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U.S. Department of Energy
Office of Environmental Management

Final Waste Management Programmatic Environmental Impact Statement

For Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

DOE/EIS-0200-F

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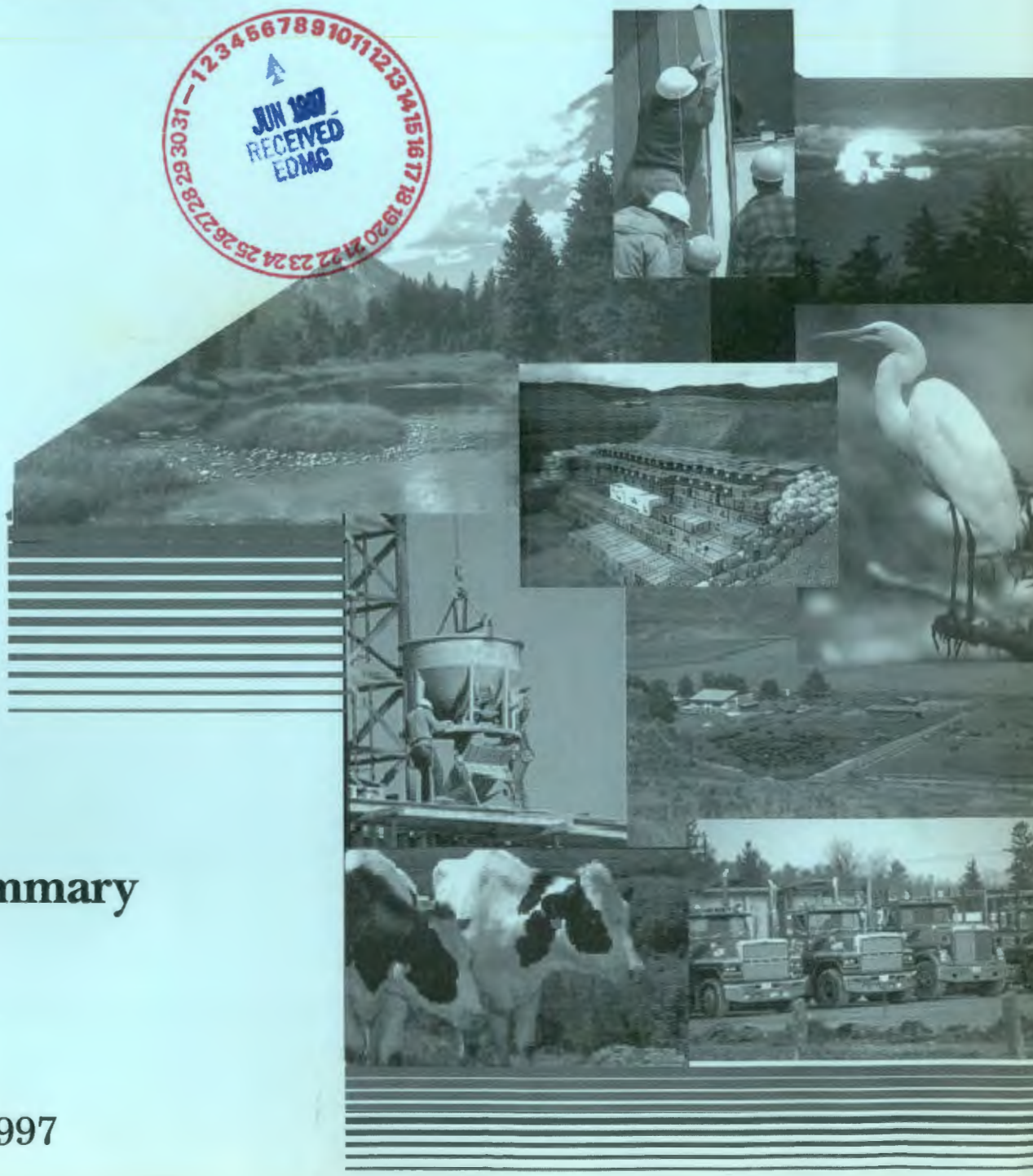

Summary

May 1997

Department of Energy
Washington, DC 20585

May 1997

Dear Citizen:

This is a summary of the *Final Waste Management Programmatic Environmental Impact Statement*. The Department of Energy has prepared the final environmental impact statement in accordance with the National Environmental Policy Act, to evaluate management and siting alternatives for the treatment, storage and disposal of five types of radioactive and hazardous wastes. These waste types are: low-level radioactive waste; low-level mixed (with hazardous components) waste; transuranic waste; high-level radioactive waste; and hazardous waste. The alternatives were evaluated for waste stored, buried or to be generated from future operations over the next 20 years at 54 sites.

