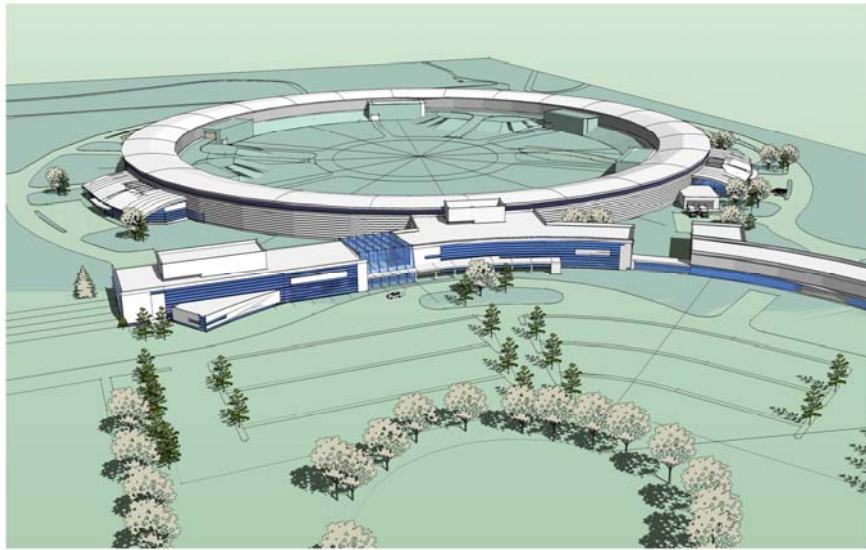


**ENVIRONMENTAL ASSESSMENT**

**FOR**

**NATIONAL SYNCHROTRON LIGHT SOURCE-II**  
**(NSLS-II)**  
**BROOKHAVEN NATIONAL LABORATORY**  
**UPTON, NEW YORK**



U. S. Department Of Energy  
Brookhaven Site Office

September 2006

**DOE/EA-1558**

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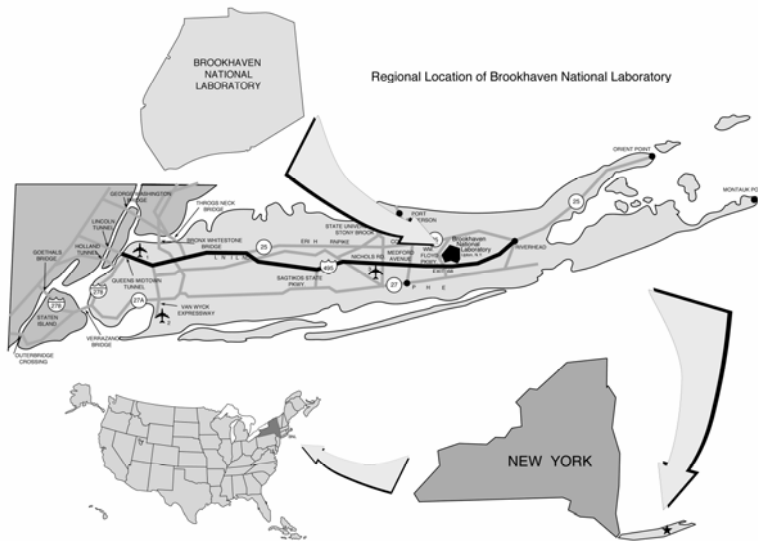
## **1.0 PREFACE**

This Environmental Assessment (EA) for the proposed National Synchrotron Light Source-II (NSLS-II) at Brookhaven National Laboratory (BNL) presents an analysis of the potential environmental consequences of the facility and compares these potential consequences to alternatives to the proposed action. This EA will be used to determine whether a “Finding of No Significant Impact (FONSI)” to the environment would result from the construction and operation of the NSLS-II or whether an Environmental Impact Statement (EIS) must be prepared.

This document complies with the National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4321-4347); the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1500-1508); and the DOE NEPA Regulations (10 CFR 1021).

## 2.0 SUMMARY

BNL is a national laboratory overseen and primarily funded by the Office of Science of the U.S. Department of Energy (DOE), and operated and managed by Brookhaven Science Associates (BSA), a limited liability company founded by Stony Brook University, and Battelle, a nonprofit, applied science and technology organization. Located 60 miles east of New York City in Upton, NY, BNL conducts research in the physical, biomedical, and environmental sciences, in energy technologies and national security (See Figures 1 and 2). Among its missions, the Laboratory is charged with conceiving, designing, constructing and operating world-class, complex, leading-edge research facilities in response to the needs of the DOE and to a large community consisting of university, industry, government and international users [SER].



**Figure 1. Regional view of Brookhaven National Laboratory location**



**Figure 2. Aerial view of Brookhaven National Laboratory**

This EA addresses the Proposed Action by the DOE to construct and operate NSLS-II at BNL, an advanced synchrotron light source designed to study the properties and functions of materials with nanoscale resolution. Using x-ray beams of unprecedented intensity and brightness, and exceptional stability, the NSLS-II light source would fulfill a vital national and international need for a cutting-edge light source, and reinforce and enhance the nation's scientific leadership and global competitiveness. NSLS-II would uniquely allow a broad range of scientific inquiry concentrating particularly on grand-challenge science at the "nanoscale," the length range from 1 to 100 nanometers. A nanometer is one billionth of a meter or one ten-thousandth the diameter of a human hair. Working in the nanoscale, NSLS-II would meet the needs of a broad-based national and international user community, and impact numerous disciplines and scientific initiatives to allow future progress in basic and applied research in biology and medicine, material and chemical sciences, geosciences, environmental sciences, energy security and technology, and nanoscience.

As the world's most advanced storage-ring-based synchrotron light source, NSLS-II, would incorporate advanced insertion devices, optics, detectors and non-destructive tools and instruments to image the structure and characterize the properties of atoms buried inside a material under real physical and chemical conditions. Nanoscience at NSLS-II would focus on research into clean and affordable energy; molecular electronics for new faster, cheaper, electronics that consume less power; and, high temperature superconductors for the efficient transmission of electricity.

The NSLS-II light source would generate the world's brightest x-rays at 10,000 times that of BNL's current light source, the National Synchrotron Light Source (NSLS), and 10 times its intensity. NSLS-II would also provide world-leading high brightness in the Infrared spectral region that would further usher in new imaging techniques for basic and applied research in science and technology. NSLS-II would be a replacement to NSLS which has been operational and producing world-class science for more than 24 years, including a Nobel Prize. Invaluable operational experience gained at NSLS is translatable to the state-of-the-art NSLS-II.

The proposed NSLS-II would be sited adjacent to the existing NSLS and the newly-constructed Center for Functional Nanomaterials (CFN) which has an overarching research goal of helping to solve the nation's energy problems by exploring nanomaterials to provide the know-how to design and build energy-efficient devices for manufacturing and transportation. Also proposed for the area would be a Joint Photon Sciences Institute (JPSI) that the State of New York has offered to fund if NSLS-II is constructed at BNL. The synergy of the entire complex would create a vital nanotechnology research and development hub for the Northeastern United States that may be technologically unmatched elsewhere in the world.

To ensure that the proposed NSLS-II remains world-leading as light source technology evolves, the facility would be designed to be upgradeable in the foreseeable future. It is conceivable that NSLS-II may be upgraded to operate as an Energy Recovery Linac (ERL) for even greater performance, should ERL technology prove feasible and beneficial to facility users and DOE's mission in the future.

Construction of NSLS-II is envisioned for a 10-12 acre (4.0-4.9 hectares) site immediately south and east of NSLS and the CFN, and would include a linear accelerator, a booster synchrotron ring, an electron storage ring, beamlines, offices, laboratories, support and parking facilities. Construction would be expected to begin in 2008 with operation beginning in 2013. Integrated Safety Management (ISM) would be fully incorporated into all phases of work management at NSLS-II so that all workers and employees, at every level, the public and the environment are protected during construction and all operations. In addition, worker health and safety requirements of 10 CFR 851 will be fully implemented at BNL by February 2007.

Detailed analysis of all potential environmental, safety and health hazards would be made as the design, construction, and operation of the facility progresses. A series of safety assessment documents would be prepared, beginning with the Preliminary Hazards Analysis which would be developed during the conceptual design of the facility. As design and engineering progresses, more detailed safety assessment documents would be prepared which identify the hazards associated with the facility and establish appropriate controls to mitigate all hazards. Prior to operation of the accelerators, a detailed readiness review must be completed which determines that all required safeguards identified in the safety assessments are in place. These reviews would also ensure that all required safeguards from an environmental perspective have been provided.

Summary of NSLS-II estimated parameters:

- Storage ring electron energy of 3.0 billion electron volts
- Stored current of at least 500 milliamps
- Top-off injection mode
- Circumference in the range of 2,560 feet (780 meters)
- Circular footprint of 400,000 square feet (37,000 square meters)
- Parking Area of 100,000 square feet (9,300 square meters)

This EA analyzes the potential environmental consequences of two proposed actions: the No Action Alternative, and construction and operation of the NSLS-II.

In the No Action Alternative, NSLS-II would not be constructed and operated. The existing NSLS would continue operations until its user population eventually migrates to more advanced facilities in other locations worldwide. As a consequence, the DOE mission need for an advanced, state-of-the-art medium energy (3.0 billion electron volts) electron storage ring that produces the brightest x-rays in the world would not be fulfilled. National and global competitiveness would be lost and the U.S. would fall behind in the grand-challenge of basic and applied research for biology and medicine, materials and chemical sciences, geosciences and environmental sciences, and nanoscience. If NSLS-II were not built at BNL, another consequence of the No Action Alternative would be the withdrawal by New York State of its proposed \$30 million in funding for the Joint Photon Sciences Institute (JPSI). Loss of JPSI would forfeit an intellectual center at BNL, the Northeast, and the scientific and technological competitiveness of the U.S. in the cutting-edge global development and application of photon sciences.



An additional Alternative Action of an “In-Place Upgrade” of the current NSLS was not analyzed. This option would enhance the NSLS performance and capability, with construction actions performed primarily within the existing building footprint and result in minimal changes to keep the facility operational. However, in 2004, DOE determined that the upgrade would not meet its overall science mission requirements for a brighter, world-leading photon source with the research and development capabilities such as those proposed for NSLS-II.

A summary of the potential environmental consequences of the No Action Alternative, with current NSLS operations, and the proposed NSLS-II is presented below in Table 1. Full analysis of these topics is covered in the Environmental Impacts section. Potential environmental consequences for NSLS-II were estimated from data amassed from BNL’s 24 year-operational experience of NSLS.

<b>Table 1. Summary of Potential Environmental Consequences and Controls for the No Action Alternative and the NSLS-II Proposed Action</b>		
<b>Comparison Factors</b>	<b>No Action: NSLS Current Operations</b>	<b>Proposed NSLS-II</b>
General Information	No change from the existing NSLS facility.	New annular ring shaped building with the following estimated parameters: a footprint of 400,000 square feet; an accelerator circumference of 780 meters; 100,000 square feet for parking and additional infrastructure such as roads.
Soils	No change from the existing NSLS facility.	<u>Construction</u> - Estimated 20,000 cubic yards sand/soil needed for fill and 10,000 cubic yards needed for concrete slab and shielding (possible on-site sources). Temporary concrete mixing plant may be established using sand from the project site. If additional sand is required, other sites would be evaluated. Disturbed areas restored by regrading topsoil and planting native vegetation. Erosion control and dust mitigation would be implemented.  <u>Operation</u> – See also “Radiological Impacts.”
Water Resources	No change from the existing NSLS facility.	<u>Construction</u> – Approximately 6000 gpd water usage for dust mitigation and potential use for temporary concrete-mixing plant. Storm water runoff would be controlled; the need for a SPDES General Permit #GP-02-01 would be evaluated as would the potential effect of the storm water on the groundwater tritium plume. Water sampling wells lying within the footprint of the construction site would be relocated to areas that would meet regulatory decision requirements. Existing water supply would be adequate.  <u>Operation</u> – BNL’s water supply capacity of 5.1 mgd is adequate for the NSLS-II 0.3 mgd estimated daily usage; no new wells would be required. The estimated increased effluent discharge of up to 58,000 gpd to sanitary waste stream would be proportionate to number of staff, users, and experiments; this would be well within the 3 mgd system capacity and be moderated by LEED efficiencies. Storm water discharge due to increased impervious areas (up to 500,000 gallons from a 2 inch rainfall) would be evaluated and managed through local recharge and to recharge basins HW and HS. Environmental Management System (EMS) programs to control potential environmental aspects and hazardous effluents. Hazardous materials storage would be managed under Suffolk County Article 12 controls. See also “Radiological Impacts.”
Air Resources	No change from the existing NSLS facility.	<u>Construction</u> – Temporary increase in emissions due to construction equipment, delivery vehicles and worker vehicles. No change expected to the BNL Clean Air Act Title V permit. The temporary concrete mixing plant would be

