66 additional CWC storage buildings

- commitment of from about 148 ha (365 ac) of land for below-grade disposal of LLW, MLLW, and ILAW for the Hanford Only waste volume to about 149 ha (368 ac) for the Lower Bound waste volume

- small additions of pollutants to the atmosphere from operating heavy equipment during construction and operation of burial trenches, operation of facilities, and from transportation of materials and wastes

- small increments in dose to the public and potential for one radiological latent cancer fatality to the workers

- eventual migration of mobile radionuclides such as technetium-99, iodine-129, and uranium isotopes to groundwater and ultimately to the Columbia River, leading to contamination of groundwater and very small additional radiation doses to downstream populations

- potential for no radiological fatalities, but up to one non-radiological fatality as a result of waste transport

- potential for 1 radiological latent cancer fatality together with 9 transport accidents and 1 non-radiological fatality from transport of TRU waste to WIPP (none of these fatalities was expected to occur in the states of Oregon or Washington)

- potential for two transport accidents in Oregon and one in Washington involving receipt of waste from offsite generators in the Lower Bound waste volume case (no fatalities were predicted).

6.0 Regulatory Framework

This section describes the regulatory framework affecting the alternatives, including the permit requirements associated with the alternatives. The U.S. Department of Energy (DOE) has procedures implementing the National Environmental Policy Act (NEPA) (42 USC 4321 et seq.) in the Code of Federal Regulations (CFR) (10 CFR 1021). Section 1021.103 of the procedures adopts the Council on Environmental Quality (CEQ) regulations at 40 CFR 1500–1508 for implementing NEPA. This draft Hanford Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) was prepared in accordance with the DOE and CEQ NEPA implementing procedures.

6.1 Potentially Applicable Statutes

Significant statutes with potential applicability to the subject matter of the HWS-EIS are listed below.

- **American Antiquities Preservation Act (16 USC 431 et seq.)**
  The American Antiquities Preservation Act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally controlled lands.

- **American Indian Religious Freedom Act (42 USC 1996)**
  The American Indian Religious Freedom Act states that it will be the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including, but not limited to, access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

- **Archaeological and Historic Preservation Act (16 USC 469 et seq.)**
  The purpose of the Archaeological and Historic Preservation Act is to provide for the preservation of historical and archeological data (including relics and specimens) that might otherwise be irreparably lost or destroyed as the result of federal actions.

- **Archaeological Resources Protection Act (16 USC 470aa et seq.)**
  The Archaeological Resources Protection Act requires a permit for any excavation or removal of archaeological resources from federal or Indian 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. Consent must be obtained from the 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.

- **Atomic Energy Act (42 USC 2011 et seq.)**
  The Atomic Energy Act (AEA) provides the fundamental jurisdictional authority to DOE and the Nuclear Regulatory Commission (NRC) over governmental and commercial use of nuclear materials. The AEA authorizes DOE to establish standards to protect health or minimize dangers to life or

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property with respect to activities under DOE jurisdiction. The DOE has used a series of departmental orders to establish an extensive system of standards and requirements to ensure safe operation of DOE facilities. The AEA gives the Environmental Protection Agency (EPA) the authority to develop generally applicable standards for protection of the general environment from radioactive materials. The EPA has promulgated several regulations under this authority.

- **Bald and Golden Eagle Protection Act (16 USC 668 et seq.)**
  The Bald and Golden Eagle Protection Act makes it unlawful to take, pursue, molest, or disturb bald and golden eagles, their nests, or their eggs anywhere in the United States. A permit must be obtained from the U.S. Department of the Interior to relocate a nest that interferes with resource development or recovery operations.

- **Clean Air Act (42 USC 7401 et seq.)**
  The Clean Air Act (CAA) 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 CAA requires each federal agency, with jurisdiction over properties or facilities engaged in any activity that might result in the discharge of air pollutants, to comply with all federal, state, interstate, and local requirements with regard to the control and abatement of air pollution. Section 109 of the CAA directs EPA to set national ambient air quality standards (NAAQS) for criteria pollutants. EPA has identified and set NAAQS for the following criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. The NAAQS are set out in 40 CFR 50. Section 111 of the CAA requires establishment of national performance standards for new or modified stationary sources of atmospheric pollutants. Specific emission increases must be evaluated in order to prevent significant deterioration of air quality. Emissions of air pollutants are regulated by the EPA in 40 CFR 50-99. Emissions of radionuclides and hazardous air pollutants are regulated under the National Emissions Standards for Hazardous Air Pollutants Program (40 CFR 61 and 40 CFR 63).

- **Clean Water Act (CWA) (33 USC 1251 et seq.) (the CWA is also known as the Federal Water Pollution Control Act)**
  The Clean Water Act (CWA) was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The CWA prohibits "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the CWA requires all branches of the federal government with jurisdiction over properties or facilities engaged in any activity that might result in a discharge or runoff of pollutants to surface waters, to comply with federal, state, interstate, and local requirements. In addition to setting water quality standards for waterways, the CWA provides guidelines and limitations for effluent discharges from point sources and gives authority for the EPA to implement the National Pollutant Discharge Elimination System (NPDES) Permitting Program. Stormwater discharges are regulated under the NPDES Program.

- **Comprehensive Environmental Response, Compensation, and Liability Act as amended by the Superfund Amendments and Reauthorization Act (42 USC 9601 et seq.)**
  The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides a statutory framework for the remediation of waste sites containing hazardous substances and, as

amended by the Superfund Amendments and Reauthorization Act, an emergency response program in the event a release (or threat of a release) of a hazardous substance to the environment occurs. Using a hazard ranking system, federal and private contaminated sites are ranked and may be included on the National Priorities List. CERCLA requires federal facilities with contaminated sites to undertake investigations, remediation, and natural resource restoration, as necessary.

- **Emergency Planning and Community Right-to-Know Act (42 USC 11001 et seq.)**
  Federal facilities are required under Subtitle A of the Emergency Planning and Community Right-to-Know Act to provide information regarding the inventories of chemicals used or stored at a site and releases from that site to EPA and the state and local emergency response offices. The goal of providing this information is to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. The required information includes inventories of specific chemicals used or stored and descriptions of releases that occur from sites.

- **Endangered Species Act (16 USC 1531 et seq.)**
  The Endangered Species Act is intended to prevent further decline of endangered and threatened species and to restore those species and their habitats. Section 7 of the act requires federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service to ensure that any action carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of any critical habitat for such species.

- **Fish and Wildlife Coordination Act (16 USC 661 et seq.)**
  The Fish and Wildlife Coordination Act promotes more effectual planning and cooperation between federal, state, public, and private agencies for the conservation and rehabilitation of the nation’s fish and wildlife. The act requires federal agencies to consult with the FWS whenever they plan to conduct, license, or permit an activity involving the impoundment, diversion, deepening, control, or modification of a stream or body of water. The act also requires consultation with the head of the state agency that administers wildlife resources in the affected state. The purpose of this process is to promote conservation of wildlife resources by preventing loss of and damage to such resources and to provide for the development and improvement of wildlife resources in connection with the agency action.

- **Hazardous Materials Transportation Act of 1975 (49 USC 5101 et seq.)**
  The Hazardous Materials Transportation Act authorizes the U.S. Department of Transportation to regulate the transportation of hazardous materials by rail, aircraft, vessel, and public highway. Hazardous materials are defined as those chemicals that the Department of Transportation has determined pose unreasonable risks to health, safety, and property during transport activities. The statute and its implementing regulations address issues such as shipping papers to identify and track hazardous materials, packaging and container design, marking, labeling, and performance standards, and employee and public training programs. The regulations also contain specific requirements relating to the type of shipment being used (i.e., rail, aircraft, vessel, and public highway).

- **Migratory Bird Treaty Act (16 USC 703 et seq.)**
  The Migratory Bird Treaty Act is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. The act regulates the harvest of migratory birds by specifying factors such as the mode of harvest, hunting seasons, and bag limits. The act stipulates that, except as permitted by regulations, it is unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, or kill any migratory bird.

- **National Historic Preservation Act (16 USC 470 et seq.)**
  The National Historic Preservation Act provides for placement of sites with significant national historic value on the National Register of Historic Places. Permits and certifications are not required under the act; however, consultation with the Advisory Council on Historic Preservation is required if a federal undertaking might impact a historic property resource. This consultation generally results in a memorandum of agreement that includes stipulations to minimize adverse impacts to the historic resource. Coordination with the State Historic Preservation Office is undertaken to ensure that potentially significant sites are properly identified, and appropriate mitigation measures are implemented.

- **Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.)**
  The Native American Graves Protection and Repatriation Act directs the Secretary of the Interior to guide federal agencies in the repatriation of federal archaeological collections and collections affiliated culturally to American Indian Tribes that are currently held by museums receiving federal funding. This act establishes provisions for the treatment of inadvertent discoveries of American Indians' remains and cultural objects. When discoveries are made during ground-disturbing activities, the following steps are to occur: (1) activity in the area of the discovery is to cease immediately, (2) reasonable efforts are to be made to protect the items discovered, (3) notice of discovery is to be given to the federal agency and the appropriate Tribes, and (4) a period of 30 days is to be set aside following notification for negotiations regarding the appropriate disposition of the discovered items.

- **National Environmental Policy Act (42 USC 4321 et seq.)**
  The National Environmental Policy Act (NEPA) establishes a national policy that encourages awareness of the environmental consequences of human activities and promotes consideration of those environmental consequences during the planning and implementing stages of a project. Under NEPA, federal agencies are required to prepare detailed statements to address the environmental effects of proposed major federal actions that might significantly affect the quality of the human environment.

- **Pollution Prevention Act (42 USC 13101 et seq.)**
  The Pollution Prevention Act establishes a national policy that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

- **Resource Conservation and Recovery Act (RCRA) of 1976 as amended by the Hazardous and Solid Waste Amendments (42 USC 6901 et seq.) of 1984 (RCRA is also known as the Solid Waste Disposal Act)**
  The treatment, storage, and/or disposal of hazardous and nonhazardous waste is regulated under the Solid Waste Disposal Act of 1965, which was amended by the Resource Conservation and Recovery Act of 1976 (RCRA), and the Hazardous and Solid Waste Amendments of 1984. Any state that seeks to administer and enforce a hazardous waste program pursuant to RCRA may apply for EPA authorization of the state program. The Washington State Department of Ecology (Ecology) has been delegated the authority for implementing the federal RCRA program in the State of Washington. The EPA regulations implementing RCRA define hazardous wastes and specify the transportation, handling, and waste management requirements of these wastes (40 CFR 260-282).

  The Federal Facilities Compliance Act of 1992 (FFCA) (Public Law 102-386) amends RCRA and waives sovereign immunity for fines and penalties for RCRA violations at federal facilities. A provision of the FFCA postpones fines and penalties for 3 years for mixed waste storage prohibition violations at DOE sites and requires DOE to prepare plans for developing the required treatment capacity for mixed waste stored or generated at each facility. Each plan must be approved by the host state or the EPA after consultation with other affected states, and a consent order requiring compliance with the plan must be issued by the regulator. The FFCA also states that DOE will not be subject to fines and penalties for land disposal restriction storage prohibition violations for mixed waste as long as DOE is in compliance with an approved plan and consent order and meets all other applicable regulations.

- **Safe Drinking Water Act (42 USC 300f et seq.)**
  The primary objective of the Safe Drinking Water Act is to protect the quality of public water supplies. The act grants EPA the authority to protect the quality of public drinking water supplies by establishing national primary drinking water regulations. EPA delegates authority for enforcement of the standards to the states. EPA regulations specify maximum contaminant levels in public water systems.

- **Toxic Substances Control Act (15 USC 2601 et seq.)**
  The Toxic Substances Control Act provides EPA with the authority to require testing of chemical substances (both new and old) entering the environment and, where necessary, to regulate those chemicals. TSCA also regulates the treatment, storage, and disposal of certain toxic substances (e.g., polychlorinated biphenyls, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium).