The study is contained in 5 volumes. Volume 1, the main body of the document, contains the analyses for each waste type and the potential health, environmental and cumulative impacts of the 36 waste management program alternatives that were considered. Volume 2 contains the detailed data for each of the Department's sites included in the study. Volumes 3 and 4 contain the supporting appendices. Volume 5 contains an indexed summary of the comments received during the 5-month public comment period on the draft environmental impact statement, along with the Department's responses to those comments.

A complete copy of the final environmental impact statement is available in public reading rooms which are located across the U.S. A list of the reading rooms, copies of this summary, the full 5-volume document, or its supporting technical reports can be obtained on request from the following address or telephone number. Information is also available on our Internet home page at http://www.em.doe.gov.

Center for Environmental Management Information
P.O. Box 23769
Washington, D.C. 20026-3769
1-800-736-3282 (in Washington, D.C.: 202-863-5084)

The Department of Energy will issue Records of Decision for each of the five waste types in a phased manner, commencing no sooner than 30 days after publication of the final environmental impact statement. While some waste treatment and storage decisions may be made soon, the Department intends to consult further with stakeholders before identifying low-level and mixed waste disposal site preferences. We will publicly announce these disposal site preferences at least 30 days prior to making disposal decisions.

Sincerely,

Alvin L. Alm
Assistant Secretary for
Environmental Management

Printed with soy ink on recycled paper

U.S. Department of Energy
Office of Environmental Management

Summary

Final Waste Management Programmatic Environmental Impact Statement

For Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

DOE/EIS-0200-F

SUMMARY

May 1997

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Acronyms and Abbreviations

AEA	Atomic Energy Act
Ames	Ames Laboratory
Am-241	americium-241
ANL-E	Argonne National Laboratory-East
ANL-W	Argonne National Laboratory-West
BCL	Battelle Columbus Laboratory
Bettis	Bettis Atomic Power Laboratory
BNL	Brookhaven National Laboratory
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH	contact-handled
Charleston	Charleston Naval Shipyard
CO	carbon monoxide
Colonie	Colonie Interim Storage Site
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ETEC	Energy Technology Engineering Center
FEMP	Fernald Environmental Management Project
Fermi	Fermi National Accelerator Laboratory
FFCAct	Federal Facility Compliance Act
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	fiscal year
GA	General Atomics
GE	General Electric Vallecitos Nuclear Center
GJPO	Grand Junction Projects Office
GTCC	greater-than-Class-C
Hanford	Hanford Site
HLW	high-level waste
HW	hazardous waste
INEL	Idaho National Engineering Laboratory
ITRI	Inhalation Toxicology Research Institute

K-25	Oak Ridge K-25 Site
KAPL	Knolls Atomic Power Laboratory
KAPL-K	Knolls Atomic Power Laboratory (Kesselring)
KAPL-N	Knolls Atomic Power Laboratory (Niskayuna)
KAPL-W	Knolls Atomic Power Laboratory (Windsor)
KCP	Kansas City Plant
LANL	Los Alamos National Laboratory
lb	pound
LBL	Lawrence Berkeley Laboratory
LDRs	land disposal restrictions
LEHR	Laboratory for Energy-Related Health Research
LLMW	low-level mixed waste
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
m^3	cubic meters
Mare Is	Mare Island Naval Shipyard
MEI	maximally exposed individual
Middlesex	Middlesex Sampling Plant
Mound	Mound Plant
mrem	millirem
nCi/g	nanocuries per gram
NEPA	National Environmental Policy Act
NO_2	nitrogen dioxide
Norfolk	Norfolk Naval Shipyard
NRF	Naval Reactors Facility
NTS	Nevada Test Site
O&M	operations and maintenance
O_3	ozone
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
Palos	Palos Forest
Pantex	Pantex Plant
Pb	lead
Pearl H	Pearl Harbor Naval Shipyard
PEIS	Programmatic Environmental Impact Statement
PGDP	Paducah Gaseous Diffusion Plant
Pinellas	Pinellas Plant