Table 1 -continued

Table 1. Summary of Potential Environmental Consequences and Controls for the No Action Alternative and the NSLS-II Proposed Action		
Comparison Factors	No Action: NSLS Current Operations	Proposed NSLS-II
		<p>supplied with emission controls as required by 6 NYCRR Part 201.</p> <p><u>Operation</u> – Increased emissions due to electricity, steam and chilled water usage. Trace emissions from laboratory hoods limited by experiment and environmental review programs; these would be added to Clean Air Act Title V permit if needed. See also “Radiological Impacts.”</p>
Ecological Resources	No change from the existing NSLS facility.	<p><u>Construction</u> – Construction would overlap the 1000-foot tiger salamander (TS) NYSDEC buffer area by about 400 feet. This is not expected to increase the already disturbed area and there would be no net decrease to the TS habitat area.. Potential loss of killdeer bird nesting sites; actions can be mitigated by available alternative sites.</p> <p><u>Operation</u> - Increased water flow to recharge basin HS due to increased impermeable area. Potential benefit to TS habitat by providing water during drought periods.</p>
Cultural Resources	No change from the existing NSLS facility.	<p><u>Construction</u> – Demolition of five buildings over 50 years old. No structures determined to be eligible for listing on the National Register of Historic Places (NRHP). Need for archeological survey to be evaluated.</p> <p><u>Operation</u> – None.</p>
Socioeconomic Factors	No change from the existing NSLS facility.	<p><u>Construction</u> - Expenditures would benefit construction and manufacturing organizations with secondary benefits through jobs, wages and spending.</p> <p><u>Operation</u> - Operational, equipment, and staff and user spending would benefit local and statewide economies.</p>
Transportation	No change from the existing NSLS facility.	<p><u>Construction</u> – Temporary increase in construction equipment, delivery vehicles and worker vehicles.</p> <p><u>Operation</u> – NSLS-II would operate a small fleet of vans and trucks. Increase in staff and users vehicle use.</p>
Visual	Addition of new building	<u>Operation</u> – The new 2-story, low profile NSLS-II building would occupy 400,000 square feet in BNL’s core developed area and would not be seen from off-site.
Construction Hazards	No change from the existing NSLS facility.	<u>Construction</u> - Hazards typical for mid- to large-scale construction activity such as electrical, mechanical, elevated work, noise and lifting.

Table 1 -continued

Table 1. Summary of Potential Environmental Consequences and Controls for the No Action Alternative and the NSLS-II Proposed Action		
Comparison Factors	No Action: NSLS Current Operations	Proposed NSLS-II
Industrial and Experimental Hazards  Nanoscience Hazards		<p>Contractor accident prevention and environmental protection will be established through a Health and Safety Plan. BNL to complete a review to identify all pertinent ESH issues to be addressed during construction.</p> <p><u>Operation</u> - Hazards such as electrical, magnetic, noise, mechanical, elevated work and lifting mitigated by Integrated Safety Management (ISM) program reviews and controls. Biosafety Level 1 and 2 materials accommodated. Experiment hazards such as chemicals, compressed gases, electrical, magnetic, ozone, cryogens, flammables, lasers and radiological would be reviewed and control requirements defined.</p> <p><u>Nanoscience</u> – Cradle-to-grave guidelines and cautionary requirements would be developed to ensure the safety of workers, the public and the environment as well as safe use of experimental materials and proper disposal of wastes.</p>
Accidents and Natural Hazards	NSLS history indicates few accident or spill hazards.	<p><u>Operation</u> – Very low incidence rates estimated for accidents (slips, trips, falls, strains) and spills with minor to no impacts to the environment. Low earthquake probability. 6000 feet away from and 33 feet above the Peconic River 100 year flood plain.</p>
Waste Management	With in-kind replacements, minimal increases which would be handled and disposed of according to requirements and regulations.	<p><u>Construction</u> - One-time construction wastes. Recycling would minimize waste stream. Meet US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) standards.</p> <p><u>Operation</u> - Wastes would include hazardous, industrial, and minor quantities of radioactive or mixed wastes. Total estimated 3,000-5,000 pounds annually; continuation of programs to reduce waste.</p>
Pollution Prevention	Actively pursued.	<p><u>Construction</u> - Meet USGBC LEED standards to achieve certification for design, recycling, use of local materials, and manufactured products with reduced pollution footprint.</p> <p><u>Operation</u> - Pollution prevention and recycling programs would be in place. Replacement of hazardous materials with environmentally friendly alternatives, where possible. Reduction of water and mercury usage, where possible.</p>
Commitment of Resources	Minimal changes in resource use.	<p><u>Construction</u> – Minimal increase in electrical demand for lighting and tools. Temporary increase in fuel demand for construction</p>

Table 1 -continued

Table 1. Summary of Potential Environmental Consequences and Controls for the No Action Alternative and the NSLS-II Proposed Action		
Comparison Factors	No Action: NSLS Current Operations	Proposed NSLS-II
		<p>machinery.</p> <p><u>Operation</u> - Electrical, steam and chilled water demands would increase. Chilled water beyond BNL's current capacity would be needed.</p>
Radiological Impacts	Slight impacts.	<p><u>Construction</u> – None.</p> <p><u>Operation</u> – Average annual dose to staff expected to be less than 100 millirem. Maximum dose at the site boundary is estimated to be less than 0.1 millirem/year for scattered radiation and less than 0.01 millirem/year for air releases. Activation of soils and leachate calculated to be below BNL action levels (BNL action levels are 5% of the federal drinking water standards). Controlled through shielding, interlocks and administrative processes, and kept As Low As Reasonably Achievable (ALARA). Radiological accident potential would be minimal.</p>
Environmental Justice	No change from the existing NSLS facility.	<p><u>Construction</u> – No impact to the Environmental Justice requirement.</p> <p><u>Operation</u> - No environmental justice impact or negative economic or health effects on any potentially affected population are anticipated.</p>

Analysis of the potential environmental consequences of construction and operation of the proposed NSLS-II indicates minor impacts to the environment.

### **3.0 PURPOSE AND NEED**

The purpose of the proposed NSLS-II at BNL is to provide an advanced synchrotron light source to study the properties and functions of materials primarily, in the nanoscale range, at a level of detail and precision never before possible. NSLS-II is a new photon source designed to deliver x-rays of unprecedented intensity and brightness. The facility will have a broad impact on a wide range of disciplines and scientific initiatives, ranging from structural genomics through imaging the structure and chemical properties of single atoms within materials. As a unique world-class research facility, NSLS-II is needed to reinforce and enhance the nation's global competitiveness and enable unique research and development with newly-created synchrotron light source technologies. Future progress in nanoscience, engineering and technology is dependent on the development of technological tools such as those proposed for the NSLS-II.

NSLS-II will fulfill a vital national and international need for a cutting-edge synchrotron light source to study and develop new materials with advanced properties. NSLS-II would provide non-destructive tools to image and characterize the structures and interfaces in advanced materials over a wide range of temperatures and pressures. High technology insertion devices, optics, detectors, and scientific instruments envisioned for NSLS-II are expected to result in beam characteristics and instrumentation unmatched worldwide. Photon beams of ultra-high brightness, flux, and exceptional stability will optimize the study of materials with a spatial resolution of one nanometer (nm) and an energy resolution of 0.1 millielectron volt (meV), making it possible to use spectroscopy to view a single atom. The nanoscale resolution of the NSLS-II will explore and characterize the atomic and electronic structure of materials as well as their chemical composition and magnetic properties. The ultra-bright x-rays of BNL's NSLS-II will enable basic and applied research in energy, biology and medicine, materials and chemical science, geosciences and environmental sciences, and nanoscience.

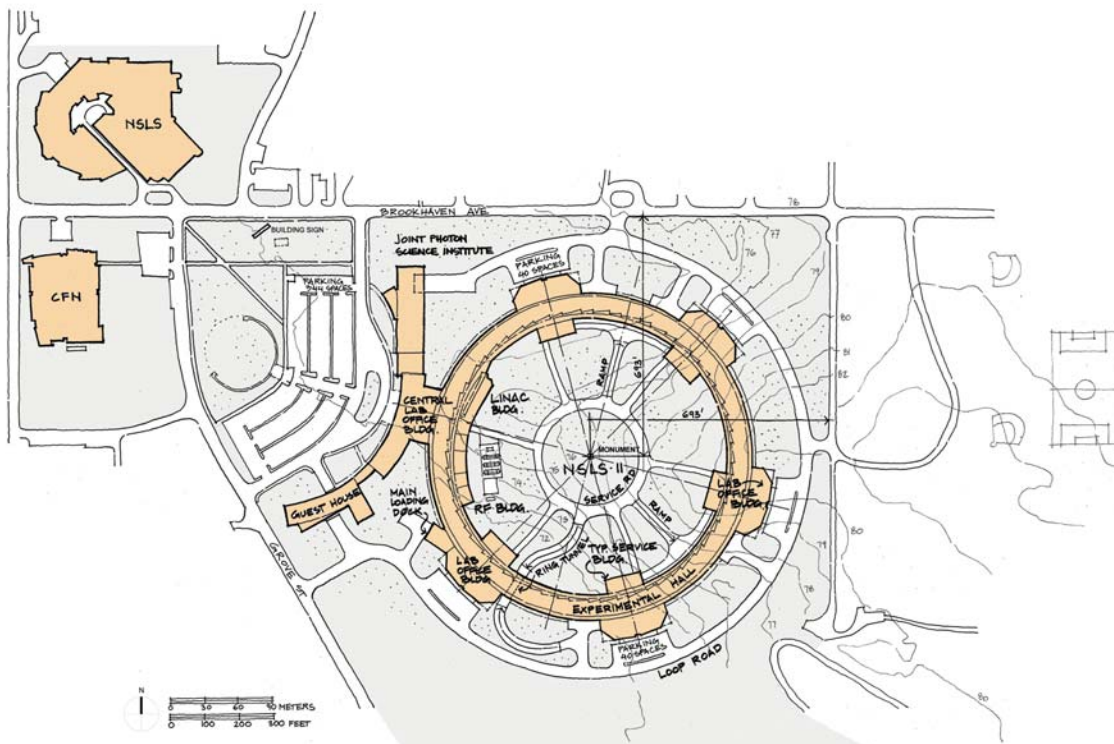
## 4.0 DESCRIPTION OF ALTERNATIVES, INCLUDING THE PROPOSED ACTION

### 4.1 Proposed Action

The Proposed Action would construct and operate NSLS-II, a new state-of-the-art medium energy, 3.0 billion electron volt electron storage ring to study the properties and functions of materials concentrating primarily in the nanoscale range from 1 to 100 nanometers. This synchrotron light source of unprecedented intensity and brightness would provide a source of electrons from a linear accelerator and booster ring assembly to maintain a constant current in the storage ring. The exceptional stability designed into the ring, beamlines, and research equipment would result in stable temperature and synchrotron light intensity conditions for long-duration experiments. The ring is estimated to measure some 2,560 feet (780 meters) in circumference with beamlines on the order of 200 feet (60 meters) in length. Design and engineering will begin in 2007 and construction in 2008. The new facility is expected to be operational in 2013.

#### 4.1.1 Building site location

The 10-12 acre (4.0- 4.9 hectares) area immediately south and east of the existing NSLS would be proposed for construction of NSLS-II (see Figure 3 below).



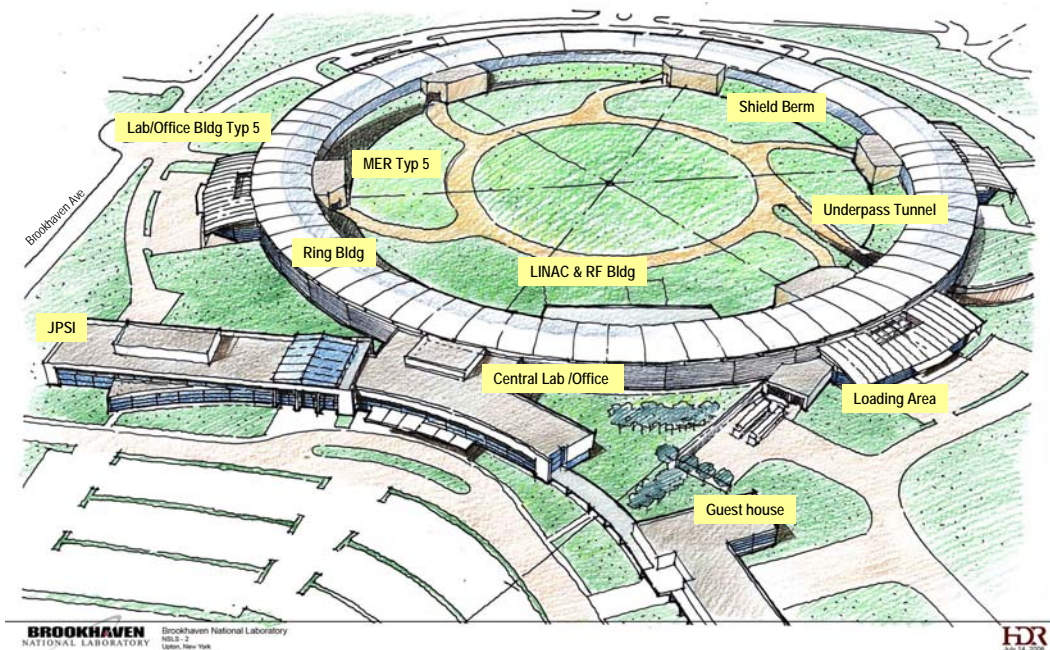
**Figure 3. Proposed siting of NSLS-II relative to the NSLS and the Center for Functional Nanomaterials (CFN)**

Project infrastructure would include connections to utilities such as water, steam, electricity and communications. Electrical power currently available on the BNL site would be sufficient to operate NSLS-II. This power would be delivered to NSLS-II through a new on site 69 kilovolt cable and associated unit substation originating at the Long Island Power Authority (LIPA) feeder near the main on-site substation. Section 5.0

Affected Environment provides additional information on the proposed location. Figure 3 shows NSLS-II outlined in the center to the southeast of the current NSLS building and east of the Center for Functional Nanomaterials (CFN). This location creates a synergistic research and development complex that would further profit by the location nearby of a \$30 million Joint Photon Sciences Institute (JPSI) that New York State has offered to fund if NSLS-II is sited at BNL (see Figure 4 and Section 4.1.10 Connected Actions).