- **Washington State Hazardous Waste Management Act (RCW 70.105)**
  The Washington Hazardous Waste Management Act grants Ecology 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 Washington Administrative Code (WAC). Washington State has received authority from EPA to implement the full RCRA program within the State's borders.

- **Washington Clean Air Act (RCW 70.94) and Associated Regulations**
  Most of the provisions of the Washington Clean Air Act mirror the requirements of the Federal Clean Air Act. The Federal Clean Air Act establishes a minimum or "floor" for Washington air quality programs. The Washington Clean Air Act authorizes Ecology and local air pollution control authorities to implement programs consistent with the Federal Clean Air Act. For example, the Washington Clean Air Act authorizes an operating permit program, enhanced civil penalties, new administrative enforcement provisions, motor vehicle inspections, and provisions addressing ozone and acid rain.

  Washington State also has an extensive set of regulations governing toxic air pollutants (WAC 173-460). These regulations are similar to the programs for regulating hazardous air pollutants under the Federal Clean Air Act. In contrast to the Federal Clean Air Act program, which applies to new and existing emission sources, the toxic air pollutant rules apply only to new sources and any modification of an existing source where the modification will increase emissions of toxic air pollutants. Ecology's toxic air pollutant rules are implemented under the New Source Review Program.

  The Washington State Department of Health regulations, "Radiation Protection—Air Emissions" (WAC 246-247), contain standards and permit requirements for the emission of radionuclides to the atmosphere from DOE facilities based on Ecology standards, "Ambient Air Quality Standards and Emission Limits for Radionuclides" (WAC 173-480).

  The local air authority, Benton Clean Air Authority, enforces regulations pertaining to detrimental effects, fugitive dust, incineration products, odor, opacity, asbestos, and sulfur oxide emissions. The Authority also has been delegated authority to enforce the EPA asbestos regulations.

  Many of the preceding statutes are further discussed in the following subsections.

6.2 Land-Use Management

In September 1999, DOE issued the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 1999). The Record of Decision (ROD) issued in November 1999 (64 FR 61615) states that the purpose of the land-use plan and its implementing policies is to facilitate decision making about the Hanford Site's uses and facilities over at least the next 50 years. The ROD adopts the Preferred Alternative land-use maps, designations, policies, and implementing procedures as described in the 1999 EIS and designates the Central Plateau (200 Areas) for Industrial-Exclusive use (Figure 4.2). This designation would allow for continued waste management operations in the 200 Areas.

The Hanford Reach National Monument was created on June 9, 2000, by a proclamation signed by President Clinton under the authority of the Antiquities Act of 1906 (65 FR 37253). The Monument includes 792.6 km^2 (306 mi^2) of federally owned land making up a portion of the Hanford Site (Figure 4.3). The principal components of the Monument are the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE), the McGee Ranch and Riverlands area, the Saddle Mountain National Wildlife Refuge, the quarter mile Hanford Reach Act (Hanford Reach Act [1988] as amended by Public Law 104-333)

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6.3 Hanford Federal Facility Agreement and Consent Order

The Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement [TPA]) is an agreement between DOE, the U.S. Environmental Protection Agency (EPA), and Ecology (Ecology et al. 1989) for achieving compliance at the Hanford Site with RCRA (42 USC 6901 et seq.), CERCLA (42 USC 9601 et seq.), and the Washington State Hazardous Waste Management Act. The TPA (1) defines CERCLA, RCRA, and Washington State cleanup commitments and sets due dates, (2) establishes responsibilities among the agencies, and (3) reflects the goal of achieving regulatory compliance and completing remediation activities with enforceable milestones.

RCRA was enacted in 1976 and was significantly amended by the Hazardous and Solid Waste Amendments of 1984. RCRA establishes requirements covering handlers of hazardous waste, including generators, transporters, and those who own or operate hazardous waste treatment, storage, and disposal facilities. RCRA also authorizes EPA to regulate underground tank storage of substances other than hazardous waste and the disposal of nonhazardous solid waste. RCRA does not apply to any activity or substance that is subject to the Atomic Energy Act except to the extent that such application or regulation is not inconsistent with the requirements of the Atomic Energy Act [42 USC 6905(a)]. CERCLA is a federal statute designed to respond to past disposal of hazardous substances. CERCLA provides EPA the authority to clean up sites where disposal of hazardous substances has occurred. Section 120 of CERCLA (42 USC 9620) provides that federal agencies are subject to and shall comply with CERCLA to the same extent as nongovernmental entities. Section 105 of CERCLA (42 USC 9605) directs EPA to prepare the national contingency plan (NCP) containing procedures for cleanup response actions. The plan appears at 40 CFR 300. The National Priorities List (NPL) is part of the NCP. Four areas of the Hanford Site (100, 200, 300, and 1100) were listed on the NPL in November 1989. The 1100 Area was subsequently delisted. The TPA was entered into in 1989 in anticipation that the Hanford Site would be placed on the NPL. The Washington Hazardous Waste Management Act provides the statutory basis for the regulation of hazardous waste in Washington.

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6.4 Hazardous Waste Management

Hazardous waste management (including the management of hazardous components of radioactive mixed waste) at the Hanford Site is regulated by Ecology and EPA pursuant to RCRA and the Washington State Hazardous Waste Management Act. Hazardous waste activities at Hanford are subject to regulation under RCRA by virtue of Section 6001 of RCRA. Washington received authority from EPA to operate the RCRA corrective action program in 1994 (59 FR 55322) and additional RCRA authority in 1996 (61 FR 7736).

Ecology's regulations are consistent with, and at least as stringent as, the EPA regulations implementing RCRA. Under RCRA, *hazardous wastes* are regulated. The waste categories defined in the Ecology regulations (WAC 170-303) are *dangerous wastes*, *acutely hazardous waste*, *extremely hazardous wastes*, and *special wastes*.

Hazardous waste treatment, storage, and/or disposal (TSD) facilities are regulated under Section 3004 of RCRA and are required to have a permit by Section 3005 of RCRA. The Hanford Site's RCRA permit is in two portions, one portion issued by EPA Region 10 and the other portion issued by Ecology. The EPA portion of the RCRA permit covers the Hazardous and Solid Waste Amendments portion of the RCRA permit (EPA 1994). The second portion of the Hanford Site RCRA permit covers the dangerous waste provisions and was most recently modified by Ecology in February 2001 (Ecology 2001a). The Ecology portion of the RCRA permit includes standard conditions, general facility conditions, and specific conditions for individual operating TSD units, TSD units undergoing corrective action, and TSD units undergoing closure. The RCRA permits, along with other environmental permits covering the Hanford Site, are described in the *Annual Hanford Site Environmental Permitting Status Report* (DOE 2002a).

For all alternatives, the non-radioactive hazardous components of mixed waste would be stored at the Hanford Site in accordance with applicable EPA and Ecology regulations. Ultimate treatment and disposal would be conducted in accordance with applicable standards and regulations at the Hanford Site or offsite locations.

Storage and disposal of waste containing polychlorinated biphenyls (PCBs) would meet the EPA requirements in 40 CFR 761. These regulations are issued under the Toxic Substances Control Act (TSCA; 15 USC 2601 et seq.). DOE, EPA, and Ecology signed a "Framework Agreement for Management of Polychlorinated Biphenyls in Hanford Tank Waste" in August 2000 (EPA 2000). DOE issued a *Toxic Substances Control Act Polychlorinated Biphenyls Hanford Site Users Guide* in 2001 (DOE 2001f).

6.5 Radioactive Waste Management

DOE facilities used for the management, storage, treatment, and disposal of radioactive waste and radioactive mixed waste are constructed and operated under the authority of the AEA. DOE directives are issued under the authority of Section 161(i)(3) of the AEA that permits DOE to govern activities authorized by the act to protect health and to minimize danger to life or property.

6.4 Hazardous Waste Management

Hazardous waste management (including the management of hazardous components of radioactive mixed waste) at the Hanford Site is regulated by Ecology and EPA pursuant to RCRA and the Washington State Hazardous Waste Management Act. Hazardous waste activities at Hanford are subject to regulation under RCRA by virtue of Section 6001 of RCRA. Washington received authority from EPA to operate the RCRA corrective action program in 1994 (59 FR 55322) and additional RCRA authority in 1996 (61 FR 7736).

Ecology's regulations are consistent with, and at least as stringent as, the EPA regulations implementing RCRA. Under RCRA, *hazardous wastes* are regulated. The waste categories defined in the Ecology regulations (WAC 170-303) are *dangerous wastes*, *acutely hazardous waste*, *extremely hazardous wastes*, and *special wastes*.

Hazardous waste treatment, storage, and/or disposal (TSD) facilities are regulated under Section 3004 of RCRA and are required to have a permit by Section 3005 of RCRA. The Hanford Site's RCRA permit is in two portions, one portion issued by EPA Region 10 and the other portion issued by Ecology. The EPA portion of the RCRA permit covers the Hazardous and Solid Waste Amendments portion of the RCRA permit (EPA 1994). The second portion of the Hanford Site RCRA permit covers the dangerous waste provisions and was most recently modified by Ecology in February 2001 (Ecology 2001a). The Ecology portion of the RCRA permit includes standard conditions, general facility conditions, and specific conditions for individual operating TSD units, TSD units undergoing corrective action, and TSD units undergoing closure. The RCRA permits, along with other environmental permits covering the Hanford Site, are described in the *Annual Hanford Site Environmental Permitting Status Report* (DOE 2002a).

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The principal DOE directive covering radioactive waste management is DOE Order 435.1, *Radioactive Waste Management* (DOE 2001d). This Order states that DOE radioactive waste shall be managed to accomplish the following:

1. Protect the public from exposure to radiation from radioactive materials. Requirements for public radiation protection are in DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993b).

2. Protect the environment. Requirements for environmental protection are in DOE Order 450.1, *Environmental Protection Program* (DOE 2003a), and DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993b).

3. Protect workers. Requirements for radiation protection of workers are in 10 CFR 835, "Occupational Radiation Protection." Requirements for industrial safety are in DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* (DOE 1998).

4. Comply with applicable federal, state, and local laws and regulations; applicable Executive Orders; and other DOE directives.

5. Meet the requirements in DOE Manual 435.1-1, *Radioactive Waste Management Manual* (DOE 2001e). DOE Manual 435.1-1 has specific requirements applicable to management of high-level waste in Chapter II, management of TRU waste in Chapter III, and management of low-level waste (LLW) and mixed LLW (MLLW) in Chapter IV.

DOE recently issued DOE Order 450.1, "Environmental Management Program" (DOE 2003a). The objective of the order is to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations and by which DOE meets or exceeds compliance with applicable environmental, public health, and resource protection laws, regulations, and DOE requirements. This objective will be accomplished by implementing Environmental Management Systems (EMSs) at DOE sites. An EMS is a continuing cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental goals. These EMSs will be part of Integrated Safety Management Systems established pursuant to DOE's Safety Management System Policy (DOE 1996c).

6.6 Radiological Safety Oversight

Specific requirements in 10 CFR 830 apply to DOE contractors, DOE personnel, and other persons conducting activities (including providing items and services) that affect, or may affect, the safety of DOE nuclear facilities. The regulations in 10 CFR 830 include requirements for quality assurance (10 CFR 830, Subpart A) and safety-basis requirements (10 CFR 830, Subpart B). The safety-basis requirements require the contractor responsible for a DOE nuclear facility to analyze the facility, the work to be performed, and the associated hazards; and to identify the conditions, the safe boundaries, and the hazard controls necessary to protect workers, the public, and the environment from adverse consequences.

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4. Comply with applicable federal, state, and local laws and regulations; applicable Executive Orders; and other DOE directives.

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DOE relies on these analyses and hazard controls to operate facilities safely. The requirements for nuclear safety management in 10 CFR 830 apply to the activities being considered in this draft HSW EIS.