PM_{10}	particulate matter of aerodynamic diameter less than or equal to 10 micrometers
PORTS	Portsmouth Gaseous Diffusion Plant
Ports Nav	Portsmouth Naval Shipyard
PPPL	Princeton Plasma Physics Laboratory
Pu-238	plutonium-238
Puget So	Puget Sound Naval Shipyard
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
RH	remote-handled
RMI	RMI Titanium Company
ROI	region of influence
SLAC	Stanford Linear Accelerator Center
SNL-CA	Sandia National Laboratories (California)
SNL-NM	Sandia National Laboratories (New Mexico)
SO_2	sulfur dioxide
SRS	Savannah River Site
TRUPACT-II	Transuranic Package Transporter-II
TRUW	transuranic waste
TSCA	Toxic Substances Control Act
USC	United States Code
UofMo	University of Missouri
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
WM	waste management
WM PEIS	Waste Management Programmatic Environmental Impact Statement
WSSR	Weldon Spring Remedial Action Project
WVDP	West Valley Demonstration Project
Y-12	Oak Ridge Y-12 Plant

1 Introduction*

This Waste Management Programmatic Environmental Impact Statement (WM PEIS) is a nationwide study examining the environmental impacts of managing five types of radioactive and hazardous wastes generated by past and future nuclear defense and research activities at a variety of sites located around the United States. The five waste types are low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), high-level waste (HLW), and hazardous waste (HW).

The U.S. Department of Energy (DOE) needs to enhance the management of its current and anticipated inventories of LLMW, LLW, TRUW, HLW, and HW in order to ensure safe and efficient control of these wastes, to comply with all applicable Federal and State laws, to protect public health and safety, and to protect the environment. Each waste type has unique physical characteristics and regulatory requirements and accordingly is managed separately. For each waste type, facilities are needed to treat, store, and dispose of the waste. For the first time, DOE has examined in an integrated fashion not only the impacts of complexwide (i.e., across the DOE complex) waste management alternatives for each waste type but also the specific cumulative impacts from all the waste facilities at a given site. In this context, management of these wastes includes:

- Pollution prevention
- Identifying/contracting with private vendors to manage waste
- Modifying existing waste management facilities or constructing new facilities at particular sites
- Operating existing, modified, or new waste management facilities at those sites
- Transporting waste among waste management facilities, as necessary
- Handling, surveillance, and maintenance

Definitions of Wastes Analyzed in the WM PEIS

Low-level mixed waste: *Low-level waste that contains hazardous waste under the Resource Conservation and Recovery Act.*

Low-level waste: *Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranics is less than 100 nanocuries per gram of waste. Low-level waste is subject to provisions of the Atomic Energy Act.*

Transuranic waste: *Transuranic waste is waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, per gram of waste, with half-lives greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary has determined, with concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or (c) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.*

High-level waste: *The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly from reprocessing and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation. High-level waste may include other highly radioactive material that the U.S. Nuclear Regulatory Commission, consistent with existing law, determines requires permanent isolation.*

Hazardous waste: *Under the Resource Conservation and Recovery Act, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Source, special nuclear material, and by-product material, as defined by the Atomic Energy Act, are specifically excluded from the definition of solid waste.*

* Vertical lines in margins and shading in tables indicate changes made since the publication of the Draft WM PEIS in August 1995.

This study provides information on the impacts of various alternatives, which DOE will use to decide at which sites to locate additional treatment, storage, and disposal capacity for each waste type. However, the location of a facility at a selected site will not be decided until completion of a sitewide or project-specific National Environmental Policy Act (NEPA) review.

To help DOE decide at which sites it should locate waste management facilities, this WM PEIS considers four categories of alternatives for each waste type: (1) a No Action Alternative that is generally consistent with current practice but with no management improvements; (2) a Decentralized Alternative that would, in general, result in wastes being managed where they are currently generated or stored; (3) a Regionalized Alternative that would consolidate waste management at fewer sites throughout the nation than under the Decentralized Alternative; and (4) a Centralized Alternative that would consolidate waste management at only one or two sites. For certain waste types, DOE considers more than one Regionalized or Centralized Alternative to present a wide variety of options on the number and location of sites that could manage wastes.