#### 4.1.2 Building design

The NSLS-II facility would include sustainable design principles with the goal of obtaining Leadership in Energy and Environmental Design (LEED) certification. The proposed NSLS-II building would require an estimated circular footprint of 400,000 square feet (37,000 square meters). The central portion of the building would, in part, be returned to grass cover, with roadways covering the remaining surface. Access to the inner area of the building is via a tunnel roadway to be constructed under the building. Parking space of up to 100,000 square feet (9,300 square meters) would be required around the building perimeter.



**Figure 4: Artist's rendering showing the proposed NSLS-II**

The NSLS-II building would include a linear accelerator and booster synchrotron injection system, a main storage ring, beamlines, offices, laboratories and support facilities. Figure 4 shows an artist's rendering of the NSLS-II building, and the relative locations of the NSLS-II Dormitory and the JPSI. The “bump-outs” along the inner and outer circumference of the NSLS-II building show the proposed locations for the mechanical equipment rooms and the laboratory/office modules, respectively. The larger “bump-out” in the building's foreground shows the location of the main entrance and administrative offices. Figure 3 shows the linear accelerator (LINAC bldg.). The booster ring and the storage ring are located along the inner circumference of the building. The beamlines would emerge outward tangentially from the storage ring.



### 4.1.3 Electron Injection System and Storage Ring

NSLS-II will be designed with a full energy, top-off mode injection system. This system would utilize an electron source that feeds a small linear accelerator (linac) to accelerate the electrons up to an estimated energy of 200 million electron volts. The linac would be housed in a small shielded enclosure located approximately 12 feet (3.7 meters) below grade in the infield of the storage ring. The electrons from the linac, at 200 million electron volts, would be transported to a booster ring which would be located in the same shielded tunnel as the electron storage ring. Once in the booster, the electrons would be further accelerated to an energy of 3.0 billion electron volts at which time the electrons would be transported out of the booster and into the electron storage ring. This would occur at frequent intervals to maintain a stable electron current in the storage ring, i.e., top-off mode. NSLS-II would have a single electron storage ring providing synchrotron light spanning from the infrared to hard x-ray energies. The proposed parameters of the storage ring are as follows:

**Table 2. NSLS-II Electron Storage Ring Parameters**

Circumference	780 meters
Energy	3.0 billion electron volts
Current	500 milliamps

### 4.1.4 Magnets

Bending and alignment magnets would guide the electrons in the accelerator system. Bending magnets and magnetic insertion devices would be used to generate the synchrotron light emitted in the electron storage ring. In addition, the insertion devices would provide enhanced synchrotron light intensities and energies at their locations. The NSLS-II storage ring would consist of an estimated 25 insertion device beamlines. Most of the insertion devices in NSLS-II would be low temperature devices, either cryogenic permanent magnet undulators or superconducting undulators.

### 4.1.5 Beamlines

Beam pipes would transport the synchrotron light produced by the magnets in the electron storage ring to experimental stations where the light would be used to examine material samples for research purposes. Initial NSLS-II construction would include five beamlines on the storage ring. In the future, it is expected that at least 25 beamlines would be funded and constructed.

### 4.1.6 Scientific Program

NSLS-II would produce synchrotron light, a very high-intensity, extremely stable, broad-spectrum form of electromagnetic radiation with infrared, visible, ultraviolet, and x-ray energies. NSLS-II would uniquely enable a broad range of scientific inquiry involving research in life sciences, materials sciences, chemical sciences, geosciences and ecology. It would concentrate particularly on science at the “nanoscale,” phenomena occurring on length scales in the range from 1 to 100 billionths of a meter or nanometers. NSLS-II would produce very intense, very bright, well-collimated beams which would allow experimenters to:

- Distinguish features down to 1 nanometer in diameter to allow the study of samples with unprecedented accuracy. Examples range from the electronic

properties of carbon nanotubes to defects in semiconductors to biological samples.

- Measure changes in synchrotron light energies to within 0.1 millielectron volts that would allow the study of dynamics in samples with world-leading precision. In particular, new classes of studies would be possible of the vibrational modes in liquids, polymers and proteins, and atomic vibrations in solids.
- Probe atomic structure, electronic structure, chemical composition, and magnetic properties in a broad range of materials with exquisite sensitivity.
- Investigate surface features. Signals from the surface of a sample are extremely small compared to those coming from the bulk of the sample and can be distinguished given enough intensity. Such studies would be possible at NSLS-II with unprecedented spatial resolution.
- Study sub-surface features. Unlike scanning microscopes, x-rays are able to “see” beneath the surface of samples to study, for example, “buried” interfaces such as those found in many of today’s and tomorrow’s electronic devices.
- High-brightness beams would allow research at the extreme temperatures, pressures, and applied magnetic fields required in materials science and geophysics.
- Handle a high number of samples. Because of the very high intensity beams, many experiments would take significantly shorter times than they have in the past. This would allow many more samples to be examined in a given period, greatly aiding in systematic studies of various problems.
- Research and development would continue for advanced instruments, optics, and detectors to further enhance the facility capabilities.

#### **4.1.7 Operations**

It is anticipated that NSLS-II would operate 24 hours a day, seven days a week. Periods of facility shutdown for routine maintenance and testing would be scheduled to maximize available beam time for the researchers.

The storage ring would serve multiple experiments at a given time, based on the number of beamlines in operation. A staff of about 300-400 and an annual user population of approximately 3500 is anticipated.

In addition to accelerator and beamline operations, many other support operations would be in place including safety systems, mechanical, electrical, vacuum, accelerator, and beamline research and development, instrumentation and administrative support.

#### **4.1.8 Transitioning Operations from NSLS to NSLS-II**

When NSLS-II construction has been completed, equipment, personnel and programs would transition from NSLS to NSLS-II. The major steps in this transition include:

- Continue operations at NSLS until NSLS-II is operational
- Move NSLS programs to NSLS-II; including the transfer of equipment compatible with the operation and requirements of NSLS-II
- Overlap operations while programs transfer over
- Transfer NSLS staff to NSLS-II

#### **4.1.9 Decommissioning of NSLS-II**

Planning for the decommissioning of the NSLS-II facility is described in Section 6.4 Environmental Consequences.

#### **4.1.10 Connected Actions**

##### *Joint Photon Sciences Institute (JPSI)*

In order to fully exploit the unique capabilities of NSLS-II, the JPSI would be established as an interdisciplinary institute devoted to basic research in areas of the physical sciences, engineering, and the life sciences that would be employing synchrotron-based methods. A partnership between DOE and New York State, JPSI would serve as an intellectual center for development and application of the photon sciences and as an entry point for users to NSLS-II. New York State has offered to fund the \$30 million JPSI building if NSLS-II is sited at BNL. JPSI would be located next to NSLS-II and CFN, and would include specialized state-of-the-art laboratories, office space, and meeting areas.

##### *NSLS-II Dormitory*

The NSLS-II dormitory is envisioned as a multistory residence building to provide short-term housing for visiting researchers and users of NSLS-II. Vehicle access, pedestrian access, parking and utility services would be considered during design of NSLS-II. The building would be similar to a small commercial hotel or motel.

##### *Warehouse*

Construction of NSLS-II may require demolition of BNL's remaining materials receiving and handling warehouse, a structure dating to the 1940s. Alternate warehouse space would be located in other existing facilities.

#### **4.1.11 Future Upgrades**

It is possible that based on the needs of NSLS-II, state-of-technology advances and funding availability, several reasonably foreseeable upgrades may be undertaken within the footprint of the existing building to enhance accelerator performance. While it is expected to operate at 500 milliamp stored current, an upgrade to higher current of 1,000 milliamps is a possibility. Another possibility would be to increase the storage ring energy from 3.0 to 3.6 billion electron volts. These would require an evaluation and possible refit of storage ring chambers and apertures, and the installation of increased radiofrequency power and additional shielding. Novel insertion devices or electron beam conditioning optics might also be added to modify the performance of the facility.

##### *Energy Recovery Linac (ERL)*

NSLS-II would operate as an ultra-high brightness electron storage ring. This is made possible by the compact size of the electron bunches (referred to as the beam emittance) stored in the ring. A characteristic limitation of storage rings is the minimum electron

beam emittance that can be achieved. It may be possible in the future to significantly improve the emittance of NSLS-II by providing electrons to the storage ring from a new linear accelerator operating in an energy recovery mode. The possibility of upgrading the NSLS-II in the future through use of an ERL would be explored if and when the technology has proven itself and if the performance characteristics of the ERL would be beneficial for the user community.

#### *Beamlines Beyond the Building Envelope*

It is also possible that beamlines up to 650 feet (200 meters) in length would extend out from the main NSLS-II ring structure to enhance the scientific capabilities of the facility. The construction and configuration of these beamlines would be contingent on whether the scientific need is established at that time. The area south and east of the proposed NSLS-II is largely undeveloped, and therefore, would be suitable for such an upgrade.

#### *General Facility and Equipment Upgrades and Maintenance*

Over the course of five to twenty years from initial commissioning, it would be expected that most of the NSLS-II systems would be maintained and upgraded in order to optimize the operating and research capabilities of the facility. As technology evolves, scientific and support systems and associated components would be improved, and state-of-the-art upgrades made. These systems, along with their associated components, would generally include but not be limited to: accelerators, beamlines, safety related systems, controls, optics, detectors, computers, and diagnostics. In general, upgrades to each system would replace existing components with the latest generation in order to improve efficiency and reliability. The scope of upgrades would include disassembling and removing existing systems, design engineering, purchasing of components, assembly, testing and installation. Programmatic needs may also require upgrades to buildings and would include increasing the office and research space.

## **4.2 No Action**

Under the No Action Alternative, NSLS-II would not be constructed and operated. As a consequence, the DOE mission need for an advanced, state-of-the-art medium energy (3.0 billion electron volts) electron storage ring that produces the brightest x-rays in the world would not be fulfilled. National and global competitiveness in science and technology would be lost. Most importantly, the U.S. would fall behind in the grand-challenge of basic and applied research in biology and medicine, materials and chemical sciences, geosciences and environmental sciences, and nanoscience.

A further consequence of the No Action Alternative would be the withdrawal by New York State of its proposed \$30 million in funding for the JPSI if NSLS-II were not built at BNL. Loss of JPSI would forfeit an intellectual center at BNL and the Northeast as well as the U.S. for development and application of photon sciences and the development of advanced materials for economic and energy security.

## **4.3 In-place Upgrade of NSLS**

An additional Alternative Action of an “In-Place Upgrade” of the current NSLS was not further analyzed. An extensive review of this option was prepared for DOE’s Basic Energy Sciences (BES) in September 2004. The upgrade sought to enhance NSLS performance and capability with construction actions performed primarily within the

existing building footprint and result in minimal changes to keep the facility operational. However, at that time, BES concluded that the upgrade would not meet its overall science mission requirements for a brighter, world-leading photon source with the research and development capabilities such as those proposed for NSLS-II.

## **5.0 AFFECTED ENVIRONMENT**

This section describes the general environment at the proposed site of NSLS-II, along with specific environmental parameters that may be affected by the proposed action. For additional information on the BNL site, including detailed environmental monitoring results, please refer to the Annual Site Environmental Report [SER].

### **5.1 Site Description**

The BNL site encompasses a total of 5,265 acres (2,131 hectares), with most principal facilities located near its central developed area, which occupies approximately 1,656 acres (670 hectares). The balance 3,607 acres (1,460 hectares) of the site are largely wooded and part of the Long Island Pine Barrens.