DOE has requirements for occupational radiation protection in 10 CFR 835 that establish radiation-protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities. The requirements are applicable to general employees involved in activities being considered in the HSW EIS that have the potential to result in the occupational exposure of an individual to radiation or radioactive material. The 10 CFR 835 requirements are further discussed in Section 6.8.

The Price-Anderson Act, Section 170 of the AEA, provides a system of indemnification for legal liability resulting from a nuclear incident in connection with contractual activity for DOE. An extensive discussion of the Price-Anderson Act is included in the Yucca Mountain Final EIS (DOE 2002d)

Many DOE directives that affect radiological safety apply to constructing and operating the facilities addressed in the HSW EIS. Among the more significant directives are the following:

- DOE Order 420.1A, *Facility Safety* (DOE 2002c), establishes facility safety requirements related to nuclear safety design, criticality safety, fire protection, and the mitigation of phenomena related to natural hazards.

- DOE Order 425.1C, *Startup and Restart of Nuclear Facilities* (DOE 2003b), establishes DOE requirements for startup of new nuclear facilities and for the restart of existing nuclear facilities that have been shut down. The requirements specify a readiness review process that must demonstrate that it is safe to start (or restart) the applicable facility. The facility must be started (or restarted) only after documented independent reviews of readiness have been conducted and the approvals specified in the Order have been received.

- DOE Policy 441.1, *DOE Radiological Health and Safety Policy* (DOE 1996a), states that it is DOE policy to conduct its radiological operations in a manner that ensures the health and safety of all its employees, contractors, and the general public. The Policy states that in achieving this objective, DOE will ensure that radiation exposures to its workers and the public and releases of radioactivity to the environment are maintained below regulatory limits, and deliberate efforts are taken to further reduce exposures and releases to as low as reasonably achievable (ALARA). DOE is committed to implementing a radiological control program of the highest quality that consistently reflects this Policy.

- DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993b), establishes standards and requirements for DOE operations for protection of members of the public and the environment against undue risk from radiation. It is DOE policy to implement legally applicable radiation-protection standards and to consider and adopt, as appropriate, recommendations by authoritative organizations, for example, the National Council on Radiation Protection and Measurements and the International Commission on Radiological Protection. It is also DOE policy to adopt and implement standards generally consistent with those of the U.S. Nuclear Regulatory Commission (NRC) for DOE facilities and activities not subject to NRC licensing authority.

- DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities* (DOE 2001c), establishes the selection, qualification, and training requirements for DOE contractor personnel involved in the operation, maintenance, and technical support of DOE nuclear reactors and non-reactor nuclear facilities. DOE objectives under this Order are to ensure the development and implementation of contractor-administered training programs that provide consistent and effective training for personnel at DOE nuclear facilities. The Order contains minimum requirements that must be included in training and qualification programs.

6.7 Radiation Protection of the Public and the Environment

DOE standards for radiation protection of the public and the environment are set out in DOE Order 5400.5 (DOE 1993b). In addition to establishing a general limit for public dose from DOE activities, the Order requires DOE activities to be conducted in a manner that complies with regulations issued by other government agencies, as applicable. The Order also specifies standards for radiological exposures to native aquatic animals. Requirements of the DOE Order and other applicable standards are discussed in this section.

Activities associated with any alternative under consideration in this HSW EIS would be managed in accordance with Chapter II of DOE Order 5400.5, which provides that DOE activities shall be conducted so that the exposure of members of the public to radiation sources, as a consequence of all routine DOE activities, shall not cause an effective dose equivalent exceeding 1 mSv/yr (100 mrem/yr).

In addition, radioactive emissions from DOE facilities are subject to the EPA National Emission Standards for Hazardous Air Pollutants requirements at 40 CFR 61. In particular, Subpart A (General Provisions), Subpart H (National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities), and Subpart Q (National Emission Standards for Radon Emissions from Department of Energy Facilities) are applicable to all alternatives. Air emissions resulting from the implementation of any alternative would comply with the EPA 0.1 mSv/yr (10 mrem/yr) standard at 40 CFR 61.92. For all new construction or modifications to existing facilities where the estimated effective dose equivalent could exceed 1 percent of the 0.1 mSv/yr (10 mrem/yr) standard, an application for approval of construction or modification would be submitted to the appropriate regional EPA office under the procedures at 40 CFR 61.07 (40 CFR 61.96[b]).

New sources of radioactive emissions at Hanford are also subject to the licensing requirements of the Washington State Department of Health (WDOH) (WAC 246-247). DOE holds a license (No. FF-01) issued by the WDOH covering airborne radioactive effluents from Hanford operations. The license is incorporated as Attachment 2 in the Hanford Air Operating Permit (Ecology 2001b). DOE would submit a Notice of Construction to the WDOH, as required by WAC 246-247-060, before constructing or modifying any facility associated with any alternative under consideration in this HSW EIS that has projected radioactive emissions or changes in radioactive emissions. All new construction and significant modifications of emission units would use best available radionuclide control technology (WAC 246-247-

adopt and implement standards generally consistent with those of the U.S. Nuclear Regulatory Commission (NRC) for DOE facilities and activities not subject to NRC licensing authority.

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040[3], WAC 173-480-060). Standards and/or permits and license requirements (conditions) for applicable radiation and non-radiation emission unit compliance are compiled in the Hanford Air Operating Permit (Ecology 2001b).

DOE would ensure that U.S. Department of Transportation (DOT) radiation-level limitations for packaging in 49 CFR 173.441 are met and that requirements in 49 CFR 173.443 related to radioactive contamination on the external surfaces of each package offered for shipment are met. Transportation issues are further discussed in Section 6.11.

Chapter II of DOE Order 5400.5 states that it is DOE policy to provide a level of protection for persons consuming water from a drinking water supply operated by DOE or its contractors that does not exceed the maximum contaminant levels at 40 CFR 141.15 and 141.16. Specifically, DOE Order 5400.5 states that DOE drinking water systems shall not cause persons consuming the water to receive an effective dose equivalent greater than 4 mrem (0.04 mSv) in a year. Combined radium-226 and radium-228 shall not exceed 5×10^{-9} µCi/mL, and gross alpha activity (including radium-226, but excluding radon and uranium) shall not exceed 1.5×10^{-8} µCi/mL.[a] The maximum contaminant levels at 40 CFR 141.15 and 141.16 are not directly applicable to groundwater and are used in this HSW EIS solely as a benchmark for water quality in the Hanford aquifer and the Columbia River for the long-term analysis.

DOE has a voluntary consensus technical standard that provides methods, models, and guidance within a graded approach that DOE personnel and contractors may use to characterize radiation doses to aquatic and terrestrial biota that are exposed to radioactive materials (DOE 2002b).

6.8 Occupational Safety and Occupational Radiation Exposure

Section 4(b)(1) of the Occupational Safety and Health Act of 1970 [29 USC 653(b)(1)] exempts DOE and its contractors from the occupational safety requirements of the U.S. Department of Labor Occupational Safety and Health Administration (OSHA). However, DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* (DOE 1998), states that DOE will implement a written worker protection program that

> (1) provides a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm to their employees, and (2) integrates all requirements contained in paragraphs 4a to 4l of DOE Order 440.1A; 29 CFR 1960, “Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters”; and other related site-specific worker protection activities.

Relevant requirements in OSHA regulations and additional DOE-specified requirements are mandated by the DOE occupational, safety, and health program (DOE 1998).

(a) In December 2000, EPA issued revised maximum contaminant levels for radionuclides to be effective in December 2003 (65 FR 76708). The new rule includes requirements for uranium.

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(a) In December 2000, EPA issued revised maximum contaminant levels for radionuclides to be effective in December 2003 (65 FR 76708). The new rule includes requirements for uranium.

DOE Order 5480.4, *Environmental, Safety, and Health Protection Standards* (DOE 1993a), requires that DOE and its contractors that are subject to this order are to comply with the OSHA Occupational Safety and Health Standards at 29 CFR 1910.

The DOE radiation protection standards, limits, and program requirements for protecting occupational workers and visitors from ionizing radiation resulting from the conduct of DOE activities are in 10 CFR 835. All activities associated with any alternative would be conducted consistent with 10 CFR 835 requirements. The annual total effective dose equivalent (TEDE) limit for general employees is 0.05 Sv (5 rem) (10 CFR 835.202[a][1]). DOE policy is to maintain radiation exposure in controlled areas ALARA through facility and equipment design and administrative controls (10 CFR 835.1001). In addition, exposure of members of the public authorized to enter the controlled area where there are activities associated with implementing any alternative would not exceed 1 mSv (100 mrem) TEDE in a year (10 CFR 835.208). DOE Order 5480.4 specifies a number of American National Standards Institute standards applicable to radiation protection that DOE and its contractors must meet.

6.9 Non-Radioactive Air Emissions

Emissions of criteria or toxic pollutants from new sources would most likely be in small quantities under any alternative evaluated in the HSW EIS. Any such emissions would not be expected to require prevention of significant deterioration (PSD) permitting under 40 CFR 52.21 or WAC 173-400-141 because Hanford is within an area that is in attainment with or is unclassifiable for all national ambient air quality standards (40 CFR 81.348). New source review applicability for non-PSD criteria or toxic air permitting would be evaluated on a case-by-case basis under WAC 173-400-110 and WAC 173-460. All emissions of criteria or toxic pollutants would comply with applicable standards for air sources, as specified under the general air regulation (WAC 173-400). The EPA general conformity rule (40 CFR 93, Subpart B) requires that federal agencies prepare a written conformity analysis and determination covering compliance with an applicable state implementation plan for proposed activities if the total of direct and indirect emissions of a non-attainment or maintenance criteria pollutant caused by the activity would exceed the threshold emission levels shown at 40 CFR 93.153(b). General conformity is discussed in Section 5.2 of the HSW EIS. As noted earlier, the Washington State Clean Air Act authorizes Ecology and local air pollution control authorities to implement programs consistent with the Federal Clean Air Act.

6.10 State Waste Discharge Requirements

Ecology regulates industrial waste discharges under the WAC 173-216 permit program covering discharges. Ecology has issued the 200 Area Effluent Treatment Facility (ETF) Discharge Permit ST-4500 and the 200 Area Treated Effluent Disposal Facility (TEDF) Discharge Permit ST-4502 (DOE 2002a).

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6.11 Transportation Requirements

The transportation of all radioactive and other hazardous materials associated with any alternative selected for implementation would comply with applicable DOE directives and the regulations of EPA, DOT, and Ecology. Applicable DOE directives include DOE Order 460.1A, *Packaging and Transportation Safety* (DOE 1996b), DOE Order 460.2, *Departmental Materials Transportation and Packaging Management* (DOE 1995), and DOE Manual 460.2-1, *Radioactive Material Transportation Practices Manual* (DOE 2002e). DOE Order 460.2 states that DOE operations shall be conducted in compliance with all applicable international, federal, state, local, and tribal laws, rules, and regulations governing materials transportation that are consistent with federal regulations, unless exemptions or alternatives are approved in accordance with DOE Order 460.1A (DOE 1996b). DOE Order 460.2 also states that it is DOE policy that shipments will comply with the DOT 49 CFR 106-180 requirements, except those that infringe upon maintenance of classified information.

The Hazardous Materials Transportation Act of 1975 (HMTA) (49 USC 5101 et seq.), as amended by the Hazardous Materials Transportation Uniform Safety Act of 1990, is the major Federal transportation-related statute affecting DOE. HMTA is implemented by regulations issued by the DOT Research and Special Programs Administration, Federal Highway Administration, Federal Railroad Administration, Federal Aviation Administration, and the U.S. Coast Guard.