1.1 Sources of DOE Waste

At its peak, the nuclear defense complex consisted of 16 "major" sites, including large reservations in Nevada, Idaho, Washington, and South Carolina. National laboratories in New Mexico and California designed weapons that were produced in Colorado, Florida, Missouri, Ohio, Tennessee, and Washington. Like most industrial and manufacturing operations, the production of nuclear weapons generated waste. However, many problems posed by DOE's nuclear operations are unlike those associated with most other industries. Among these problems are radiation hazards; structures with radioactive contamination, such as nuclear reactors; and chemical plants that processed nuclear materials.

Nuclear weapons have played an important role in national security, and the nation continues to maintain an arsenal of nuclear weapons and some production capability. Continued support of the nation's Naval Nuclear Propulsion Program is also needed. However, since the end of the Cold War and the nuclear arms race, national priorities have shifted. Today, waste management and environmental restoration activities have become central to DOE's mission. DOE must provide for the proper management of its wastes within a complex and dynamic regulatory environment. DOE is not responsible, in general, for the management of wastes produced from commercial applications of radiation and atomic energy, and management of such wastes is not addressed in this WM PEIS.

1.2 Environmental Management Accelerating Cleanup: Focus on 2006

The DOE Environmental Management (EM) Program is continually working to accelerate cleanup schedules, increase efficiency, and foster cooperative relationships with its regulators and other stakeholders. However, there is concern whether support can be sustained for a program that may stretch beyond 70 years with an estimated cost of more than $200 billion. DOE wants to accelerate reduction of this "cleanup mortgage" of the Cold War to reduce long-term economic and environmental liabilities. DOE is working on a 2006 Plan (previously known as the Ten Year Plan) to meet this challenge. The vision of this plan is that, within the next decade, most DOE facilities will be able to treat and dispose of their backlog of nuclear materials and wastes safely and to clean up the land and buildings on site. These steps would dramatically reduce long-term costs and open a large portion of the lands and other resources controlled by DOE for other purposes.

However, some aspects of the EM Program will demand additional time and resources. For example, DOE will not be able to complete the treatment and disposal of certain wastes, such as high-level radioactive waste stored in tanks at Hanford or TRUW stored throughout the complex, within the next 10 years. In addition, there will be ongoing groundwater cleanup projects, decontamination of buildings, and

surveillance and maintenance activities. At a small number of sites, DOE will continue treatment of a few remaining waste streams beyond the next 10 years.

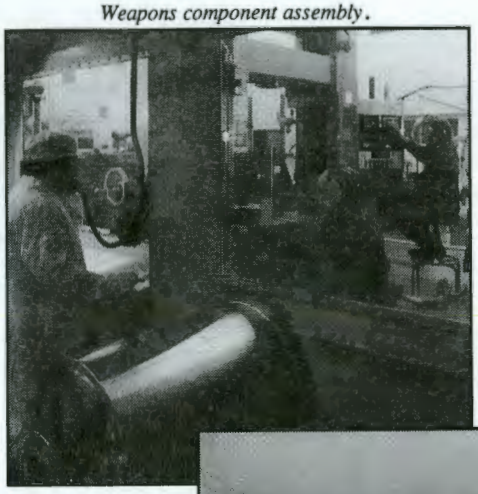
DOE will use the 2006 Plan to inform budget decisions and to sequence projects and actions to meet program objectives. EM will implement this vision in collaboration with regulators and the public. Development of the 2006 Plan will be guided by the following seven principles:

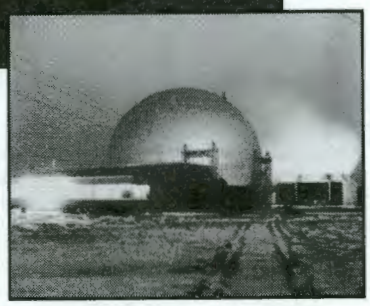
- Eliminate urgent risks
- Reduce mortgage and support costs to free up funds for further risk reduction
- Protect worker health and safety
- Reduce the generation of waste
- Create a collaborative relationship between DOE and its regulators and stakeholders
- Focus technology development on cost and risk reduction
- Integrate waste treatment and disposal within the complex

DOE's sites have already prepared initial draft site plans, and DOE is now developing a national discussion draft based upon these principles. The discussion draft will be distributed for public comment to elicit feedback on the strategic approaches for accomplishing compliance and completion goals, and on DOE's management strategies to accomplish these goals. This approach will ensure that DOE has a broad perspective when developing a draft National 2006 Plan later this year. The 2006 Plan will be a living document, evolving to reflect revised assumptions, stakeholder viewpoints, and newly obtained information.