The proposed location for NSLS-II is in a highly developed portion of the Laboratory that has experienced numerous ground-disturbing activities beginning in 1917 with the construction of World War I Camp Upton. The proposed construction site is relatively flat, with most of the area at the same grade or within four feet (1.2 meters) of the same elevation. The west side of the proposed site contains existing warehouse and office structures that date to the 1940s, along with a small telephone equipment building. Roadways, railroad tracks, paved parking areas, utilities, groundwater monitoring wells and other infrastructure features are also located in the area. The area to the east consists primarily of an open grass field for employee recreational use, e.g., softball fields. The proposed footprint would encompass two small regrowth wooded areas, three acres (1.2 hectares) of wooded areas separating the warehouses and field, and a five acre (2.0 hectares) section immediately south of the field. The geologic makeup of both the Laboratory and proposed project site consists primarily of glacial sands.

### **5.2 Land Use and Demography**

Land use to the east within one mile (1.6 kilometers) of the Laboratory consists of preserved open space, public and private land dedicated to public recreation, and low-density residential areas, one dwelling or less per acre. To the North is a mixture of residential properties, commercial retail and service properties, and public utility services. Institutions consisting of schools and churches, open space, and low-to-medium density residential areas are found to the West. To the South are commercial and industrial properties, vacant land, and medium-to-high density residential areas of two or more dwellings per acre. On-site land use consists of open space, industrial and commercial, agricultural, and residential areas.

Based on data provided in the LIPA's 2004 Long Island Population Survey [LIPA], approximately 39,000 persons live within 2.5 miles (4 kilometers) of the Laboratory's boundary.

The Laboratory's on-site population includes approximately 2,700 employees and more than 3,500 guest researchers that periodically visit each year. An average of 180 people live in temporary on-site housing, and an average of 160 guest scientists and students who visit the laboratory stay in the Lab's dormitories.

### **5.3 Water**

Water resources associated with BNL include both surface waters and groundwater.

#### *Surface Water*

The BNL site lies within the headwaters region of the Peconic River watershed. Liquid effluents from the BNL Sewage Treatment Plant (STP) discharging into the Peconic River receive tertiary treatment and conform to the criteria in the approved State Pollutant Discharge Elimination System (SPDES) permit issued by the New York State Department of Environmental Conservation (NYSDEC).

Pocket seasonal wetlands are also found throughout the site. The nearest regulated wetland (Basin HW), a smaller NY State Class I wetland, would be approximately 1200 feet (360 meters) from the proposed NSLS-II. Federal designated wetland TS-W6a is located approximately 2,600 feet (792 meters) southeast and down gradient from the proposed project site.

#### *Groundwater*

The BNL site is situated over a U.S. EPA-designated sole source aquifer that is the primary source of drinking water for both on- and off-site private and public supply wells, and water for industrial use such as cooling and steam generation. In the area proposed for NSLS-II, ground surface is 73 feet (22 meters) above sea level and the top of the groundwater table ranges from 38-47 feet (11-14 meters) above sea level.

Past practices resulted in contamination of the groundwater with volatile organic compounds (VOCs) and radionuclides at various locations of the Laboratory site. The High Flux Beam Reactor (HFBR) tritium plume is currently situated along the western edge of proposed location of NSLS-II and 20 feet (6.1 meters) below the water table or 50–55 feet (15.2-16.8 meters) below grade [SER]. NSLS-II is not expected to impact current groundwater conditions during construction or operations.

### **5.4 Climate**

Climate can influence several environmental parameters including regional and local air quality, stormwater drainage, surface waters, and natural hazards.

The climate at the Laboratory can be characterized as breezy and well-ventilated, like most of the eastern seaboard. The Long Island Sound, the Atlantic Ocean, and associated bays influence wind directions and humidity and provide a moderating influence on extreme summer and winter temperatures. The prevailing ground-level winds are from the southwest during the summer, from the northwest during the winter, and about equal from these two directions during the spring and fall [Nagle, 1975; 1978].

The BNL Meteorology Group has been recording weather data since August 1948 to serve the needs of this DOE site. The average yearly precipitation is 48.53 inches (123.3 centimeters) and the average yearly snowfall is 31.2 inches (79.35 centimeters). The average monthly temperature is 50.1° Fahrenheit (10.1° Celsius). Additional historical meteorological data are available from the BNL Meteorology Group webpage [MET].

## **5.5 Air**

The overall regional air quality is affected by a mix of maritime and continental influences. This results in the region, and the BNL site, being very well ventilated by winds from all directions.

The local air quality management in the New Jersey-New York-Connecticut Interstate Air Quality Control Region, which includes Suffolk County and BNL, is in attainment with most National Ambient Air Quality Standards (NAAQS) for criteria pollutants, which include sulfur dioxide, nitrogen oxides, particulate matter, lead, and carbon monoxide. The region is considered a non-attainment area for ozone.

## **5.6 Ecology**

A portion of the proposed NSLS-II construction area is used by one or two pair of killdeer (*Charadrius vociferous*), a migratory bird, for nesting in the spring.

No threatened or Endangered Species are known to be present in the immediate area proposed for NSLS-II. However, depending on the final proposed footprint, the developed area may extend up to 400 feet (122 meters) into the northeast edge of a 1000 foot (305 meter) administrative buffer area that surrounds eastern tiger salamander habitat associated with recharge basin HW. Across the Laboratory, twenty-two breeding sites were confirmed for the New York State endangered eastern tiger salamander (*Ambystoma t. tigrinum*) [BNL 2003].

An asphalt-lined channel, located approximately 500 feet (150 meters) west of the proposed NSLS-II site, collects stormwater runoff from the area and discharges into recharge basin HS, a confirmed tiger salamander habitat. Recharge basin HS is monitored under NYSDEC - SPDES permit #NY 0005835 [SER].

## **5.7 Cultural Resources**

The *Cultural Resource Management Plan for BNL* (CRMP) [BNL 2005] identifies the Laboratory's historic and cultural resources, and describes the strategies developed to manage them in accordance with applicable laws and regulations. Because most of the proposed project site has seen minimal disturbance since the founding of BNL, there may be a moderate to high potential for the presence of twentieth century archeological deposits, including the eras of World War I (1917-1921) and World War II (1940-1946) Camp Upton, and the Civilian Conservation Corps (1934-1936) [Merwin].

Five buildings over 50 years old, including warehouse structures (Buildings 87, 100, 209, 210) and office Building 211 are located within the proposed footprint for NSLS-II construction activities. None of the structures currently located within the proposed project area have been determined eligible for listing on the National Register of Historic Places.

## **5.8 Radiological Characteristics**

The radiological characteristics of the BNL site are presented below as an overview of BNL's monitoring efforts in order to provide a baseline for potential environmental affects.



The radiological characteristics of BNL operations are determined through routine and permit-based monitoring efforts. Water discharged from the Sewage Treatment Plant is routinely monitored at the plant's Peconic River Outfall. In 2004, all effluents were found to be less than the Safe Drinking Water Act limits of four millirem annual dose limit for gross beta, fifteen picocuries per liter for average gross alpha activity, and 20,000 picocuries per liter average tritium concentration.

BNL utilizes ten recharge basins permitted under SPDES to discharge once-through cooling water, cooling tower blow-down, and stormwater runoff. Routine monitoring of these basins indicated no elevations of gross radiological activity. No gamma-emitting radionuclides attributable to BNL operations were detected [SER].

BNL is subject to the requirements of 40 CFR Part 61, Subpart H, National Emission Standards for Hazardous Air Pollutants (NESHAP). The U.S. Environmental Protection Agency (EPA) established a national policy on the airborne emission of radionuclides, and a dose limit to the public of 10 millirem/yr for the airborne pathway. The effective dose equivalent from all air emission sources at BNL for 2004 was calculated to be 0.044 millirem, far below the allowable limit [SER].

### 5.9 Natural Hazards

Natural phenomena, which could lead to operational emergencies at BNL, include hurricanes, tornadoes, thunderstorms, snowstorms, and ice storms. Hurricanes occasionally hit Long Island and the high wind speeds associated with them are most likely to damage structures. Record high winds for BNL were recorded during Hurricane Carol in September 1954 [Hoey]. Tornadoes and hailstorms are extremely rare on Long Island. Thunderstorms, snowstorms, and ice storms do occasionally occur, and have the potential to cause significant damage to facilities.

The banks of the Peconic River, which traverse portions of the eastern side of the BNL site, are within the Federal Emergency Management Agency designated 100-year floodplain [FEMA]. The proposed location for NSLS-II is approximately 6,000 feet (1,828 meters) from the closest part of the river and 33 feet (10 meters) higher in elevation.

Earthquakes on Long Island are extremely rare, and no active earthquake-producing faults are known in the Long Island area [Hoey]. Long Island lies in a zone 2 or moderate damage seismic probability area and it is assumed that an earthquake of Modified Mercalli VII could occur [HFBR EIS]. A recent history of earthquakes in the central Long Island area is presented below [USGS]:

**Table 3. Recent History of Earthquakes in the Central Long Island Area**

<u>Year</u>	<u>Date</u>	<u>Intensity - Modified Mercalli</u>
1925	Feb 25	I-III
1929	Nov 18	I-III
1935	Nov 1	I-III
1937	Jul 18	I-III

1944	Sep 5	I-III
1950	Mar 29	I-III
1951	Jan 25	I-III
1985	Oct 19	IV-V (4-5 on Richter scale)

The likelihood of a serious earthquake in the BNL area is slight and seismologists expect no significant earthquakes in the foreseeable future [Hoey].

### **5.10 Socioeconomic and Transportation Conditions**

BNL employs approximately 2700 full and part-time personnel and has over 3500 visiting researchers annually. An additional 40,000 members of the public visit the Laboratory site each year as part of educational and group tours, conferences and events. Direct spending of \$454.4 million by BNL in fiscal year 2004 caused a total output of goods and services to the region to expand by more than \$800 million. Earnings increased by more than \$308 million and more than 7,700 secondary jobs were created throughout the economy [Kamer].

BNL staff and the majority of visitors commute in their own private or rental vehicles. The Laboratory operates and maintains a fleet of approximately 340 vehicles, ranging from cars and light trucks to delivery, construction and heavy equipment machines. Included in the BNL fleet are 77 alternative-fuel vehicles, which account for 48% of the light duty vehicles and roughly 23% of all of the vehicles. The general public is restricted from access to the BNL site, unless participating in a scheduled event. Commercial delivery and construction and service contractor vehicles are permitted access to the site as necessary.

## **6.0 ENVIRONMENTAL CONSEQUENCES**

### **6.1 Proposed Action**

As appropriate, sections below are divided into Construction and/or Operation. The environmental impacts associated with construction of the NSLS-II facility would take place over an approximate five-year period. Commissioning and operations would commence once the construction phase has been completed. Many of the anticipated environmental impacts associated with NSLS-II operations are based, due to the similarity of many operational aspects, on the 24 years of experience in operating the existing NSLS. Implementation of planning, control and mitigating activities, identified in the following sections, would reduce the overall environmental impacts associated with NSLS-II. Construction and operation of the Proposed Action would, therefore, be expected to result in slight or minor impacts to the environment.

It should be noted that, in addition to this Environmental Assessment, a detailed analysis of other safety and health hazards would be made as the design, construction, and operation of the facility progresses. A series of safety assessment documents would be prepared, beginning with the Preliminary Hazards Analysis which would be developed during the conceptual design of the facility. As design and engineering progresses, more detailed safety assessment documents would be prepared that identify the hazards associated with the facility and establish appropriate controls to mitigate all hazards. Prior to operation of the accelerators, a detailed readiness review would be completed which determines that all required safeguards identified in the safety assessments would be in place. These reviews would also ensure that all required safeguards from an environmental perspective have been provided.

#### **6.1.1 Soils**

##### Construction

Approximately 20,000 cubic yards (15,300 cubic meters) of soil/sand may be required for the NSLS-II building to be used as fill under the floor slab. An estimated 10,000 cubic yards (7,650 cubic meters) of additional sand may be used for concrete for the building structure. Construction efficiencies may warrant establishing a temporary concrete mixing plant at BNL with sand obtained from the project site. Sources of sand may include grading and excavation associated with building construction, landscape design, extension of utilities, and creating new and/or enlarging existing recharge basins to accommodate NSLS-II storm runoff. All areas would be reclaimed concurrently with excavation or soon thereafter.

Based on the current design and geotechnical data, the need for additional sand is not anticipated. If it is determined that additional sand is required beyond that available from the project site, the source(s) would be evaluated. A NYSDEC Mined Land Reclamation permit would be obtained if necessary. Areas where topsoil is removed would be stabilized with gradual grades and return of topsoil to promote regrowth of indigenous vegetative species.

Standard erosion-control practices, such as hay bales and silt fencing, would be employed to mitigate the impacts of construction on soils, and nearby surface waters, when

necessary. Upon completion, all open areas would be restored by regrading topsoil and seeding with native grasses or plantings, as appropriate.

### Operation

Information is available in section 6.1.15 Radiological Impacts.