Under the HMTA, DOT has requirements for marking, labeling, placarding, providing emergency response information, and training of hazardous material transport personnel at 49 CFR 172. Specific packaging requirements for radioactive materials are in 49 CFR 173, Subpart I. These requirements invoke the NRC packaging requirements for radioactive material as set forth in 10 CFR 71. DOT regulations for truck transportation of radioactive and other hazardous materials are in 49 CFR 172, 173, 177, 178, and 397. DOT regulations for rail transportation of radioactive and other hazardous materials are in 49 CFR 172, 173, 174, and 178. The Ecology regulations applicable to transportation of hazardous waste in Washington State are in WAC 173-303-240 through 270.

Transportation of waste products and contaminated equipment that is conducted entirely on DOE property, to which public access is controlled at all times through the use of gates and guards, is subject to applicable DOE directives and transportation safety requirements set forth in 10 CFR 830, Subpart B, but is not directly subject to the DOT regulatory requirements. DOE transport of these materials over highways to which the public has access would be subject to applicable DOT, EPA, and Ecology regulations, as well as to applicable DOE directives.

6.12 Cultural Resources

The DOE policy on management of cultural resources (DOE 2001a) provides that

> DOE will uphold [the National Historic Preservation Act, the Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act] by preserving, protecting, and perpetuating cultural resources for future generations in a spirit of stewardship to the extent feasible given the agency's mission and mandates. To do this, DOE will implement

6.11 Transportation Requirements

The transportation of all radioactive and other hazardous materials associated with any alternative selected for implementation would comply with applicable DOE directives and the regulations of EPA, DOT, and Ecology. Applicable DOE directives include DOE Order 460.1A, *Packaging and Transportation Safety* (DOE 1996b), DOE Order 460.2, *Departmental Materials Transportation and Packaging Management* (DOE 1995), and DOE Manual 460.2-1, *Radioactive Material Transportation Practices Manual* (DOE 2002e). DOE Order 460.2 states that DOE operations shall be conducted in compliance with all applicable international, federal, state, local, and tribal laws, rules, and regulations governing materials transportation that are consistent with federal regulations, unless exemptions or alternatives are approved in accordance with DOE Order 460.1A (DOE 1996b). DOE Order 460.2 also states that it is DOE policy that shipments will comply with the DOT 49 CFR 106-180 requirements, except those that infringe upon maintenance of classified information.

The Hazardous Materials Transportation Act of 1975 (HMTA) (49 USC 5101 et seq.), as amended by the Hazardous Materials Transportation Uniform Safety Act of 1990, is the major Federal transportation-related statute affecting DOE. HMTA is implemented by regulations issued by the DOT Research and Special Programs Administration, Federal Highway Administration, Federal Railroad Administration, Federal Aviation Administration, and the U.S. Coast Guard.

Under the HMTA, DOT has requirements for marking, labeling, placarding, providing emergency response information, and training of hazardous material transport personnel at 49 CFR 172. Specific packaging requirements for radioactive materials are in 49 CFR 173, Subpart I. These requirements invoke the NRC packaging requirements for radioactive material as set forth in 10 CFR 71. DOT regulations for truck transportation of radioactive and other hazardous materials are in 49 CFR 172, 173, 177, 178, and 397. DOT regulations for rail transportation of radioactive and other hazardous materials are in 49 CFR 172, 173, 174, and 178. The Ecology regulations applicable to transportation of hazardous waste in Washington State are in WAC 173-303-240 through 270.

Transportation of waste products and contaminated equipment that is conducted entirely on DOE property, to which public access is controlled at all times through the use of gates and guards, is subject to applicable DOE directives and transportation safety requirements set forth in 10 CFR 830, Subpart B, but is not directly subject to the DOT regulatory requirements. DOE transport of these materials over highways to which the public has access would be subject to applicable DOT, EPA, and Ecology regulations, as well as to applicable DOE directives.

6.12 Cultural Resources

The DOE policy on management of cultural resources (DOE 2001a) provides that

> DOE will uphold [the National Historic Preservation Act, the Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act] by preserving, protecting, and perpetuating cultural resources for future generations in a spirit of stewardship to the extent feasible given the agency’s mission and mandates. To do this, DOE will implement

> management accountability for compliance with Federal statutes, Executive orders, treaties, DOE orders, and implementation guidance. The Department also ensures that DOE contractors are obligated to implement DOE programs and projects in a manner that is consistent with this Policy and that reflects this commitment in site management contracts.

The background statement in "Management of Cultural Resources at Department of Energy Facilities" (DOE 2001b) further states that

> DOE recognizes the cultural and scientific value of the resources that may exist on the properties under its management or over which it has direct or indirect control. Therefore, DOE has implemented a program to protect these resources and ensure that all DOE facilities and programs comply with all existing cultural resource executive orders, laws, and regulations. Thus, DOE is able to preserve, protect, and perpetuate cultural resources for future generations.

The DOE management document (DOE 2001b) defines cultural resources to include "historic properties" as defined in the National Historic Preservation Act, "archaeological resources" as defined in the Archaeological Resources Protection Act of 1979, and "cultural items" as defined in the Native American Graves Protection and Repatriation Act (see Section 6.14).

The National Historic Preservation Act authorizes the Secretary of the Interior to maintain a National Register of Historic Places (16 USC 470a[a][1]). Federal agencies are to consider the effect of their actions on properties included in or eligible for inclusion in the Register and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such actions (16 USC 470f).

The Archaeological Resources Protection Act of 1979 prohibits the excavation of material remains of past human life on public or Indian lands that have archaeological interest and are at least 100 years old without a permit from the appropriate federal land manager or an exemption (16 USC 470aa, 470bb, 470ee).

The Native American Graves Protection and Repatriation Act of 1990 prohibits the intentional excavation or removal of human remains or cultural items without a written permit, and prescribes protective measures and repatriative actions to be taken in the event that human remains or cultural items are discovered inadvertently (25 USC 3001 et seq.).

DOE and Hanford Site contractor compliance with cultural resources compliance legislation is discussed in Section 2.2.14 of the *Hanford Site Environmental Report for Calendar Year 2001* (Poston et al. 2002).

6.13 Treaties, Statutes, and Policies Relating to Native Americans

DOE's relationship with American Indians is based on treaties, statutes, Executive Orders, and DOE policy statements. Representatives of the United States negotiated treaties with leaders of various Columbia Plateau American Tribes and Bands in June 1855 at Camp Stevens in the Walla Walla Valley. The negotiations resulted in three treaties, one with the 14 tribes and bands of the group that would management accountability for compliance with Federal statutes, Executive orders, treaties, DOE orders, and implementation guidance. The Department also ensures that DOE contractors are obligated to implement DOE programs and projects in a manner that is consistent with this Policy and that reflects this commitment in site management contracts.

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1. Treaty with the Walla Walla, Cayuse, etc. (June 9, 1855; 12 Stats. 945)

2. Treaty with the Yakama (June 9, 1855; 12 Stats. 951)

3. Treaty with the Nez Perce (June 11, 1855; 12 Stats. 957)[a].

The Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe are federally recognized tribes that are eligible for funding and services from the Bureau of Indian Affairs by virtue of their status as Indian tribes (67 FR 46328).

The terms of the three preceding treaties are similar. Each of the three tribal organizations agreed to cede large blocks of land to the United States. The Hanford Site is within the ceded lands of the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation. The treaties reserved to the Tribes certain lands for their exclusive use (the three reservations). The treaties also secured to the Tribes certain rights and privileges to continue traditional activities outside the reservations. These included (1) the right to fish at usual and accustomed places in common with citizens of the United States, and (2) the privileges of hunting, gathering roots and berries, and pasturing horses and cattle on open and unclaimed lands. None of the activities involved in the HSW EIS would take place on open and unclaimed land.

The *U.S. Department of Energy American Indian and Alaska Native Tribal Government Policy* (DOE 2000) states, in part, that DOE

- recognizes the federal trust relationship with American Indians and Alaska Native Nations and will fulfill its trust responsibilities to them

- recognizes and commits to a government-to-government relationship and will institute appropriate protocols and procedures for program and policy implementation

- compliance with applicable federal cultural resource protection and other laws and executive orders will assist in preservation and protection of historic and cultural sites and traditional religious practices.

The American Indian Religious Freedom Act (42 USC 1996) establishes that U.S. policy is to protect and preserve for American Indians their inherent rights of freedom to believe, express, and exercise their traditional religions, including access to sites, use and possession of sacred objects, and the freedom to worship through ceremonies and traditional rites.

(a) The three treaties, as well as additional treaties, are included in Appendix A of the Hanford Comprehensive Land-Use Plan EIS (DOE 1999).

The Native American Graves Protection and Repatriation Act establishes the right of lineal descendents, Indian Tribes, and Native Hawaiian organizations to certain Native American human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered on federal lands after November 16, 1990 (25 USC 3001 et seq.). When discovered during an activity on federal lands, the activity is to cease and appropriate tribal governments are to be notified. Work on the activity may resume, if resumption of the activity is otherwise lawful, 30 days after the receipt of certification that tribal governments have received the notice.

Executive Order 13007, “Indian Sacred Sites,” (61 FR 26771) directs federal agencies, 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 their religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites.

The DOE Richland Operations Office (DOE-RL) interacts and consults regularly and directly with the three federally recognized tribes affected by Hanford Site operations, that is, the Nez Perce Tribe, the Confederated Tribes of the Umatilla Reservation, and the Yakama Nation. In addition, the Wanapum, who still live adjacent to the Hanford Site, are a non-federally recognized tribe that has strong cultural ties to the Site. The Hanford area was also used by groups whose descendants are now enrolled members of the Confederated Tribes of the Colville Reservation. The Wanapum and the Confederated Tribes of the Colville Reservation are also consulted on cultural resource issues in accordance with DOE policy and relevant legislation.

6.14 Environmental Justice and Protection of Children

Section 2-2 of Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” (59 FR 7629) states that:

> Each Federal agency shall conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin.

The CEQ has issued guidance for federal agencies to use in implementing Executive Order 12898 in conjunction with NEPA (CEQ 1997). DOE has also issued an information brief for DOE staff covering Executive Order 12898 (DOE 1997).

Section 1 of Executive Order 13045, “Protection of Children from Environmental Health Risks and Safety Risks,” (62 FR 19885) requires federal agencies to:

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- make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children

- ensure that their policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

6.15 Chemical Management

Chemical management would be conducted according to DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards* (DOE 1993a), which requires DOE and its contractors to comply with National Fire Protection Association Codes and Standards and the Occupational Safety and Health Standards in 29 CFR 1910. The Hanford strategy for chemical management is described in Section 2.2.3 of the *Hanford Site Environmental Report for Calendar Year 2001* (Poston et al. 2002).

6.16 Emergency Planning and Community Right-to-Know

Part 5 of Executive Order 13148, "Greening the Government Through Leadership in Environmental Management," (65 FR 14595) requires that federal executive branch agencies comply with the requirements for toxic chemical release reporting in Section 313 of the Emergency Planning and Community Right-To-Know Act (42 USC 11001). DOE's compliance with the Emergency Planning and Community Right-To-Know Act at the Hanford Site is discussed in Section 2.2.5 of the *Hanford Site Environmental Report for Calendar Year 2001* (Poston et al. 2002). Compliance activities would be supplemented with any additional notification, planning, or reporting requirements that may arise.

6.17 Pollution Prevention

Part 5 of Executive Order 13148, "Greening the Government Through Leadership in Environmental Management," (65 FR 14595) requires that federal executive branch agencies comply with Section 6607 of the Pollution Prevention Act (42 USC 13101 et seq.). Section 6607 requires that owners of a facility required to file an annual toxic chemical release form under Section 313 of the Emergency Planning and Community Right-To-Know Act (42 USC 11001) for any toxic chemical shall include with each such annual filing a toxic-chemical source reduction and recycling report for the preceding calendar year. DOE's compliance with the Pollution Prevention Act at the Hanford Site is discussed in Section 2.2.5 of the *Hanford Site Environmental Report for Calendar Year 2001* (Poston et al. 2002). If implementation of any alternative considered in this EIS were to trigger reporting under Section 313 of the Emergency Planning and Community Right-To-Know Act, DOE would comply with the reporting requirements and the requirement for a toxic-chemical source reduction and recycling report.