The Final WM PEIS evaluates many waste management activities that may become components of the 2006 Plan.

Weapons component assembly.





Experimental Boiling Water Reactor at ANL-E, December 31, 1956.

1.3 Focus of the WM PEIS

DOE issued an Implementation Plan for this WM PEIS in January 1994. In that document, DOE identified the proposed action as the formulation and implementation of "an integrated environmental restoration and waste management program in a safe and environmentally sound manner and in compliance with applicable laws, regulations, and standards." However, since issuing the Implementation Plan, DOE has decided to shift the focus of the WM PEIS.

Specifically, DOE has determined that its original plan to integrate waste management and environmental restoration decisions is not appropriate, primarily because of the site-specific nature of environmental restoration decisions. These decisions, including the level of site remediation, should reflect site-specific conditions and involve local communities.

In a *Federal Register* notice issued on January 24, 1995, DOE proposed to modify the scope of the WM PEIS to eliminate the analysis of environmental restoration alternatives. Appendix A of this WM PEIS summarizes the comments received in response to the proposed change in scope and DOE's responses to those comments. Appendix A also describes various means for public involvement in planning and decision making for the Department's environmental restoration activities.

On September 22, 1995, DOE published a *Federal Register* notice announcing the release of the Draft WM PEIS and invited the public to comment on the document during the 90-day public comment period (September 22 through December 21, 1995). Opportunities to comment were provided in 13 video conference hearings held from October 17, 1995, through January 24, 1996. Several of these video conferences linked sites together with DOE Headquarters; altogether, 18 locations were involved in the hearings.

The video conference format was used to provide a wider opportunity for Headquarters' participation, support an interactive approach, and reduce costs. The public hearings were advertised through local newspapers, morning and evening drive-time radio announcements, and other DOE site-specific mechanisms, such as direct mailings to interested members of the public, meeting announcements to active groups or advisory boards, and additional advertising as deemed necessary by the DOE representatives. The specific notification approach varied by site depending on the needs of the local population. Public comments collected at the hearings were summarized in the *Draft WM PEIS Hearing Summary Report: A Compilation of Public Hearing Summaries* and placed in DOE public reading rooms in early February 1996. Comments were also received from the public and other interested parties directly through the mail.

On December 19, 1995, in response to requests from the public, congressional representatives, and major environmental groups, DOE announced an extension of the WM PEIS public comment period through February 19, 1996. Comments received throughout the comment period have been analyzed and considered in developing the Final WM PEIS, and are summarized in the Final WM PEIS Comment Response Document (Volume V of the Final WM PEIS). Documents relating to the WM PEIS are available in public reading rooms, listed in Chapter 1 (Section 1.9) of the Final WM PEIS.

During the public comment period for the Draft WM PEIS, more than 1,200 individuals, states, tribal nations, agencies, and organizations provided DOE with comments. Comments were received from virtually all of the communities near the DOE sites identified as "major" sites in the WM PEIS, and from many other interested members of the public. Many citizens and organizations submitted questions, comments, or objections regarding proposed waste management activities at particular DOE sites. Some suggested alternatives for waste management activities; others expressed their preferences for the alternatives described in the WM PEIS. A few commenters thought that DOE should prepare one comprehensive environmental impact statement on all of its activities; some expressed their support for DOE's current efforts.

Specific concerns raised during the comment period included the risk assessment methodologies (e.g., models and assumptions) used in the analysis, risks to densely populated areas and minority and low-income populations, risks associated with subsistence fishing in some communities, transportation risks, impacts on future generations, and additional exposures to populations affected by other DOE activities.

Commenters challenged DOE's designation of particular sites as major sites in the WM PEIS and requested that these sites be removed from consideration. Related to this issue were comments regarding the accuracy of current waste loads at particular sites.

DOE also received comments and questions on the relationship of the WM PEIS to other DOE programs or projects; purported inconsistencies between the

WM PEIS and other DOE documents; waste types or radioactive materials not analyzed in the WM PEIS; waste management technologies, particularly for waste treatment; the decision criteria DOE will use in making its waste management decisions; the future availability of geologic repositories at Yucca Mountain, Nevada, and the Waste Isolation Pilot Plant in New Mexico; and DOE credibility. Many commenters questioned DOE's February 1995 decision to remove environmental restoration alternatives from the scope of the WM PEIS.