### **6.1.2 Water**

#### Construction

During the construction phase of NSLS-II, water would be used to mitigate dust production, in addition to other routine construction applications. The operation of a temporary concrete mixing plant would require an estimated water usage of about 5300 gpd (See Table 4 below). Existing BNL procedures and review processes would be used to evaluate the applicability of NYSDEC permits, and monitor/control any effluent discharges associated with a concrete plant. Water demands during construction would be met using BNL's existing water supply system which has ample reserve capacity. Federal designated wetland TS-W6a is located approximately 2,600 feet (792 meters) southeast and down gradient from the proposed project site. The general topography of the construction site is level with a mean elevation 76 feet (23 meters) above sea level. This level terrain continues for approximately 800 feet (250 meters) in the easterly direction at which point the topography slopes down to the wetland which is at an elevation of 50 feet (15 meters) above sea level. Storm water runoff potentially may flow along Brookhaven Avenue, which runs along the north side of the project site, and eventually to the wetlands.

Storm water runoff from the construction site would be controlled using standard erosion control measures, including silt-fencing and hay-bales. Due to the potential for runoff to a regulated surface water, the need for a SPDES General Permit #GP-02-01 for Construction Activity would be evaluated and applied for, if necessary.

Depth to the water table in the proposed construction area would be approximately 26-35 feet (7.9-10.7 meters). None of the proposed structures would be deeper than 18 feet (5.5 meters) thus no direct impacts to groundwater or dewatering actions would be anticipated.

Since the BNL High Flux Beam Reactor (HFBR) tritium plume is approximately 20 feet (6.1 meters) below the water table or 50-55 feet (15.2-16.8 meters) below grade in the vicinity of the Proposed Action, there would be no potential for human contact with the contaminated water, either directly or indirectly through exposure to water vapors. The proximity of NSLS-II to the HFBR tritium plume would, therefore, not affect human health of the construction workers or building occupants. The depth of the plume would also preclude any direct effects from construction actions and structures on the plume. The potential for stormwater to affect migration of the tritium plume would be evaluated during the planning processes. The stormwater system would be designed to ensure the tritium plume and any other contamination plumes would not be affected.

Water quality sampling wells currently within the construction footprint would be relocated. New well locations would be established, as needed, to ensure effective monitoring of contaminant plumes, and meet existing regulatory requirements.

### Operation

Historical water consumption rates for the Laboratory have steadily declined over the past 10 years with a peak rate in 1995 at 3.7 mgd (14 million liters/day). As presented in Table 4 below, the estimated increase in water usage during both construction and operation of NSLS-II would have a minimal impact on the available water supply for the Laboratory, and would not require installation of any new supply wells. During full operation of NSLS-II, a total estimated water usage of 0.3 mgd (1.1 million liters/day) would be expected for personnel potable use, comfort and experimental system cooling, building plumbing fixtures, and experimental processes. The majority of water used for accelerator and comfort cooling would be recirculated in closed-loop systems. A small amount would be used in single pass systems if other cooling systems were not operational. Estimated chilled water needs are discussed in the Commitment of Resources section below. The total increase in water demand would be evaluated in accordance with the established protocols to ensure any changes in well-use would not alter known contaminate plume patterns. Total BNL water consumption would continue to be well below historical rates and BNL's current capacity. No new wells would be developed as a result of NSLS-II construction or operation. The capacity of existing wells would suffice as permitted. The BNL Water and Sanitary Planning committee oversees water usage, the balance of wells in use, and recharging of storm and cooling water.

**Table 4: BNL Water Supply System Capacity and NSLS-II Estimated Water Usage**

<b>CRITERIA</b>	<b>VOLUME</b>
BNL Capacity	5.1 mgd
BNL Current Usage	1.4 mgd
NSLS-II Construction – Estimated Usage	6,000 gpd
NSLS-II Operation – Estimated Usage	0.3 mgd

Operation of NSLS-II would increase the effluent discharge to the sanitary waste stream, due to the increase in staff and scientific users, along with a potential increase in the number of experiments. The estimated increased discharge of 10,000 gpd (37,850 liters/day) would increase the current total Laboratory discharge rate of 330,000 gallons/day (1,250,000 liters/day). However, it would be well within the three mgd (11,356,000 liters/day) capacity of the plant and would have a minor impact. NSLS-II will incorporate LEED criteria for water use reduction which may reduce the current estimated increase for water use or discharge.

Approximately 10 – 40 gpm (38 – 151 liters/min.) of water would be used for accelerator and comfort cooling. This includes water used in both once-through cooling systems and cooling tower blow down. This waste water would be discharged to the BNL sanitary system and would be treated prior to discharge to the Peconic River. Under worst case assumptions, an increase of 58,000 gpd (220,000 liters/day) of discharge to the Peconic River is still well within the 3.0 million gallon per day capacity of the sewage treatment plant.

Storm water run-off from NSLS-II would be managed through a combination of local recharge and through discharge to two existing recharge basins (Basins HS and HW), both of which are permitted to receive storm water run-off and are monitored under NYSDEC - SPDES permit #NY 0005835, Outfalls 005 and 008, respectively [SER]. Due to the increase in impermeable surfaces, storm water discharge may increase by an estimated 500,000 gallons (1,893,000 liters) per the traditional construction standard 2-inch storm event. Engineering and environmental evaluations would be conducted to determine whether these basins would have sufficient capacity to handle the estimated increased flow, or if additional water management means, such as redirecting to other recharge basins or constructing a landscape pond, need to be considered.

The storage of toxic or hazardous materials at NSLS-II would meet the requirements of Suffolk County Sanitary Code Article 12 – Toxic and Hazardous Materials Storage and Handling Controls and NYS Chemical Bulk Storage requirements (6NYCRR Part 597), as applicable. This would include proper registration, posting and secondary containment of tanks containing oil, diesel fuel and chemical treatment fluids. Work planning, process assessments, experiment safety review and training are methods that have proven successful for ensuring that hazardous effluents do not make their way into either the sanitary waste stream or stormwater system. These programs would be implemented as part of the facility Environmental Management Program. Occasionally an experiment would involve small quantities of radioactive material. Such experiments would be highly controlled by specific facility procedures and the likelihood of these materials entering the sanitary or groundwater systems would be remote due to strict procedures.

Additional information is available in section 6.1.15 Radiological Impacts.

### **6.1.3 Air Construction**

There would be a temporary increase in emissions due to construction and delivery vehicles, and other equipment such as electrical generators. Airborne dust would also be generated as a result of excavation and vehicle traffic on unpaved surfaces. Dust generation would be controlled, as needed, by spraying water on soil surfaces. Refer to Section 6.1.7 Transportation - Construction for additional information on the estimated number of vehicles.

A review of both construction and facility operations would be performed to determine if the potential emissions of the project would exceed pollutant thresholds required in 40 CFR Part 93 Subpart B. If a conformity analysis is necessary under the regulation, calculations will be done to determine the potential impact of construction and facility operations emissions on regional air quality. Any permit (e.g., NYSDEC Air Facility Permit), mitigation or regulatory actions identified as a result of the analysis would be implemented as necessary. Because no new air emission sources, other than lab hoods, would be constructed as part of the proposed action permanent facilities, there should be no impact on the existing Clean Air Act Title V permit for the Laboratory. The temporary concrete mixing plant, if built and operated, would be supplied with emission controls as required by 6NYCRR Part 201.

## Operation

There would be some small increased emissions due to the use of steam, chilled water and electricity (see Section 6.3.14 below) by operation of the proposed facility. When NSLS-II is fully operational, air emissions from the BNL Central Steam Facility (CSF) would be expected to increase by an estimated 5% as compared to current CSF emissions. Even with this anticipated increase, CSF emissions would be well below permitted and historical levels [SER].

Products emitted to the ambient air from hoods or hatches would typically consist of trace emissions of evaporated solvents, acids and other chemicals. These emissions would be associated with research and development activities, and, would therefore, be exempt from Federal and New York State permitting requirements.

Experiments and work undertaken at the NSLS-II would be reviewed to identify and manage the types and quantities of chemicals used. A proactive pollution prevention program would consider the use of alternative chemicals to mitigate or reduce emissions. Quantities of chemicals brought to the NSLS-II experiments would be kept to the minimum necessary through experiment safety review. Gases would be used for experimental purposes. These gases would consist in large part of nitrogen, helium and argon, and would typically be used to provide inert or non-reactive atmospheres for experiments. Small amounts of other gases with reactive or toxic properties could also be used in experiments. Their use would undergo experiment safety review and controls, such as minimizing quantities and proper ventilation or filtration, as needed, would be imposed to ensure the safety of the workers and minimize the impact to the environment.

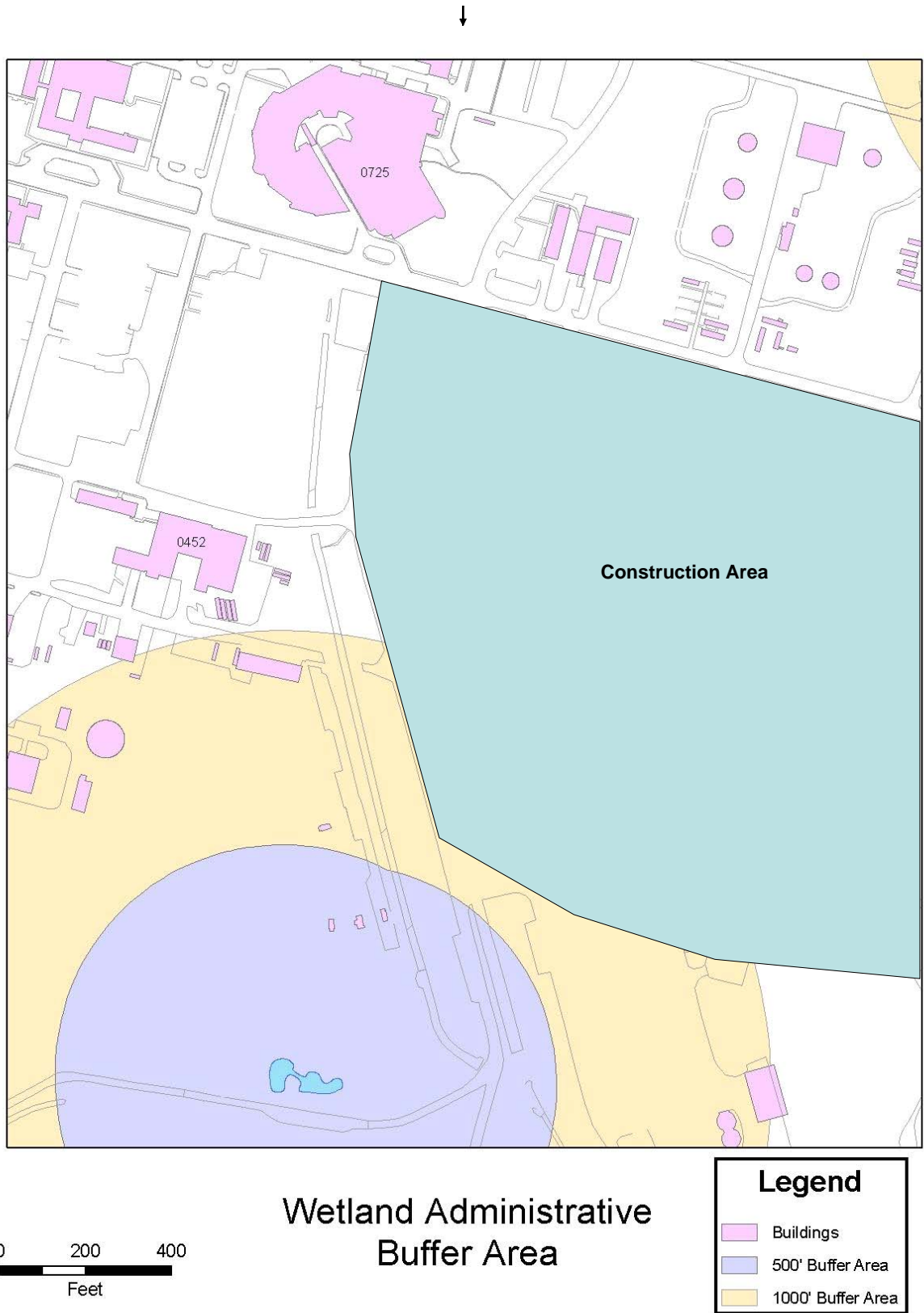
Liquid nitrogen and liquid helium would be used for keeping experimental samples, such as protein crystals, cold. These cryogenics would also be used to cool beamline equipment, such as detectors, and in closed-loop systems to cool accelerator components such as magnetic insertion devices. Workers would be trained in the proper handling of cryogenics. Enclosed spaces containing cryogenics would be monitored for oxygen deficiency and ventilated if needed for the protection of the workers.

Administrative programs would ensure that potential emission sources are reviewed in accordance with applicable air emissions SBMS Subject Areas. Additional information is available in section 6.1.15 Radiological Impacts.