6.18 Endangered Species

Section 7 of the Endangered Species Act (16 USC 1536) requires that Federal agencies 1) use their authority in furtherance of the purposes of the act by carrying out programs for the conservation of listed

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6.19 Permit Requirements

The CEQ regulations implementing NEPA (40 CFR 1502.25[b]) require that a draft EIS list all federal permits, licenses, and other entitlements that must be obtained to implement the alternatives.

The principal existing Hanford facilities that would be involved in implementing the alternatives in the HSW EIS are the Central Waste Complex, 200 Area Effluent Treatment Facility (ETF), Liquid Effluent Retention Facility, LLW Trenches, MLLW Trenches, T Plant Complex, and the Waste Receiving and Processing Facility. Table 6.1 indicates whether operation of each of these facilities is covered in the existing Dangerous Waste portion of the Hanford RCRA permit (Ecology 2001a), the Hanford Air Operating Permit (Ecology 2001b), or the Hanford Waste Discharge Permit (DOE 2002a). In all cases where units are covered in the Dangerous Waste portion of the Hanford RCRA permit, the coverage is in Part III of the permit that contains unit-specific conditions for final status operations. The MLLW trenches and T Plant Complex are being incorporated into the Dangerous Waste portion of the Hanford RCRA permit (DOE 2002a).

Table 6.1. Coverage of Hanford Solid Waste Management Units in Existing Permits

Unit	Dangerous Waste Portion of Hanford RCRA Permit	Hanford Air Operating Permit	Hanford State Waste Discharge Permit
Central Waste Complex	Yes	Yes	No
200 Area ETF	Yes	Yes	Yes
Liquid Effluent Retention Facility	Yes	Yes	No
LLW Trenches	Not Applicable	Not Applicable	Not Applicable
MLLW Trenches	Yes[a]	Yes	No
T Plant Complex	Yes[a]	Yes	No
Waste Receiving and Processing Facility	Yes	Yes	No

(a) Interim status currently, final status in process.

DOE would obtain appropriate required permits for any new or modified facility. For example, a new waste processing facility would require a variety of approvals, permits, or permit modifications, including a modification to the dangerous waste portion of the Hanford RCRA permit, submission of a notice of construction to the WDOH, modification of the Hanford Air Operating Permit, construction approval by EPA under 40 CFR 61, and/or approval from EPA under TSCA and the regulations in 40 CFR 761(d), if waste containing PCBs is treated or disposed of at the facility. Permits might be required for operating pulse driers to process leachate. New immobilized low-activity waste (ILAW) trenches could also require endangered and threatened species, and 2) consult with appropriate Federal agencies to ensure that any action carried out by DOE is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat for such species. Additional information is provided in Sections 4.6.4 and 5.5.12 of this HSW EIS and in Section 2.2.12 of the *Hanford Site Environmental Report 2001* (Poston et al. 2002).

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(a) Interim status currently, final status in process.

DOE would obtain appropriate required permits for any new or modified facility. For example, a new waste processing facility would require a variety of approvals, permits, or permit modifications, including a modification to the dangerous waste portion of the Hanford RCRA permit, submission of a notice of construction to the WDOH, modification of the Hanford Air Operating Permit, construction approval by EPA under 40 CFR 61, and/or approval from EPA under TSCA and the regulations in 40 CFR 761(d), if waste containing PCBs is treated or disposed of at the facility. Permits might be required for operating pulse driers to process leachate. New immobilized low-activity waste (ILAW) trenches could also require a variety of approvals, permits, or permit modifications, including a modification to the dangerous waste portion of the Hanford RCRA permit. The ILAW disposal facility would be subject to the landfill design requirements as specified in “Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities” (40 CFR 264, Subpart N), and WAC 173-303-665. The primary design features mandated by these regulations are the leachate collection system and the trench liner system (double liners, primary, and secondary).

The list of permits and approvals that may be required to implement the ILAW disposal alternatives is provided in Table 6.2. In some cases, specific operating requirements or pollution control equipment would be required to ensure compliance with air and water quality regulations.

Table 6.2. Potential Permits and Approvals Needed for ILAW Storage and Disposal

Activity and Waste Type	Regulatory Action Required	Regulation or Directive	Regulatory Agency
Air emissions	Controls for new sources of toxic and hazardous air pollutants (approval)	WAC 173-460, 40 CFR 61	Ecology and EPA
Air emissions	Notice of Construction (approval), licensing, and possible site-wide air operating permit modification (permit)	WAC 173-400, WAC 246-247	Washington State Department of Health and Ecology
Dangerous (including mixed) waste generation, storage, treatment, and disposal	Dangerous waste permit, RCRA permit (permit)	WAC 173-303, 40 CFR 260-280	Ecology EPA
Radiological	Disposal authorization statement	DOE M 435.1-1	DOE

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a variety of approvals, permits, or permit modifications, including a modification to the dangerous waste portion of the Hanford RCRA permit. The ILAW disposal facility would be subject to the landfill design requirements as specified in “Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities” (40 CFR 264, Subpart N), and WAC 173-303-665. The primary design features mandated by these regulations are the leachate collection system and the trench liner system (double liners, primary, and secondary).

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Dangerous (including mixed) waste generation, storage, treatment, and disposal	Dangerous waste permit, RCRA permit (permit)	WAC 173-303, 40 CFR 260-280	Ecology EPA
Radiological	Disposal authorization statement	DOE M 435.1-1	DOE

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10 CFR 830. “Nuclear Safety Management.” U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_02/10cfr830_02.html.

10 CFR 835. “Occupational Radiation Protection.” U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_02/10cfr835_02.html.

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B.S., Accounting and Business Administration, Southern Oregon College, 1966

Technical Experience: Cost/benefit analysis, evaluation of public policy, economic/financial incentives for environmental improvements (29 years)

EIS Responsibility: Section 5.0, Environmental Justice and Aesthetic Resources; Comment Response

Name: **WAYNE L. JOHNSON**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Engineering Management, Washington State University, 1995
B.S., Nuclear Engineering, Oregon State University, 1983

Technical Experience: Project management, strategic planning, nuclear engineering, environmental restoration, waste management, nuclear facility D&D, and radiological controls (19 years). Professional Engineer, Nuclear

EIS Responsibility: Project Manager, Technical Oversight

Name: **CHARLES T. KINCAID**

Affiliation: Pacific Northwest National Laboratory

Education: Ph.D., Engineering Utah State University, 1979
B.S., Civil Engineering, Humboldt State College, 1970

Technical Experience: Fluid Movement and contaminant transport in subsurface systems including vadose zone and groundwater environments, preparation and review of performance assessments and a composite analysis for waste disposal at DOE sites under DOE Orders 5820.2A and 435.1, contributions to NEPA documents in the topical areas of vadose zone and groundwater contaminant transport.

EIS Responsibility: Appendix L (Simulation of Sidewide Contaminant Sources)

Name: **GEORGE V. LAST**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Environmental Science, Washington State University, 1997
B.S., Geology, Washington State University, 1976

Technical Experience: Geology, hydrology, hazardous waste site remedial investigations and feasibility studies (25 years)

EIS Responsibility: Vadose Zone section of the SAC appendix

Name: **MEGAN E. LERCHEN**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Inorganic Chemistry, University of Washington, 1989
B.S., Chemistry, Portland State University, 1986

Technical Experience: Project management, waste management, environmental compliance, tank waste chemistry (13 years)

EIS Responsibility: Comment Response

Name: **ANN M. LESPERANCE**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Public Health, University of California at Los Angeles [UCLA], 1992
B.A., Environmental Science and Latin American Studies, University of Wisconsin, Madison, 1980

Technical Experience: Project management, public/stakeholder involvement, public health, ecosystem management and policy (13 years)

EIS Responsibility: Regulator interface

Name: **CHARLES A. LOPRESTI**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Public Health (Industrial Hygiene), Tulane University, 1998
B.S., Physics, University of Texas at Arlington, 1969

Technical Experience: Statistical computing, modeling (22 years)

EIS Responsibility: SAC Software Development Team, Vadose Zone Release Module

Name: **NATESAN MAHASENAN**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Engineering & Public Policy, Carnegie Mellon University, 1997
M.S., Mechanical Engineering, Tulane University, 1994
B.S., Mechanical Engineering, Birla Institute of Technology and Science (India), 1992

Technical Experience: Risk Assessment, Uncertainty Analysis, Quantitative Policy Analysis (6 years)

EIS Responsibility: Section 5.0, Transportation

Name: **STEPHEN E. MCKEE**

Affiliation: Jacobs Engineering Group Inc.

Education: B.S., Civil Engineering, Cornell University, 1995

Technical Experience: Variety of civil engineering projects (5 years)

EIS Responsibility: Section 3.0, Description and Comparison of Alternatives; Section 4.0, Affected Environment; Section 5.0, Biological and Ecological Resources, Cultural Resources, Land Use, Visual Resources, and Noise

Name: **THOMAS J. MCLAUGHLIN**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Public Health/Environmental Engineering, University of Hawaii, 1974
B.S., Microbiology and Public Health, Washington State University, 1970

Technical Experience: Environmental Engineering, Mixed Waste Management, Regulations, NEPA (29 years)

EIS Responsibility: Data development interface

Name: **PETER MILLER**

Affiliation: Pacific Northwest National Laboratory

Education: B.S., Chemical Engineering, University of Illinois at Urbana, 1983

Technical Experience: Environmental regulation and project management (19 years). Licensed P.E., State of Washington

EIS Responsibility: Comment responsiveness documentation (Comment Response Document)

Name: **DONALD G. MONTGOMERY**

Affiliation: Jacobs Engineering Group Inc.

Education: B.S., Civil Engineering Construction Management, Oregon State University, 1975

Technical Experience: Estimator and construction manager for environmental remediation and operational and maintenance projects (30 years)

EIS Responsibility: Section 3.0, Description and Comparison of Alternatives; Section 5.0, Geology and Soils, Biological and Ecological Resources, Land Use, and Transportation

Name: **DUANE A. NEITZEL**

Affiliation: Pacific Northwest National Laboratory

Education: M.A., Biological Sciences, Washington State University, 1981
B.S., Zoology, University of Washington, 1968

Technical Experience: Aquatic sciences with emphasis on salmonid fisheries of the Columbia River Basin, Pacific Northwest, U.S.A. and other western states. Emphasis on energy generation impacts to aquatic systems (31 years).

EIS Responsibility: Section 4.0, Affected Environment - Lead and contributor to aquatic environment; Comment Response

Name: **IRAL C. NELSON**

Affiliation: Pacific Northwest National Laboratory

Education: M.A., Physics, University of Oregon, 1955
B.S., Mathematics, University of Oregon, 1951

Technical Experience: Various aspects of health physics (46 years), NEPA document preparation and review (31 years). Diplomate, American Board of Health Physics

EIS Responsibility: Technical lead for Section 5.0, Environmental Consequences; Comment Response

Name: **DAVID L. NICHOLS**

Affiliation: Jacobs Engineering Group Inc.

Education: B.S., Political Science and Communications, University of Iowa, 1980

Technical Experience: Public involvement tasks for DOE, EPA, DoD, and industry (air, water, and wetlands) projects (18 years)

EIS Responsibility: Section 1.0, Introduction; Section 2.0, Purpose and Need for Action

Name: **WILLIAM E. NICHOLS**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Civil Engineering, Oregon State University, 1990
B.S., Agricultural Engineering, Oregon State University, 1987

Technical Experience: Hydrologist (13 years)

EIS Responsibility: Section 5.0, Cumulative Impacts Assessment

Name: **LEILONI PAGE**

Affiliation: Jacobs Engineering Group Inc.

Education: B.S., English, University of Idaho, 1992

Technical Experience: Technical writer/editor and document production coordinator (12 years)

EIS Responsibility: Editorial and production team lead for Jacobs Engineering Group Inc.