## **6.1.4 Ecology**

### Construction

The NYSDEC requires that any work within 1,000 feet (305 meters) of a known tiger salamander breeding pond be evaluated for potential impacts to this New York State designated endangered species, and any disturbance of habitat is limited to no more than 50% of the area within 1000 feet of a known breeding pond. The current footprint for the Proposed Action would overlap the northeast quadrant of the 1,000 foot NYSDEC buffer area surrounding recharge basin HW (also known as TS-7), by about 400 feet (122 meters). The majority of this overlap region has been previously disturbed from activities



**Figure 5. Tiger salamander 1000 foot wetland administrative buffer area with outline of proposed NSLS-II construction site**



extending from 1917 to the present. It is expected that any disturbance from construction would not increase the disturbed area and there would be no net decrease in the amount of habitat available to the tiger salamander. Based on the amount of existing impervious surfaces located in the overlap region, and that no additional area would be disturbed, the proposed construction would likely have only a minor or not any impact on the tiger salamander.

The potential effect of construction actions on the killdeer (*Charadrius vociferous*) migratory bird nesting area, located along the western edge of the proposed project area, would be minimized by initiating construction and disturbance prior to or after spring nesting season. Disturbance of the nesting area during the spring season would require approval of the appropriate regulatory agencies. Numerous areas of the BNL site contain habitat similar to the pebbly surfaces favored as killdeer nesting sites. Therefore, the permanent loss of this particular nesting site would have a minor impact on the killdeer.

Trees removed from existing wooded regrowth areas would be recycled and composted. The proposed construction site, as well as potential sand removal locations, consists of previously disturbed areas and existing impervious surfaces. No Threatened or Endangered Species are known to be present. Therefore, slight to no effects on the overall ecological resources would be expected.

#### Operation

The overall increase in water to recharge basin HS may have only a slight effect on the tiger salamander habitat. The increased flow would help ensure the basin retains water through prolonged periods of dry weather, which would be beneficial to the salamanders.

### **6.1.5 Cultural Resources**

#### Construction

Since the proposed site for NSLS-II may have a moderate to high potential for the occurrence of Twentieth Century archeological deposits related to Camp Upton or the Civilian Conservation Corps, the need to perform an archeological survey would be evaluated. Any artifacts resulting from the survey would be appropriately curated and stored as prescribed in the BNL Cultural Resource Management Plan (CRMP).

Five buildings over 50 years old, including warehouse Buildings 87, 100, 209, 210 and office Building 211, may be demolished to prepare the site for NSLS-II construction activities. Section 106 Reviews have been performed for these buildings in accordance with the National Historic Preservation Act, and submitted to the NY State Historic Preservation Officer (SHPO). As described in the *Cultural Resource Management Plan for BNL*, the SHPO has indicated that the BNL World War II-era structures do not retain enough integrity to convey their historic function and are therefore not considered eligible for listing on the National Register of Historic Places. Although these structures are not eligible for listing, they do represent a specific time period in the history of the BNL site. The BNL cultural resource program has committed to develop documentation packages as select World War II-era structures are demolished. Documents associated with the buildings identified above would be included in packages that typically contain

the earliest available photographs, current photographs, references to available architectural drawings, and descriptions of various building uses [BNL 2005].

There would be no impact to cultural resources that have been determined eligible for listing on the National Register of Historic Places.

#### Operation

Slight to no impacts to the environment are expected.

### **6.1.6 Socioeconomic Factors**

#### Construction

Total project funding, estimated at \$600-800 million, would directly benefit the local construction and statewide manufacturing organizations. Secondary economic benefits would also be realized through increased personal spending, wages and the creation of new jobs across a variety of industries and economic sectors.

#### Operation

Operational and equipment spending would have an overall positive impact on both the local and statewide economies. Preliminary annual operating costs are estimated to be \$100 million in 2013 dollars, which would include staff, and facility and equipment operating and maintenance costs. Industrial and manufacturing industries would benefit from equipment and supply orders resulting in increased personal spending, wages and the creation of new jobs across a variety of industries and economic sectors.

When fully operational, the NSLS-II would result in an estimated increase of 100-200 staff and 1,000 guest researchers. The makeup of the users would be expected to be from more than 400 institutions and from over 30 countries worldwide, 70% of the institutions from the United States. Based on BNL's 2005 expenditures, the estimated 7% increase in BNL staff would result in an increase of about \$20 million, in 2005 dollars, in employees' salaries, wages, and fringe benefits. Since most employees live locally, the majority of those funds would be spent on Long Island. The visiting scientists generally stay on or near the Laboratory site and would also help to fuel the local economy [Kamer 2005].

### **6.1.7 Transportation**

#### Construction

Construction activities would result in a temporary increase in the number of vehicles entering the BNL site each day, including workers and material deliveries. The magnitude of increase would vary depending on the timing of the specific construction phase. The initial ground-clearing phase could involve an increase of approximately 10-20 vehicles. The numbers would then scale up as multi-trade activities are underway, eventually reaching a potential high of 250-300 workers. Heavy construction vehicles such as bulldozers and cranes would be brought on site and remain only for their specific period of use. The total number of additional delivery vehicles would depend on whether a concrete mixing plant is temporarily located on the BNL site during the construction phase, and also whether sand is obtained from on-site locations.

Access to the BNL site from surrounding areas is primarily from the Long Island Expressway, I-495, and the four-lane divided William Floyd Parkway, County Road 46. These major routes would be considered more than adequate to handle the slight increase in traffic.

Once onsite, access to the construction site would be provided through a designated traffic route in order to avoid the primary site roadways utilized by BNL staff and researchers. This route would be the existing one for delivery trucks to the BNL site and is capable of conveying vehicles of this size and type.

### Operation

NSLS-II would be expected to operate a small fleet of trucks and vans. As funding allows, the gasoline-powered vehicles could be changed for alternate fuel vehicles such as compressed natural gas and electric. Laboratory and commercial vehicles picking up and delivering materials and service personnel would also visit the facility.

Since most workers and guests commute in their own, private vehicles, the number of NSLS-II staff and guest researchers would result in an increase in vehicles traveling to and from the BNL site. Staffing levels at BNL have steadily decreased from a high of about 3500 in the 1980s to a current figure of some 2700 employees. The increase in staff and users resulting from the Proposed Action would remain less than the historical high. Therefore, the corresponding increased number of vehicles may have only a minor impact.

### **6.1.8 Visual**

#### Construction and Operation

Large scientific facilities and structures have been constructed on the BNL site since the late 1940s. The surface elevation of the NSLS-II proposed location would be equal to or slightly less than that of BNL's core developed area. The NSLS-II building would be a low-profile structure, two-stories high, and would be located near the center of BNL's 5,265 acre (2,131 hectares) site. The proposed facility would not be seen from off-site due to the extensive wooded buffer surrounding the Lab's core developed area, and the distance of about 5,000 feet (1,524 meters) from the proposed site to the nearest public road.

The Proposed Action would not be expected to have an adverse visual impact either on or off the laboratory property.

### **6.1.9 Construction Hazards**

#### Construction

Industrial hazards associated with the construction phase of the Proposed Action would be typical of those experienced at any general mid- to large-scale construction activity; these would include electrical, mechanical, elevated work, noise and lifting hazards. Prior to the start of construction, the selected contractor would establish a Health and Safety Plan with BNL. The contractor would be required to comply with applicable BNL ESH Standards, DOE Orders and regulatory requirements. The contractor would establish an Accident Prevention Program as well as an Environmental Protection Program that would include:

- Use of containment for spill intervention
- Proper storage and handling of hazardous materials
- Proper documentation of operations, maintenance and repair of equipment
- Retention systems for leaking and loose fluids, and
- Use of concrete or blacktop for overnight storage of vehicles

In addition, a review would be performed to identify all pertinent ESH issues that must be addressed during construction and would include:

- Environmental review
- Industrial safety review
- Facility issues
- Waste management
- Industrial hygiene issues
- Operational requirements
- Operational readiness evaluation

Noise from excavation equipment would be limited locally to the immediate construction area.

### **6.1.10 Operational Industrial and Experimental Hazards**

#### Operation

Industrial and experimental hazards associated with NSLS-II operations would include: fire, electrical, non-ionizing radiation and ionizing radiation, magnetic fields, noise, lasers, confined spaces, material handling, oxygen deficiency, gases and chemicals, toxic metals such as lead and beryllium, and cryogenics. Integrated Safety Management (ISM) or its equivalent at the time of NSLS-II operations would provide the structure for work planning conducted at NSLS-II. Work would be defined, the hazards to the workers/environment/equipment would be identified, the resulting risks for injury would be assessed, the controls to minimize or mitigate these hazards and reduce the risks would be developed, the work would be conducted within the scope of the controls, and feedback and improvement for the next cycle would be provided. Analysis by industrial hygienists would be used to assess a worker's exposure to a particular hazard and would allow a choice of substituting a less hazardous condition, an engineered control, an administrative control or personal protective equipment to bring the risk to the worker to a minimal level.

An experiment safety review process would capture NSLS-II experiments, assure hazard assessment and define requirements to control risks. NSLS-II is expected to conduct approximately 1,500 experiments per year with a significant proportion of them being in the structural biology and nanoscience fields. The risks presented by the routine biology experiments would be limited, well defined, and easy to control. The use of toxins or infectious agents in some of these biology experiments would be expected. Only materials designated as Biosafety Level 1 or 2 would be authorized and would be accommodated with the facilities available at a typical beam line.

#### Nanoscience

NSLS-II would ensure that operations involving nanomaterials would meet all precautionary requirements for the transport, use, storage, and disposal of these materials. Operations and processes with nanomaterials would be performed using appropriate engineered and administrative controls. The existing NSLS-II work planning and experiment review processes would ensure work with nanomaterials is done safely and

without harm to the public, environment or workers. Planning for work or experiments with nanomaterials would include specific requirements, as needed, for static or High Efficiency Particulate Air (HEPA) filtered ventilated enclosures or other forms of containment to prevent risk of exposure from the generation of airborne particulate concentrations. Environmental, health and safety controls and procedures for nanomaterials would be reviewed and revised as new processes or equipment are introduced.

### **6.1.11 Operational Accidents and Natural Hazards**

#### Operations

BNL maintains an extensive emergency management program that encompasses planning for and response to accident and natural hazard events. Assessment and mitigation of potential environmental impacts is a component of the response system. Incidents would be reviewed to determine causal factors and their root causes. Corrective actions would be established to improve work practices and to reduce the chances of recurrence. A Lessons Learned program would be in place to disseminate useful information to staff.

Hazards to workers, members of the public, the facility and the environment; the controls that would be implemented to reduce or eliminate the hazards; and the resulting risk levels have been examined in the existing NSLS Safety Assessment Document and worker occupational health and safety program (OHSAS). These conditions would be expected to be similar for the proposed NSLS-II. Similar analyses would be conducted for NSLS-II and overall risk to workers, the public and the environment would be mitigated to the greatest extent possible and expected to be low.

#### *Recordable Injuries*

The injuries and accidents to personnel that are reasonably foreseeable at NSLS-II would include slips, trips and falls; repetitive motion injuries; and injuries due to assembly or disassembly or operation of equipment and machinery. On the order of one to no recordable injuries per year would be expected with little or no impact to the environment. Training of workers, inspections of the work areas, and work planning would be an important part of the NSLS-II ESH program to reduce injuries to personnel.

#### *Fire*

Like any industrial facility, fire would have the potential to impact facility personnel, operations and the environment. The NSLS-II fire protection program would be based on the Fire Protection Assessment and Fire Hazard Analysis developed by the BNL Fire Protection Engineer. NSLS-II fire protection requirements would meet all applicable BNL and DOE requirements, and include sprinklers, heat and smoke detectors, fire rated walls and doors, and adequate egress. Control Room personnel would investigate alarms and assist Fire and Rescue personnel with the location of alarming zones and the nature of the associated equipment. Regular safety inspections, experiment reviews and scheduled preventive maintenance would minimize the potential of fire and any impact to the environment.

#### *High Voltage*

Operations and research activities associated with the NSLS-II facility would require considerable high voltage and high power electrical equipment. This equipment would

be designed and operated consistent with BNL and DOE requirements to minimize injuries to personnel, and to minimize equipment or facility damage resulting from malfunction. Workers would be trained to identify and control potential electrical hazards associated with their work. Worker safety requirements are based on the National Fire Protection Act (NFPA) 70E Standard for Electrical Safety in the Workplace. Equipment would be certified or reviewed by NSLS-II Electrical Equipment Inspectors following Nationally Recognized Testing Laboratory (NRTL) guidelines. Electrical distribution would be designed and installed to meet the NFPA 70 National Electric Code.

### *Spills*

It is anticipated that spills of chemicals or hazardous fluids would be rare, and their impact on the environment is reasonably foreseen as minimal. Spills and their effects would be minimized, where possible, by educating workers and facility users, reducing quantities of fluids in use, substituting less hazardous materials, providing adequate storage and containment, and providing proper waste facilities. In addition, NSLS-II ESH and Control Room personnel would be trained in spill response procedures.