Name: **DAVID R. PAYSON**

Affiliation: Pacific Northwest National Laboratory

Education: B.A., Journalism, Central Washington University, 1978

Technical Experience: Technical writing and editing (25 years)

EIS Responsibility: Editorial and production team lead

Name: **TED M. POSTON**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Fisheries, University of Washington, 1978
B.A., Biology, Central Washington University, 1973

Technical Experience: Research, environmental assessment, and noise analysis (29 years)

EIS Responsibility: Section 5.0, Noise Analysis; Comment Response

Name: **KATHLEEN RHOADS**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Radiological Sciences, University of Washington, 1979
B.S., Microbiology, University of Washington, 1972

Technical Experience: Radiological health and safety, waste management, environmental health physics, and risk assessment (29 years). Diplomate, American Board of Health Physics.

EIS Responsibility: Document manager, technical oversight; Comment Response

Name: **WAYNE A. ROSS**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Mechanical Engineering, Stanford University, 1969
B.S., Ceramic Engineering, University of Utah, 1968

Technical Experience: Radioactive waste management (28 years)

EIS Responsibility: Section 2.0, Waste Streams and Facilities; Section 3.0, Alternatives; Comment Response

Name: **MICHAEL J. SCOTT**

Affiliation: Pacific Northwest National Laboratory

Education: Ph.D., Economics, University of Washington, 1975
M.A., Economics, University of Washington, 1971
B.A., Economics, Washington State University, 1970

Technical Experience: Socioeconomic impacts of major projects and social policies (26 years)

EIS Responsibility: Section 5.0, Socioeconomics and Environmental Justice; Comment Response

Name: **DILLARD B. SHIPLER**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Physics, University of Wisconsin, Milwaukee, 1967
B.S., Math & Science, Southern Oregon College, Ashland, 1957

Technical Experience: Planning and executing research and development, operations, and support services programs related to regulatory compliance, radiological protection, environmental impact assessment, safety and risk analysis, emergency management, and radioactive waste management (41 years). Diplomate, American Board of Health Physics.

EIS Responsibility: Comment Response Document lead; Comment Response

Name: **SANDRA F. SNYDER**

Affiliation: Pacific Northwest National Laboratory

Education: M.S.P.H., Radiological Hygiene, University of North Carolina-Chapel Hill, 1991
B.S., Environmental Resource Management, Pennsylvania State University, 1986

Technical Experience: Environmental health physics and risk assessment (11 years). Air quality analysis (6 years)

EIS Responsibility: Section 5.0, Air Quality; Comment Response

Name: **LISSA H. STAVEN**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Health Physics, Colorado State University, 1990
B.S., Environmental Conservation, University of New Hampshire, 1984

Technical Experience: Environmental health physics and low-level waste disposal management practices (12 years)

EIS Responsibility: Section 5.0, Database Management

Name: **ROBERT STENNER**

Affiliation: Pacific Northwest National Laboratory

Education: Ph.D., Toxicology, Washington State University, 1996
M.S., Nuclear Engineering, Idaho State University, 1981
B.S., Mechanics, University of Wisconsin (Stout Campus), 1970

Technical Experience: Toxicology, Environmental Health, Exposure and Health Risk Assessment (28 years)

EIS Responsibility: Section 5.0, Comment Response

Name: **DENNIS L. STRENGE**

Affiliation: Pacific Northwest National Laboratory

Education: M.S., Chemical Engineering, University of Minnesota, 1968
B.S., Chemical Engineering, University of Washington, 1966

Technical Experience: Environmental health physics and risk assessment (34 years)

EIS Responsibility: Section 5.0, Health and Safety; Comment Response

Name: **LUCINDA L. SWARTZ**

Affiliation: Battelle Memorial Institute

Education: J.D., The Washington College of Law, The American University, 1979
B.A., Political Science and Administrative Studies, University of California at Riverside, 1976

Technical Experience: Environmental law and regulation, NEPA compliance (24 years).

EIS Responsibility: Document summary, document reviews

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NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE HANFORD SITE SOLID (RADIOACTIVE AND HAZARDOUS) WASTE PROGRAM ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" 46 FR 18026-18038 at 18031.

In accordance with these requirements, Battelle Memorial Institute, Pacific Northwest Division hereby certifies as follows: check either (a) or (b).

(a) X — Battelle Memorial Institute, Pacific Northwest Division has no financial or other interest in the outcome of the referenced EIS projects.

(b) ____ — ________________________ has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:

Nori Nichols
Signature

Nori Nichols
Name

Contracting Officer
Title

April 9, 2002
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE
HANFORD SITE SOLID (RADIOACTIVE AND HAZARDOUS)
WASTE PROGRAM
ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

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In accordance with these requirements, Jacobs Engineering Group Inc. hereby certifies as follows: check either (a) or (b).

(a) ✓ Jacobs Engineering Group Inc. has no financial or other interest in the outcome of the reference EIS projects.

(b)___ ______________________ has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:

[signature]
Signature

Steven Green
Name

Office Manager
Title

2/18/2003
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE HANFORD SITE SOLID (RADIOACTIVE AND HAZARDOUS) WASTE PROGRAM ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5 (c), which have been adopted by the DOE (10 CFR 1021), require contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" 46 FR 18026-18038 at 18031.

In accordance with these requirements, Dade Moeller & Associates, Inc. hereby certifies as follows: check either (a) or (b).

(a) _X_ Dade Moeller & Associates, Inc. has no financial or other interest in the outcome of the referenced EIS projects.

(b) ____ ________________ has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:

[signature]
Signature

Matthew P. Moeller
Name

President & Chief Operating Officer
Title

March 25, 2003
Date

Consultations and Coordinations

To ensure full compliance with National Environmental Policy Act (NEPA) of 1969 (42 USC 4321) regulations and to help keep concerned Tribal Nations and agencies informed of DOE actions, DOE conducted various consultations and coordinations as listed below. These interactions consisted of written correspondence regarding the proposed action, alternatives, environmental impacts, regulatory requirements, and issues of concern. Copies of formal consultation letters and responses are included in Appendixes I and K of this EIS (Volume II).

- Confederated Tribes and Bands of the Yakama Nation
- Confederate Tribes of the Colville Reservation
- Confederated Tribes of the Umatilla Indian Reservation
- Hanford Communities (intergovernmental group for Benton and Franklin counties, Richland, Kennewick, Pasco, West Richland, and the Port of Benton)
- Hanford Advisory Board
- Hanford Natural Resources Trustee Council
- National Marine Fisheries Service
- Nez Perce Tribe
- Oregon Office of Energy
- U.S. Environmental Protection Agency, Region 10
- U.S. Fish and Wildlife Service
- Wanapum
- Washington State Department of Ecology
- Washington State Department of Health
- Washington State Office of Archaeology and Historic Preservation

Cooperating Agencies

The early planning for the proposed ILAW SEIS included scope pertaining to the Waste Treatment Plant (WTP) construction. At that time, the Hanford Communities requested to become a cooperating agency (Attachment 1) with a primary interest in the socioeconomic impacts. In response, DOE welcomed the Hanford Communities as a cooperating agency (Attachment 2). The Hanford Communities commissioned Perteet Engineering, a company based in Everett, Washington to perform a socioeconomic study. Later DOE decided to limit the scope of the SEIS to only ILAW disposal. Later when DOE decided to combine the SEIS with the HSW EIS, DOE asked the Hanford Communities if they wished to continue to participate as a cooperating agency (Attachment 3). No response has been received.

In addition, DOE asked Ecology to participate as a cooperating agency in the proposed ILAW SEIS (Attachment 4). Ecology declined the offer (Attachment 5).

Soon after the Notice of Intent was issued, the Yakama Nation indicated that they wanted to be involved in the preparation of the HSW-EIS (Attachment 6). DOE accepted the Yakama Nation's offer (Attachment 7). For a time, a representative of the Yakama Nation participated in the preparation of the first draft of the HSW EIS. However, the Yakama Nation later decided that they no longer wished to participate (Attachment 8).

Hanford Communities

Richland • Kennewick • Pasco • West Richland • Benton County • Port of Benton

P.O. Box 190, Richland, WA 99352
Telephone (509) 942-7348 Fax (509) 942-7379

May 4, 2001

Dr. Harry Boston, Manager
Office of River Protection
P.O. Box 450, MSIN H6-60
Richland, WA 99352

Dear Dr. Boston:

The Hanford Communities are very interested in the Supplemental Environmental Impact Statement (EIS) that your office is undertaking associated with the tank waste vitrification project. Of particular interest is the socio-economic impact section of the EIS. The construction of the vitrification plant will draw to our region thousands of workers during the peak construction years. This influx of people will have a significant impact on all of our communities, and Richland in particular. The construction of the nuclear power plants by the Washington Public Power Supply System (WPPSS) some twenty years ago resulted in a similar influx of people to the community for a several-year period of time.

Based on our experience with the WPPSS construction projects, our communities believe it is essential that we plan for, and to the extent possible mitigate the impacts that will occur during the construction of the vitrification plant. We are presently considering a proposal to hire a consulting firm to do a socio-impact analysis for us. The company we have chosen did the socio-economic impact analysis under NEPA for the Everett Home Port, which was constructed by the U.S. Navy in the late 80s. We are presently working to define the Scope of Work of the contract. We anticipate the project will be completed in July. A copy of the draft Scope of Work has been shared with your staff and the contractors that are working on the Supplemental EIS.

end date for new date in June.

The cost of hiring Perteet Engineering to do the analysis is $65,388. The Hanford Communities considered asking the Office of River Protection (ORP) to help us in covering this cost before proceeding with the project, but determined that such a request would result in a delay that was unacceptable. Since ORP will need to address socieo-economic impacts in the EIS, and this study will provide the necessary information, we would appreciate it if you would consider providing funding to offsetting some of the consultant costs.

Because of our strong interest in developing sound information upon which we can rely for planning purposes, and the need for that analysis to be tied to accurate and complete information about your project, we would like to explore with you the option of the City of Richland serving as a cooperating agency during the preparation of the Supplemental EIS. This status would give Richland the opportunity to work with your staff to coordinate our efforts and to review draft documents for consistency as they are being developed.

vs. Hanford Communities

RECEIVED

MAY 0 8 2001

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The cooperating agency status would be limited to the community, social and economic impact aspects of the EIS and we believe would best be defined in a Memorandum of Understanding. ← action. MoU.

The staff of our respective organizations met on April 26 to have a preliminary discussion on this topic. It was a very positive and constructive meeting. It was determined that the next step would be for us to write this letter to you and to begin discussion about a Memorandum of Understanding that would be definitive and acceptable to the Department of Energy and the Hanford Communities.

We look forward to your response, and we look forward to working with you on this project which is of paramount importance to our region.

Sincerely,

Larry Haler, Chairman
Hanford Communities

1

U.S. Department of Energy

[redacted]

P.O. Box 450
Richland, Washington 99352
JUN 01 2001

01-EQD-047

Mr. Larry Haler, Chairman
Hanford Communities
P.O. Box 190
Richland, Washington 99352

Dear Mr. Haler:

REQUEST FOR COOPERATING AGENCY STATUS ON THE TANK WASTE REMEDIATION SYSTEM (TWRS) SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS)

Reference: Hanford Communities letter from L. Haler to H. L. Boston, ORP, dated May 4, 2001.

The U.S. Department of Energy, Office of River Protection (ORP) has reviewed the above Reference requesting cooperating agency status on the TWRS SEIS. ORP welcomes your participation as a cooperating agency. ORP looks forward to working with you on drafting a Memorandum of Understanding that defines your degree of involvement and your responsibilities for specific issues.

In regards to offsetting any costs associated with developing information and preparing environmental analyses for the SEIS, ORP regrets to inform you that federal funds are not available.

If you have any questions, please contact Gae M. Neath, Environmental and Quality Division, (509) 376-7828.