### *Natural Hazards*

Potential natural hazards have been outlined in Section 5.9 above. Operational emergencies due to natural hazards would not involve a significant release of or loss of operational control of hazardous or radiological material. In such an emergency, the BNL Emergency Management System would address emergency response, personnel evacuation, and facility status issues. Typical severe weather-related phenomena would affect the stability of the electrical power supplied to the accelerators. This would impact accelerator magnet power supplies and could result in the loss of the stored electron beam in the accelerators. Shielding surrounding the accelerators would be designed to protect personnel and the environment from such losses. Electrical power fluctuations, either weather-related or caused by public utility problems, would be expected to occur approximately monthly. If BNL declares a weather-related operational emergency, such as a hurricane, recommending that staff evacuate the site, ring operators would turn off all accelerators. The potential for severe facility damage due to floods or earthquakes is remote. The proposed NSLS-II location is in excess of 6,000 feet (1,830 meters) from the nearest 100-year flood plain [FEMA], as well as being 33 feet (10 meters) higher in elevation. The probability of a severe earthquake in the area is low and the facility would be designed to applicable New York State building code requirements.

## **6.1.12 Waste Management**

### Construction

Waste products resulting from building construction include excavated soils, concrete, metals and wood. The builder's contractual agreement would include requirements for management of construction debris based on the criteria in the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) standard. These criteria would include measures to promote recycling of construction debris to minimize resulting waste streams.

### Operations

The types and volume of wastes that would be generated and transported by NSLS-II are not anticipated to differ in a significant fashion from the wastes generated and transported by the existing NSLS. During a typical year of operation, NSLS-II would generate 3,000-5,000 pounds (1,400-2,300 kilograms) of wastes. Following are estimates of the types of wastes:

- Hazardous Waste (1,500 lbs): chemicals such as solvents, acids, bases and photographic processing waste
- Industrial Waste (2,500 lbs): oils and oily rags, cutting fluids, resin recharge rinse waters, and photographic wastes; oils and rinse water are the major components of industrial waste
- Radiological Waste (250 lbs): sources and other radioactive materials; eliminated by decay-in-storage when possible and disposed of as hazardous waste
- Mixed Waste (0-1 lb): eliminated by decayed-in-storage when possible and disposed of as hazardous waste
- Regulated Medical Waste (100 lbs): syringes, needles, pipettes, vials and razor blades would be disposed of by the Medical Department

The amount of waste in each category would vary from year to year, depending on the type and volume of the materials being disposed of. Based on the size of NSLS-II, an increase in waste rinse waters is anticipated due to the increased cooling water volume requirements. A decrease in waste oil quantities is expected because of a change to oil-less, scroll-type roughing pumps. NSLS-II would continue to follow BNL pollution prevention goals for reducing waste.

Experiment safety reviews and the regular safety inspections would be major factors in maintaining good housekeeping, minimizing the volumes of chemicals brought to the facility, as well as minimizing the wastes generated. Most experiments would not generate any waste.

### **6.1.13 Pollution Prevention**

#### Construction

The construction contractor would be required to meet the criteria in the USGBC LEED standard. These criteria include measures for pollution prevention which promote sustainable design, use of recycled products, recycling of construction debris to minimize the resulting waste stream, use of local products to minimize transportation-related pollution and use of products that would have a reduced pollution footprint as part of their manufacturing process.

#### Operations

Designing and constructing to meet the LEED criteria would result in an energy efficient facility, requiring less heating and cooling demand as compared to more conventional, non-LEED construction. Less utility demand would result in lower airborne emissions.

BNL has implemented extensive and active Pollution Prevention (P2) and Recycling programs that reflect the national and DOE pollution prevention goals and policies. Additional details of the P2 and Recycling programs are described in Chapter 2 of the Site Environmental Report [SER]. P2 design concepts would be considered for the

design of the equipment inside of the facility, with a focus on reducing water use and avoidance of mercury equipment where possible. When the NSLS-II becomes operational, P2 efforts would be incorporated including recycling of paper, cardboard, wood, metals, electronic equipment, glass, aerosol cans, vacuum pump and cutting oils, and other products. In addition, hazardous materials would be evaluated for replacement with environmentally friendly alternatives, where possible.

**6.1.14 Commitment of Resources**

Construction

There would be limited use of BNL electric power for lighting and power tools. There would also be an increase in fuel use to power the construction vehicles.

Operations

Operation of NSLS-II would result in an increased BNL demand for utilities including electrical, steam, and chilled water. Subsequent increases in fuel oil, water, propane, and natural gas resource utilization to supply these utilities would therefore occur. NSLS-II would require additional chilled water capacity from the current BNL Central Chilled Water Facility. Table 5 presents the projected NSLS-II utility needs.

**Table 5. NSLS-II Utility Needs and During Limited Simultaneous Operation with the Existing NSLS\***

<b>Utilities</b>	<b>NSLS-II FY2013 - Estimated</b>	<b>NSLS Existing (FY2005)</b>	<b>Simultaneous Operations - Estimated*</b>	<b>NSLS-II Full Ops. -Estimated</b>
Electrical Demand (MW)	13	5	18	17
Steam (lbs)	46 x 10 <sup>6</sup>	23 x 10 <sup>6</sup>	69 x 10 <sup>6</sup>	46 x 10 <sup>6</sup>
Chilled Water (Tons)	2,300	1,100	3,400	3,400

\*During the commissioning and initial operation of NSLS-II, there would be a 6-12 month period during which the NSLS and NSLS-II would operate simultaneously.

**6.1.15 Radiological Impacts**

Construction

No impact to the environment.

Operations

*Dose to Personnel*

The 3.0 billion electron volt energy and 500-milliamp current of the storage ring would govern the radiological characteristics of the NSLS-II facility, however, as a conservative measure, calculations for section 6.1.15 are based on 3.5 billion electron volt storage ring energy. The primary source of dose to personnel during facility operation would be: (1) scattered radiation from synchrotron light interacting with beamline components, or (2) bremsstrahlung, gamma ray or neutron radiation produced by electron interactions with machine components or residual vacuum. The radiation produced during accelerator and storage ring operation would create the highest percentage of personnel dose. Radiation exposures to workers and the public are controlled for DOE facilities by Title 10 CFR Part 835, which limits the total radiation exposure to radiation workers to 5,000 millirem per year. In addition, BNL maintains an administrative control level of 1,250 millirem for



its workers. Part 835 limits radiation exposure to members of the public to a maximum of 100 millirem per year. BNL has established an additional administrative level which limits exposure to the public off-site to 5 millirem per year from any single facility. The dose to workers and to the members of the public from NSLS-II operations would be kept well below federal limits and within BNL administrative levels through shielding, operational procedures, and review of all experiments and other use of radioactive materials. In accordance with 10 CFR 835.1001, measures would be taken to maintain radiation exposure as low as reasonably achievable (ALARA) through physical design controls and administrative controls. The primary method of radiation control would be through the physical design features such as shielding, confinement and ventilation. Administrative controls would only be employed as supplemental to control radiation exposure.

Shielding practices and requirements have been well established at numerous synchrotron light sources within the U.S., and it is straightforward to design and operate the facility to control radiation exposure to workers on-site and to the members of the public. An internal control level for the facility would be to keep the annual dose equivalent, as the result of NSLS-II operations, below 100 millirem/year for all NSLS guests, users and staff members working at the facility.

Shielding for the accelerators and the storage ring would be provided through a combination of concrete, lead, and soil, and would be designed using conservative beam loss assumptions to limit the maximum dose to 500 millirem when in contact with the shield for 2,000 hours per year. Occupational exposure of personnel is most likely to occur in the vicinity of experimental hutches along the beam lines. Shielding of these areas would be designed to maintain exposures when in contact with the hutch wall to less than 100 millirem/year for 2,000 hours of exposure per year. The shielding provided by the accelerator enclosure and along the beam lines would reduce levels from scattered radiation at the site boundary to less than 0.1 mrem/year.

Based on prior experience with the existing light sources, it would be expected that the average annual dose to full time staff from NSLS-II operations would be maintained below 100 millirem per year with these design criteria. For example, at the current NSLS, the average recorded annual exposure is less than 10 millirem per year.

To estimate the potential risk to workers from radiation exposure associated with NSLS-II operations, we assume that the average dose to full-time workers would be 50 millirem in a year. Based on the currently recommended dose-to-risk conversion factor of  $6 \times 10^{-4}$  excess fatal cancers per person-rem [ISCORS], the estimated lifetime risk from this exposure to the individual would be 0.00003. If the worker received this exposure each year over a 30 year operating lifetime for the facility, the worker would incur an estimated lifetime risk of 0.001, or a one in a thousand chance of a cancer fatality, which can be compared to normal lifetime risk within the U.S. of about 0.2, a one in five chance. Therefore, a worker at NSLS-II would not be expected to incur any harmful health effects from radiation exposures during a 30-year operational history for the facility.

Radiation exposure to visiting scientists conducting research at the facility would be lower than calculated above because of the reduced time working at the facility. Radiation exposure to other workers on the BNL site and to members of the general public at the site boundary and beyond would also be lower and would not be measurable above natural background at the site boundary.

#### *Radiological Accident Potential*

The radiological accident potential at NSLS-II is low as demonstrated by the excellent record at other light sources. In the 24 years of accelerator and beamline operations at the existing NSLS, no injury to staff and members of the public or the environment from a radiation accident has occurred. The NSLS-II facility will be well shielded and any radiation levels from accidental beam losses within the enclosure will be reduced to minor levels in occupied work areas. The beam lines will also be well shielded to keep radiation levels low during operations. The most severe radiation accident would be exposure to the very high radiation levels which would be present within the beam line experimental hutches or within the accelerator enclosures when the facility is operating. Accidental access to these areas, when radiation is present, would be prevented by providing interlock systems which automatically turn the radiation off if the access door is opened by someone seeking entrance to the area. In addition, prior to setting the interlock systems, there are administrative search procedures which ensure that no personnel remain inside the shielded enclosures prior to start of operation.

Other potential sources of radiation exposure include activated air, water, soil or accelerator components and radioactive sources used for experimental purposes.

#### *Air Resources*

Routine accelerator operations at NSLS-II would generate small amounts of air activation products such as Nitrogen<sup>13</sup> (half-life = 10 minutes), Carbon<sup>11</sup> (half-life = 20 minutes) and Oxygen<sup>15</sup> (half-life = 2.1 minutes) in a few locations. These would be produced within the accelerator enclosure, but would decay quickly because of the short half-life of the radionuclides and remain primarily within the confines of the enclosure. Calculations have demonstrated that there will be no generation of airborne radioactivity that would pose a radiological hazard to the worker. Doses to individuals at the site boundary have also been calculated assuming release to the atmosphere rather than confinement within the accelerator enclosure. The maximum annual dose from air releases at the boundary using CAP88 is less than 0.01 millirem per year [CAP] which is one tenth the NESHAP permitting requirement. Therefore, the dose/risk to the members of the public would be minimal. A NESHAP evaluation would be conducted prior the start of NSLS-II operation.

The photon beams utilized in the NSLS-II research program may produce ozone within an experimental hutch if the beam traverses air. Any research which requires open-air traversal within a hutch by a high-intensity synchrotron beam would be evaluated to determine if additional safeguards are needed to reduce ozone generation. Several practices would be implemented at NSLS-II to reduce or eliminate the production of ozone: placing apparatus within inert gas-filled chambers, reducing beam size, or scrubbing exhaust air through charcoal filters. These control features have worked well, and ozone production and exposure have not proved to be a problem for workers entering

the hutch or working in the experimental area around the hutch. These practices will be incorporated into NSLS-II design and operational practices to minimize ozone generation during NSLS-II operations.

### *Soil and Water Resources*

Operation of synchrotron light sources within the U.S. has had limited impact on soil and water because of the low beam power of these types of electron synchrotron facilities. Calculations estimating induced activity in soil adjacent to beam loss points within the accelerator enclosures have been made for NSLS-II to determine if soil and ground water would potentially be impacted by accelerator operations. These calculations would be detailed in the Safety Analysis Document (SAD) for NSLS-II.

The assessment found there would be a potential for minor soil activation near high beam loss points (e.g. beam stops, injection regions) within the accelerator enclosure. Of the radionuclides that may be produced in the soils, tritium and sodium-22 would be of most concern to ground water quality because they can be easily leached from the soils by rainwater infiltration. A conservative analysis of these beam loss points indicates that only trace levels of sodium-22 and tritium would be created in the soil immediately adjacent to the loss point, and that additional protective measures would not be required. BNL has a stringent Accelerator Safety design standard, which mandates that activated soils be protected from rainwater infiltration by, for example, impermeable caps or roof structures, if there is a potential for sodium-22 or tritium levels in rainwater leachate to exceed five percent of the drinking water standard which equates to 20 pCi/l and 1,000 pCi/l, respectively [SBMS]. The calculated leachate concentrations are below these levels. Although the potential impact to soils at NSLS-II is expected to be low, monitoring of potential loss points would be included in the design and in operational practices to verify the predicted values and to ensure that facility operations do not impact ground water quality.

Calculations of tritium production in the NSLS-II accelerator cooling water systems confirm that tritium production is expected to be low in these systems and would not create handling or release problems when working with these systems. During operation, these cooling water systems would be periodically sampled to confirm that there is no build-up of tritium over time.

## **6.2 Connected Actions**

*Joint Photon Sciences Institute (JPSI)*

*NSLS-II Dormitory*

*Warehouse*

The environmental impact from each of the connected actions identified above would be within the bounds of those associated with NSLS-II and would only be expected to result in slight impacts to the environment. Further information on each of these reasonably foreseeable actions is available in Section 4.1.10.

Each action would be considered construction of conventional buildings or structures; JPSI is a science laboratory and office building similar to existing BNL facilities, the NSLS-II Dormitory is envisioned as a structure providing temporary staff housing for

staff and users; the Warehouse will be replaced by use of other existing facilities. Construction would occur on previously disturbed areas of the BNL site with connections to BNL utility services for electric power, steam and condensate, water, sanitary, site fire alarm, data and communications. Any new buildings would consist of more energy efficient systems, and impacts associated with emissions and energy usage by them are likely to be less than from older types of buildings. The types of bench-scale research and development activities expected to occur at the JPSI would be in support of those proposed for NSLS-II.

Established review, and work planning and control processes will be used to evaluate the planning, construction, and operational activities associated with each facility to ensure compliance with all environmental, safety and health requirements.

### **6.3 Future Upgrades**

These upgrades would be developed based on the needs and mission of NSLS-II, the state of technology advances and funding availability. Further information on these upgrades is available in Section 4.1.11.

*Energy Recovery Linac (ERL)*

*Beamlines Beyond the Building Envelope*

*General Facility and Equipment Upgrades and Maintenance*

While the environmental impacts of the potential future upgrades cannot be fully determined at this time, it would be expected that they would be within the environmental impact bounds of those associated with NSLS-II. Some may require construction of an extension to the main NSLS-II building, but the total upgrade area would be less than the proposed footprint for NSLS-II. Additional shielding would be required in certain areas to maintain radiation doses ALARA. An increased demand for energy or water resources would be expected. Certain systems and components being replaced could be activated such as the electron beam generation and transport components. Work on these NSLS-II systems would result in generation of typical wastes.

Established assessment and review processes would be employed to evaluate potential radiological and environmental impacts of any upgrade activity. Each action would be in compliance with approved BNL procedures and management systems, and applicable federal, state and local requirements.

### **6.4 Decommissioning**

Near the end of the NSLS-II operating lifetime, a plan would be developed to fully evaluate the hazards and risks posed by decommissioning the facility, and to identify the activities required to complete that decommissioning. Baseline conditions would be determined through calculations, design features, operating experience, and characterization analyses. Experience gained from decommissioning the current NSLS would be employed in planning for NSLS-II.

Another aspect of the decommissioning plan would be the determination of the final site configuration, or end-point, in which the facility, or site, would be left. Decommissioning end-state alternatives would be evaluated.

Once baseline conditions are estimated and the alternative end-points chosen, methods of accomplishing the decommissioning would be evaluated and selected. Decommissioning methods would be chosen based on radiological conditions at the NSLS-II at the time of decommissioning and on the effectiveness of the methods to achieve the desired end use of the buildings. Additional criteria in choosing the methods would be the ability of the methods to keep personnel exposure ALARA and to protect the environment and worker. For example, decay-in-storage methods would be used, where reasonable, to reduce the volume of radioactive waste.

Finally, the waste streams to be managed during decommissioning would be inventoried and analyzed, their characteristics and volumes estimated, and treatment and disposal options evaluated. Accordingly, the resulting inventory would be comprised largely of process components and structures that would be solid waste or potentially recyclable, such as scrap metal, electrical equipment, or beam line components. Wastes requiring particular scrutiny include activated metals, suspect metals, sealed radioactive sources, chemicals and gases, and other hazardous materials such as lead and beryllium. Analyses and calculations to date at the existing NSLS indicate that tritiated water and soil contamination, respectively, would likely not exceed administrative or regulatory action levels at NSLS-II. However, confirmatory sampling and analyses would be performed. Waste treatment and disposal facilities and processes in place at the time of decommissioning would be reviewed as part of the decommissioning plan.

The decommissioning plan would delineate the applicable New York State and Federal laws, consensus standards, DOE directives and other requirements applicable to the activities at the time of decommissioning, especially those required to meet the end-point criteria.

## **6.5 Environmental Justice**

EPA's Office of Environmental Justice offers the following definition of Environmental Justice:

*“The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goal of this ‘fair treatment’ is not to shift risks among populations, but to identify potential disproportionately high and adverse effects and identify alternatives that may mitigate these impacts.”*

The Proposed Action would not have environmental justice impacts because there would be no anticipated negative economic or health effects on any potentially affected population. Therefore, there would be no disproportionate impacts to either low-income or minority populations.

**6.6 Cumulative Impacts of the Proposed Action**

The cumulative impacts of resource utilization, waste generation and radiological effects discussed below would be based on BNL’s future operations, incorporating anticipated impacts due to the NSLS-II Proposed Action, along with those of the planned and potential future facilities identified below:

Major Scientific & Support Facilities (under construction or proposed):

- Center for Functional Nanomaterials (CFN)
- Electron Beam Ion Source (EBIS)
- Joint Photon Sciences Institute (JPSI) and NSLS-II Dormitory
- Research Support Building, Phase I
- RHIC-II

Note: Existing BNL scientific and support facilities are listed and described in Chapter 1 of the SER [SER]. Impacts due to the No-Action Alternative have been discussed above and would remain the same.

The estimated electrical demand for the NSLS-II Proposed Action would be 17 Megawatts. This compares to an overall estimated 65 Megawatt electrical demand for the rest of the BNL site.

The projected steam usage for the NSLS-II would be 46,000,000 pounds. This compares to an overall estimated 565,000,000 pound steam usage for the rest of the BNL site.

The NSLS-II projects a chilled water demand of 3,400 tons and the BNL estimated total would be 9520 tons. NSLS-II requirements would exceed the current BNL capacity; additional capacity would have to be developed.

The quantities and types of wastes generated by NSLS-II and BNL waste would not be expected to change significantly from historical amounts with the possible exception of a slight decrease in the amount of BNL generated radiological waste. These estimates indicate a minimal change in the waste cumulative environmental impact.

There would be slight radiological impact from the operation of NSLS-II, but below the regulatory limits. Radiation exposure to workers and the general public would be low and similar to NSLS historical values [NSLS 2001 EA]. Releases to the environment would be similar to NSLS historical values and below regulatory levels.

**Table 6. Estimated Cumulative Impacts – Comparisons of NSLS-II to the BNL site**

<b>Impact</b>	<b>NSLS-II</b>	<b>Cumulative BNL</b>	<b>NSLS-II % of BNL</b>
Electrical Demand (MW)	17	65	26%
Steam (lbs)	46 x 10 <sup>6</sup>	565 x 10 <sup>6</sup>	8%
Chilled Water (Tons)	3,400	9,520	36%
Waste (lbs per year)	3,000 – 5,000	600,000 – 900,000	0.3% - 0.5%

Once the identified chilled water and electrical infrastructure is completed, the cumulative utility and waste aspects identified above would be within available BNL capabilities, and would not create a significant burden to the site infrastructure or

resources. Overall the cumulative impact of these aspects would have a minor effect on the environment.

### **6.7 No Action**

In the No Action Alternative NSLS-II is not constructed, and the existing NSLS would continue operations at its present environmental impact levels. A complete description is provided in [NSLS 2001 EA]. Over time it would be anticipated that the NSLS user population would decline and migrate to other better-equipped synchrotron facilities possibly forcing the closure of the NSLS facility. See also Table 1: Summary of Potential Environmental Effects, located in Section 2 of this EA.

## 7.0 ACRONYMS, INITIALS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ATF	Accelerator Test Facility
BER	Brookhaven Executive Roundtable
BES	Basic Energy Sciences
BGRR	Brookhaven Graphite Research Reactor
BHSO	Brookhaven Site Office (DOE)
BNL	Brookhaven National Laboratory
BTU	British Thermal Unit
C	Celsius
CAC	Community Advisory Council
CAP	Clean Air Assessment Package
CD0	Conceptual Design Zero
CEQ	Council on Environmental Quality
CFN	Center for Functional Nanomaterials
CFR	Code of Federal Regulations
CRMP	Cultural Resource Management Plan
DART	Days Away, Restricted or Transferred
DEC	Department of Environmental Conservation
DOE	Department of Energy
EA	Environmental Assessment
EBIS	Electron Beam Ion Source
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environmental Protection Agency
ERL	Energy Recovery Linac
ESH	Environment, Safety and Health
ESH&Q	Environment, Safety, Health and Quality
EWMSD	Environment and Waste Management Systems Division
F	Fahrenheit
FEL	Free Electron Laser
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FY	Fiscal Year
GeV	Giga-[Billion] electron Volt
gpd	Gallons per day
gpm	Gallons per minute
HEPA	High Efficiency Particulate Air
HFBR	High Flux Beam Reactor
Hrs	Hours
IR	Infrared
ISCORS	Interagency Steering Committee on Radiation Standards
ISM	Integrated Safety Management
ISO	International Organization for Standardization
JPSI	Joint Photon Sciences Institute
Lab	Laboratory
lbs	Pounds



LEED	Leadership in Energy and Environmental Design
LIPA	Long Island Power Authority
MEI	Maximally Exposed Individual
MER	Mechanical Equipment Room
meV	Milli-[thousandth] electron Volt
mgd	Million gallons per day
mrem	Milliroentgen equivalent man (see below for “rem”)
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NCRP	National Council on Radiation Protection
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Act
nm	nanometer [billionth of a meter]
NRHP	National Register of Historic Places
NRMP	National Resource Management Plan
NRTL	Nationally Recognized Testing Laboratory
NSLS	National Synchrotron Light Source
NSLS-II	National Synchrotron Light Source-II
NY	New York
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OHSAS	Occupational Health and Safety Assessment Series
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
P2	Pollution Prevention
pH	Activity of Hydrogen atoms in solution
pCi/l	Pico-[trillionths] Curies per liter [Curie = basic unit used to describe the intensity of radioactivity in a sample of material]
rem	Roentgen equivalent man [standard unit that measures the effects of ionizing radiation on humans]
RF	Radiofrequency
RHIC	Relativistic Heavy Ion Collider
SAD	Safety Analysis Document
SBMS	Standards Based Management System
SC	Suffolk County
SDL	Source Development Laboratory
SER	Site Environmental Report
SPDES	State Pollutant Discharge Elimination System
STP	Sewage Treatment Plant
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Device
TS	Tiger Salamander
U.S.	United States
USC	United States Code
USGBC	United States Green Building Council
USGS	United States Geological Survey
VOC	Volatile Organic Compound

VUV  
yr

Vacuum Ultraviolet  
Year

## **8.0 LIST OF PREPARERS**

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## **9.0 LIST OF AGENCIES CONTACTED & PRESENTATIONS TO STAKEHOLDERS**

### **9.1 Agencies Contacted**

DOE NEPA regulations, found in 10 CFR 1021.301, require that the host state be provided the opportunity to review and comment on the EA document prior to DOE's approval of the EA. Copies of the draft EA were distributed to the following New York State offices:

New York State Governor's Office – Albany, NY

New York State Department of Environmental Conservation – Stony Brook, NY

Additional copies of the draft EA were also sent to the following agencies for information only:

Brookhaven Town Supervisor's Office – Farmingville, NY

Central Pine Barrens Joint Planning and Policy Commission – Great River, NY

Long Island Regional Planning Board – Hauppauge, NY

Suffolk County Department of Health Services – Yaphank, NY

Suffolk County Executive's Office – Hauppauge, NY

### **9.2 Stakeholder Presentations**

Presentations related to planning and development of NSLS-II may be provided to the following stakeholder groups:

Brookhaven Executive Roundtable (BER) – The BER is a forum for frequent, routine and executive-level communications about Brookhaven National Laboratory. Represented on the BER are the major stakeholders associated with BNL, including the owner, operator, and jurisdictional, regulatory, oversight, community and political interests. A presentation about NSLS-II was provided to the BER on June 14, 2006.

BNL Community Advisory Council (CAC) - The CAC consists of approximately 27 member organizations representing business, civic, education, employee, environment and health organizations. Members meet monthly, set their own agenda, and work to reach consensus recommendations on issues of concern to them. Meetings are open to the public; each meeting has a comment period during which community members may voice their opinions and concerns [<http://www.bnl.gov/community/CAC.asp>]. A presentation about NSLS-II was provided to the CAC on September 14, 2006.

2006 Joint NSLS and CFN Users' Meeting (Opening Plenary Session) - The Joint NSLS and CFN Users' Meeting was a forum for scientists to report new research results and advances in experimental capabilities that utilize synchrotron light and, in this case, highlight nanoscience. The plenary session, held May 15, 2006, presented information on NSLS-II and was also open to BNL employees and the public.

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