Sincerely,

Harry L. Boston
Manager

EQD:GMN

cc: P. F. X. Dunigan, Jr., RL
D. Nichols, Jacobs

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

03-WMD-0097

JAN 22 2003

Ms. Pam Brown
Hanford Communities
P.O. Box 190
Richland, Washington 99352

Dear Ms. Brown:

HANFORD COMMUNITIES PARTICIPATION IN THE PREPARATION OF THE HANFORD SITE SOLID (RADIOACTIVE AND HAZARDOUS) WASTE PROGRAM ENVIRONMENTAL IMPACT STATEMENT (HSW EIS) (SECOND DRAFT)

The U.S. Department of Energy has decided to evaluate the environmental impacts of several immobilized low activity waste (ILAW) disposal alternatives in the HSW EIS. Previous plans were to evaluate these alternatives as part of the Tank Waste Remediation System Supplemental Environmental Impact Statement (TWRS SEIS).

As you already know, the first draft of the HSW EIS was sent out to interested parties for review in May 2002. Comments received during that review were large, both in terms of numbers and significance. The U.S. Department of Energy decided to prepare a second draft in an effort to respond to comments on the first draft. Anticipated changes include:

- The addition of the same ILAW disposal alternatives that were to be addressed in the Tank Waste Remediation System Supplemental Environmental Impact Statement (TWRS SEIS) and the evaluation of those alternatives.
- The addition of alternatives for disposal of ILAW with low-level waste and mixed low-level waste and the evaluation of those alternatives.

Plans are to issue the second draft if the HSW EIS for review in March 2003.

The Hanford Communities had previously requested to be a cooperating agency for preparation of the TWRS SEIS, and had been accepted. Please advise us as soon as possible whether the Hanford Communities is interested in continuing to participate as a cooperating agency on this EIS and, if so, how you want to be involved.

Ms. Pam Brown
03-WMD-0097

-2-

JAN 22 2003

If you would like to discuss this matter or have any questions, feel free to call me on (509) 376-6536.

Sincerely,

Michael S. Collins
Document Manager

WMD:MSC

cc: C. Borgstrom, EH-42

1

U.S. Department of Energy

Office of River Protection

P.O. Box 450
Richland, Washington 99352

SEP 0 6 2002

02-EMD-147

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 W. Fourth Avenue
Kennewick, Washington 99336

Dear Mr. Wilson:

INVITATION TO PARTICIPATE AS A COOPERATING AGENCY IN DEVELOPMENT OF THE TANK WASTE REMEDIATION SYSTEM, HANFORD SITE, RICHLAND, WASHINGTON, SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS)

The U.S. Department of Energy (DOE), Office of River Protection (ORP) is inviting you to participate in the development of the SEIS for Disposal of Immobilized Low-Activity Waste, consistent with the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, 40 CFR 1501.6. Consistent with the CEQ guidance, ORP will use the environmental analysis and proposals of cooperating agencies with jurisdiction by law or special expertise, to the maximum extent possible, consistent with its responsibility as lead agency. ORP is requesting that the State of Washington Department of Ecology provide information and analysis for those portions of the supplemental environmental impact statement in which you, as a cooperating agency, have special expertise. The addition of your specialized knowledge will be of great value to the planning process and will be incorporated into the SEIS. ORP looks forward to your cooperation, involvement, and staff assistance in the planning and development of the SEIS for the future disposition of the vitrified low-activity waste at Hanford.

ORP is proposing modifications to the tank waste program. To address the proposed changes, DOE decided to issue a supplement to the Tank Waste Remediation System EIS issued in 1996. The proposed changes include vitrifying low-activity tank waste as monoliths rather than cullet and permanently disposing the monoliths in regulatory compliant trenches in the 200 Areas, versus long-term storage in concrete vaults in the 200 East Area.

Once again, we would appreciate your participation in the development of the SEIS. Please advise by return mail your acceptance of this invitation to participate, to identify your point-of-contact, and to make arrangements for consultation meetings.

Should you have any questions, please feel free to contact me, (509) 376 2247, or your staff may contact Gae M. Neath, Environmental Management Division, (509) 376-7828.

Sincerely,

James E. Rasmussen

James E. Rasmussen, Director
Environmental Management Division

EMD:GMN

cc: M. Brown, Ecology
S. L. Dahl, Ecology
J. L. Hensley, Ecology
Environmental Portal, LMSI
P. F. X. Dunigan, RL

1

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

October 10, 2002

Mr. James E. Rasmussen
Director of Environmental Management Division
Office of River Protection
United States Department of Energy
P.O. Box 550, MSIN: H6-60
Richland, Washington 99352

Dear Mr. Rasmussen,

Re: Letter, James Rasmussen to Michael Wilson, "Invitation to Participate as Cooperating Agency in Development of the Tank Waste Remediation System, Hanford Site, Richland, Washington, Supplemental Environmental Impact Statement (SEIS)", September 6, 2002

The Washington State Department of Ecology (Ecology) appreciates the offer that you made on behalf of the United States Department of Energy (USDOE), Office of River Protection (ORP) to allow our agency to participate as a cooperating agency as defined in Title 40 Code of Regulations (CFR) Section 1508.5. At this time, Ecology has chosen to decline your offer; however, Ecology will comment during the USDOE scoping process (40 CFR 1501.7(a)) and during the public comment period following the issue of the draft supplement (40 CFR Part 1503).

From our discussions to date, we understand that you are now developing a supplement to the existing Tank Waste Remediation System Environmental Impact Statement. The intent of the supplement is to evaluate permanent disposal of the vitrified low activity tank waste in large trenches on the Hanford Site. Ecology will require that these trenches be constructed and operated to the standards in Washington Administrative Code (WAC) Chapter 173-303, Dangerous Waste Regulations, Section 665. To support the issue of a permit for the construction and operation of the trenches, Ecology will undertake timely reviews of the SEIS per WAC 197-11-055(1). Under the provisions of WAC 173-802-060, Ecology will also allow the USDOE to forego submission of an environmental checklist to support the permit application because the SEIS will be prepared. Ecology may consider adopting the SEIS if the provisions of WAC 197-11-610(3) are met to our agency's satisfaction.

If you have any questions regarding this issue, please contact the Tank Waste Disposal Project Manager, Ms. Suzanne Dahl (509) 736-5705.

Sincerely,

Michael Wilson
Program Manager
Nuclear Waste Program

SD:sb

cc: (See next page)

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OCT 1 6 2002
DOE-ORP/ORPCC

Mr. James E. Rasmussen
October 10, 2002

cc: Todd Martin, HAB
Richard Gay, CTUIR
Pat Sobotta, NPT
Russell Jim, YN
Ken Niles, OOE
Administrative Record: TWRS ILAW & TWRS EIS

11/13/97 THU 16:22 FAX 509 452 2503 YAKIMA ER WM UG 002

Confederated Tribes and Bands
of the Yakama Indian Nation

Established by the
Treaty of June 9, 1855

Mr. John D. Wagoner, Manager
U.S. Department of Energy
Richland Operations Office
P.O. Box 550, M/S A-750
Richland WA 99352

November 13, 1997

SOLID WASTE EIS - PREFERRED ROLE OF THE YAKAMA INDIAN NATION

Dear Mr. Wagoner,

We have received the Solid Waste EIS Notice of Intent, and wish to participate as a co-preparer of the EIS. We would like to participate as a regular working member of the technical workgroup that meets Monday mornings. We would like to help develop the scope and outline of the EIS. We would expect to perform some of the analysis and write some sections that pertain to tribal resources and risks, as well as part of the environmental justice section. We will make our staff time available so that DOE's schedule will not be delayed.

We would also like an initial work session with DOE and the contractor staff to begin working on scope (inclusions and exclusions), the principles of cumulative impact analysis, and a number of related issues. Because there are several critical issues raised by the NOI, we would request that we begin working on this very soon. We are aware of the intertribal meeting tentatively scheduled Thanksgiving week, and would like to ensure that this is an actual working meeting (rather than simply an informational briefing) where the issues of scope and analytical method are included and open for discussion and possible modification. At that meeting we would also like to establish our roles and technical responsibilities as well as ongoing work session schedules.

Sincerely,

Russell Jim, Manager
Environmental Restoration/Waste Management Program

cc: Allison Wright, DOE-RL
Kevin Clarke, DOE-RL
Donna Powaukee, NPT
Stuart Harris, CTUIR
Merilyn Reeves, HAB

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Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352
APR 1 3 1998

98-WPD-016

Mr. Russell Jim, Manager
Environmental Restoration/
Waste Management Program
Confederated Tribes and Bands
of the Yakama Indian Nation
2808 Main Street
Union Gap, Washington 98903

Dear Mr. Jim:

REQUEST FOR YAKAMA INDIAN NATION (YIN) TO BE A COOPERATING AGENCY IN PREPARATION OF THE HANFORD SITE SOLID (RADIOACTIVE AND HAZARDOUS) WASTE PROGRAM ENVIRONMENTAL IMPACT STATEMENT (EIS)

The U.S. Department of Energy, Richland Operations Office (RL), has considered the Yakama Indian Nation request to be a cooperating agency in the preparation of the Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS. We appreciate the offer of assistance by the Yakama Indian Nation.

Following a meeting and telephone conversations with members of your staff, RL understands that your request for cooperating agency status is intended to provide the Yakama Indian Nation Environmental Restoration/Waste Management staff an opportunity to participate in the preparation of the subject EIS.

While we are unable to designate the Yakama Indian Nation as a "cooperating agency" in accordance with the Council on Environmental Quality Regulations, 40 CFR 1501.6, we are hopeful that we can accomplish the same ends by designating the Yakama Indian Nation a "consulting" agency in the same way as was offered to the Yakama Indian Nation in preparation of the Hanford Remedial Action EIS. As a "consulting" agency, the Yakama Indian Nation involvement would be similar to that of a cooperating agency in the preparation of the EIS that will lead to a U.S. Department of Energy Record of Decision. This involvement could include Yakama Indian Nation preparation or assistance in preparation of portions of the draft EIS, participation in EIS management meetings, and reviews of predecisional drafts. Such participation is consistent with your scope of work under the Cooperative Agreement (DE-FC06-90RL11979) and would be funded by your existing budget. Your specific involvement would be subject to our approval and mutual agreement, as well as an understanding of expectations for schedule and review processes.

Please contact Elizabeth M. Bowers on (509) 373-9276 or Paul F. X. Dunigan, Jr. on (509) 376-6667 to discuss the details of your involvement in the drafting of this EIS.

Sincerely,

John D. Wagoner
Manager

WPD:GLS

cc: T. Woods, YIN

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Mr. Russell Jim
98-WPD-016

APR 1 3 1998

bcc: WPD OFF FILE
WPD RDG FILE
CA Hansen, AME
PF Dunigan, EAP
EV Hiskes, OCC
KV Clarke, OEA
RF Guercia, WPD
GL Sinton, WPD w/background
AMW RDG FILE

RECORD NOTE: This letter closes out Action Numbers 9818663 and 9718488.

Background Information on the Participatory Role of the Yakama Indian Nation in the NEPA Process for the Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS

Indian Tribe Participation as Defined in NEPA Regulations

Guidance on the role of Indian Nations in the EIS process is confusing and often conflicting. In *40 CFR Parts 1501.6* (NEPA Implementing Regulations), cooperating agencies status is determined on the following conditions:

- Upon request of the lead agency, any other Federal agency which has jurisdiction by law shall be a cooperating agency.
- Any Federal agency which has special expertise with respect to any environmental issue, which should be addressed in the statement may be a cooperating agency upon request of the lead agency.
- An agency may request the lead agency to designate it a cooperating agency.

If requested to be a cooperating agency, the agency must assume responsibility for developing information and preparing environmental analyses, including portions of the environmental impact statement which the cooperating agency has special expertise. It must make staff available and normally use its own funds for this activity. It also must participate in the NEPA Process as soon as possible including the public scoping periods. Thus, from these definitions, it seems as though Indian Nations would not qualify as cooperating agencies in that they are not "Federal" agencies.

However, in contrast to 40 CFR 1508.6, in part *1508.5 of 40 CFR* direct references to Indian Tribe participation in the NEPA process indicate that Indian Nations may in fact qualify for cooperating agencies when their reservations could be impacted by the actions:

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> *A cooperating agency is defined as any Federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact... An Indian Tribe, may on agreement with the lead agency,become a cooperating agency if the effects are on a reservation (40 CFR 1508.5).*

Effects are defined by the regulation as ecological, aesthetic, historic, cultural, economic, social, or health, whether direct, indirect or cumulative (*40 CFR 1508.8*). Hence, the situation with the YIN does seem to fit within the parameters of a cooperating agency.

In the Council on Environmental Quality's (CEQ) Guidance on NEPA, "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," the CEQ states that Indian Tribes should be consulted when the proposal may affect an Indian reservation. *40 CFR Part 1508.5* is stated as the justification for this statement, however, when reading the statute it seems that Indian Nations can have a much larger participatory role in the NEPA Process.

In DOE Guidance for Implementing NEPA, (*10 CFR 1021*), DOE must provide the host tribe an opportunity to review and comment on any Environmental Assessment. (Note: The guidance doesn't specify that the same applies for an EIS). Other Indian Tribes can be given the opportunity to comment and review at DOE's discretion (*10 CFR 1021.301*).

<u>YIN Jurisdiction By Law as defined in Agreements Between the YIN and RL</u>

According to the Agreement-in-Principle between RL and YIN, YIN shall review and comment, as necessary, on NEPA documentation prepared by DOE to address DOE program activities conducted at the Hanford Site; such documentation will include draft environmental assessments and draft EIS. The YIN will also participate in the normal public participation process leading to the issuance of final NEPA documentation. The same role for the YIN in NEPA compliance is also reiterated in the Environmental Management Program Scope of Work for the YIN. The YIN is to review and provide comments on all relevant NEPA documentation.

As described above it seems that both CEQ and RL have interpreted 40 CFR parts 1501-1508 to indicate that the lead agency should make an extended effort to consult with the appropriate Indian Nations when conducting an EIS as opposed to granting cooperating agency status. The Indian Nations should be provided NEPA documents and their opinions and comments should be sought out by RL through briefings and consultations about the NEPA process.

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Confederated Tribes and Bands
of the Yakama Indian Nation

Established by the
Treaty of June 9, 1855

27 February, 2003

Keith Klein, Manager
U.S. Department of Energy
Richland Operations Office
P.O. Box 550 MSIN: A7-50
Richland, WA 99352

RE: Participation in the Preparation of the *Second Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement*, April 2002, DOE/EIS-0286D

Dear Mr. Klein:

The Yakama Nation recently received a letter, dated January 23, 2003, from Mr. Michael S. Collins, Document Manager, of your staff inquiring about our participation as a cooperating agency in the development of the second draft of the *Hanford Site Solid Waste Environmental Impact Statement* (EIS). In that letter, U. S. Department of Energy (USDOE) indicates that it intends to release the second draft in March 2003. The Yakama Nation believes that USDOE's proposal to dispose of immobilized low activity waste at Hanford is inconsistent with requirements in the Nuclear Waste Policy Act. Because of this issue and others, the Yakama Nation respectively declines to be a cooperating agency in the preparation of the EIS.

The USDOE has a fiduciary trust responsibility to consult the Yakama Nation prior to taking an action that will impact the Yakama people and retained treaty resources and rights. The proposed actions identified in the draft EIS and anticipated changes highlighted in the January 23, 2003 letter will have long-term impacts to the Yakama people and treaty resources and rights. I request that USDOE provide a briefing to the Yakama Nation Environmental Restoration/Waste Management Program on the scope and proposed alternatives in the second draft.

The Yakama Nation ERWM program found the initial draft EIS to be environmentally unsatisfactory (considering that off-site waste may be disposed at Hanford and threaten the Columbia River) and inadequate because of the lack of waste stream characterization and omission of pre-1970 transuranic waste in its scope. Mr. Collins in his January 23, 2003 letter did not mention pre-1970 waste as an issue to be analyzed in the second draft. How will this waste stream be handled? Please provide us with the framework and timeline for retrieving and disposing of this waste off-site.

The Yakama Nation has concerns regarding the importation of off-site waste for Hanford disposal given the proximity of the Columbia River and its importance to populations

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downriver and to their health and the Yakama peoples'. Please let us know when consultation can begin on this matter. At issue is whether the Hanford Site should even be considered as a disposal site for any waste given that radiological and hazardous wastes located on the Central Plateau have reached the Columbia River via the ground water and threaten humans and aquatic receptors. To date, USDOE has been unsuccessful at preventing these contaminants from reaching the river. In August 2002, the EPA released the results of a fish study[1] that found the highest concentration of chemical contaminants in Columbia River fish to be in the Hanford Reach, posing up to a 1 in 50 cancer risk among tribal people. Based on this extraordinary risk, how can you assure us that additional waste disposed at the Site will not contribute to an increased risk to tribal members and aquatic organisms given the previously stated facts?

Consultation needs to be initiated with the Yakama Nation regarding what issues should be part of the National Environmental Policy Act analysis. Hopefully, our governments can reach a mutual agreement on the acceptability of actions consistent with federal and tribal laws and policies and the doctrine of Trust Responsibility. For the Yakama Nation decisions must protect the resources to which the Yakama Nation has specific aboriginal and Treaty reserved rights, protect the unique culture and worldview and enable continued practice of the tribal religion.

Given the significance of these issues, the Yakama Nation respectively declines the offer to be a cooperating agency on the Hanford Site Solid Waste Program EIS. Please contact me in the near future to arrange a meeting to discuss these concerns. I may be reached at 509/452-2502.

Sincerely,

Russell Jim, Manager
Environmental Restoration/Waste Management Program

Tom Fitzsimmons, Director, Washington Department of Ecology
John Iani, Region X Administrator, USEPA
Michael Collins, USDOE-RL

RL COMMITMENT CONTROL
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[1] U.S. Environmental Protection Agency, Region X, Seattle, Washington, 98101, "Columbia River Basin Fish Contaminant Survey, 1996-1998, EPA 910-R-02-006, July 2002

YAKAMA NATION ERWM PROGRAM
Specific comments on the draft Solid Waste Program EIS

1). The purpose and need statement needs to include pre-1970 TRU waste because it was managed as LLW before the definition of TRU was developed in 1970 and since solid LLW is already part of the proposed action.

2). Existing conditions at the low-level burial grounds have been ignored in the analysis. Two prime examples of this are; leaks under the burial grounds, (USDOE) presentation material) and subsidence (collapse of the surface of the burial grounds).

3). The pre-1970 TRU waste is being ignored and moved into other DOE-EM categories through a process that violates the federal cleanup agreement currently in existence.

4). Previous studies conducted for the USDOE indicate that high-level waste has been disposed of in the low-level burial grounds, and this omission is of serious concern.

5). The total inventory buried in the low-level burial grounds needs to be defined and presented in order to establish a factual basis for any decision made in this NEPA Under the alternatives, neither a liner is mentioned in the construction of the new LLBG trenches nor an analysis of risk performed for the life of the contaminants that would be placed in the trenches beyond the year 2046.analysis.

6). Any new trenches must contain liners even if the law does not require one. This would assist in preventing the movement of waste to the vadose zone/ ground water during the period that these contaminants pose a threat to the environment and human health.

7). A borrow site has been identified south of highway 240 on the Arid Lands Ecology Reserve. Full use of this area would result in the destruction of 926 hectares (2287 acres) of shrub steppe habitat. In addition, the proposed borrow site would impact cultural resources, aesthetic views, e.g. vision quests from sacred religious sites atop Rattlesnake and Gable Mountain, pose transportation hazards along highway 240and impact the Hanford Reach National Monument since the project abuts the National Monument boundary. USDOE anticipates only impacting 81 hectares (200 acres) for capping material. This appears to be the lower bounding limit since the soil/basalt volume calculations are based on construction of a modified RCRA C barrier, which requires less material than a Hanford barrier. It also does not include the cumulative needs from other projects that will require geological resources from this site.

The Yakama Nation has never been consulted by USDOE-RL on the location of this borrow site which will have significant adverse impacts on the resources mentioned in the previous paragraph. The Yakama Nation was not consulted on the *Use of Existing Borrow Areas,* DOE/EA-1403 (EA) October 2001 nor consulted on the development of the *Industrial Mineral Resources Management Plan and Aesthetic and Visual Resources Management Plan,* which requires a NEPA analysis. From a cursory review of DOE/EA-1403, we found major deficiencies in the NEPA analysis that should have led USDOE-

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RL to a determination to prepare an environmental impact statement. In addition, the EA failed to fully bound the impacts for geologic materials needed for capping material as document on page 1.24 of this EIS where USDOE states, "Although the total quantities of material necessary for final closure of the 200 LLBGs were not included in this EA [referring to DOE/EA-1403, October 2001] the locations evaluated included likely sources for these materials for the foreseeable future". Therefore, USDOE needs to perform another NEPA analysis (preferably an EIS) for capping material and other uses. USDOE will need to consult the Yakama Nation closely on this issue so that our governments may reach a mutual agreement on geologic source sites for barrier construction and other needs.

8). The cumulative impacts analysis fails to consider past, present and future impacts to the environment including contaminant load and ground water.

Multiple past projects have had an impact on the shrub steppe habitat along with natural/human induced events, such as, the 2000 range fire which destroyed all mitigation for these past projects. No contingency plans have been initiated for the loss of these mitigation projects since the fire. Under USDOE's management, the quality of the Hanford Site's biological and cultural resources continues to degrade. USDOE has a fiduciary trust responsibility to ensure the protection of Treaty reserved resources such as foods and medicinal plants. Therefore, corrective actions are required for impacts from this proposed action.

9). USDOE-RL identified resources, i.e. 178 ha (440 acres) of land, that will be declared Irreversible and Irretrievable because of this proposed action. USDOE-RL has a fiduciary responsibility to the Yakama Nation and as part of that responsibility, USDOE needs to fully mitigate for impacts prior to declaring the resources I&I. The mitigation hierarchy, as defined under 40 CFR § 1508.20, includes compensation. USDOE-RL will need to compensate the Yakama Nation for the loss of this land, if the waste cannot be disposed of off-site, because the action is occurring on Yakama ceded land. The Yakama Nation has not agreed to the creation of a sacrifice zone. USDOE-RL needs to consult the Yakama Nation on this matter and come to a mutual agreement before issuance of the final document and Record of Decision.

10). This proposed action could potentially impact up to 133 hectares (329 acres) of land in the 200 Areas plus an additional 81 hectare (200 acres) at the borrow site. These impacts will occur on Yakama Nation ceded land and impact reserved Treaty resources and rights. Therefore, USDOE must include mitigation measures (avoid, minimize, rectify, and compensate) in the final document and record of decision. USDOE-RL needs to consult the Yakama Nation to cooperatively develop a formal agreement on appropriate mitigation measures for this proposed action before issuance of the final document and Record of Decision.

11). Under section 4.7.1, language needs to be inserted that recognizes the Hanford Site as wintering grounds for the Yakama people and that they fished, hunted and gathered roots and medicinal plants in the area.

12). Under section 6.13 Treaties, Statutes, and Policies Relating to Native Americans, USDOE-RL asserts that they interact and consult regularly and directly with the three federally recognized tribes. No government-to-government consultation has occurred between the Yakama Nation and the Secretary of Energy on this proposed action.

7.1 References

42 USC 4321 et seq. National Environmental Policy Act (NEPA) of 1969, as amended. Online at: http://www4.law.cornell.edu.

DOE-RL. 2002. *Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland Washington*. DOE/EIS-0286 Draft, U.S. Department of Energy Richland Operations Office, Richland, Washington.