Several commenters used this opportunity to raise budget concerns, especially the need to ensure the availability of funding to implement DOE's waste management activities. Some offered comments on policies or Federal programs not related to this WM PEIS, including suggestions to eliminate the production of radioactive and hazardous waste by eliminating certain DOE defense- and energy-related programs.

All comments were carefully considered by DOE. DOE made appropriate changes to the Draft WM PEIS as a result of the comments and prepared the Comment Response Document, Volume V of this Final WM PEIS, to respond to the specific comments received. In general, public comments, coupled with consultations with commenting agencies and State and tribal governments, resulted in additional analyses, clarification or correction of facts, and expanded discussion in several technical areas. The Comment Response Document provides an explanation of why certain comments did not warrant change to the WM PEIS.

In response to the comments received and in defining the preferred alternatives, the most significant changes to the WM PEIS are the following:

- DOE's preferred alternatives are identified.
- DOE modified the Decentralized Alternative for HW to replace Los Alamos National Laboratory (LANL) with Idaho National Engineering Laboratory (INEL) as a candidate site for onsite treatment of hazardous waste. This change recognizes the HW treatment capacity that exists at INEL and does not currently exist at LANL.
- With respect to revised information on waste loads, DOE prepared a new appendix, Appendix I, which presents updated waste volume inventories and projections for all waste types. Further, Appendix I allows site-specific comparisons with earlier estimates of inventories

Major Sites Analyzed in the WM PEIS

"Major" sites are those that are the focus of the WM PEIS because they meet one or more of the following criteria: (1) they are candidates to receive waste generated off site; (2) they are candidates to host disposal facilities; (3) they manage HLW; or (4) they were included to be consistent with the Federal Facility Compliance Act process. The 17 major sites are:

Argonne National Laboratory-East
Brookhaven National Laboratory
Fernald Environmental Management Project
Hanford Site
Idaho National Engineering Laboratory

Lawrence Livermore National Laboratory
Los Alamos National Laboratory
Nevada Test Site
Oak Ridge Reservation
Paducah Gaseous Diffusion Plant
Pantex Plant

Portsmouth Gaseous Diffusion Plant
Rocky Flats Environmental Technology Site
Sandia National Laboratories-New Mexico
Savannah River Site
Waste Isolation Pilot Plant
West Valley Demonstration Project

and projections upon which the analysis in the Draft WM PEIS was based to determine whether the more recent data would substantially change any of the impacts described in the Draft WM PEIS. DOE performed new analyses using updated waste inventory data at selected sites for LLMW and for LLW and TRUW under several alternatives. The results of these additional analyses are contained in the relevant waste-type chapters of the WM PEIS.

- DOE modified its analysis of environmental justice concerns to better determine whether disproportionately high and adverse health impacts to minority or low-income populations could occur. The maps illustrating the proximity of these populations around the major DOE sites have been improved and moved from the former Appendix I (as found in the Draft WM PEIS) to Appendix C of the Final WM PEIS. DOE performed additional analyses of the potential for offsite general population risk as a result of the disposal of LLMW and LLW. With respect to transportation impacts, DOE clarified the comparison of radiological risks in truck and rail transportation and included the potential number of shipments that would enter and exit each site. DOE also emphasized that the intersite routes used in the analysis are representative of possible routes, not selections.

- DOE revised Chapter 11, "Cumulative Impacts," to provide a more comprehensive evaluation of other DOE actions (e.g., tritium supply and recycling, weapons material stockpile stewardship and management, and storage and disposition of excess fissile materials) that may affect the sites.

- With respect to environmental restoration wastes, DOE substantially modified Appendix B to include updated waste volume estimates for all sites and provided more detailed discussion about how environmental restoration wastes are generated, which of these wastes may be transferred to the Waste Management Program, and how the transferred wastes may affect the WM PEIS alternatives. Appendix B also discusses the uncertainties in estimating the volumes of environmental restoration wastes and the potential effects on waste management facilities. Section 1.7.1 of Volume I was revised and now discusses how the environmental restoration program is considered in the WM PEIS and why, given current uncertainties, a full impact analysis of environmental restoration wastes cannot be done in the WM PEIS. This section also sets forth the Department's reasons for proceeding with impact analyses using only waste management wastes. A qualitative analysis of how environmental restoration transferred wastes may affect the WM PEIS alternatives is also given in each waste-type chapter (Sections 6.15, 7.15, and 8.15 of Volume I).

Other changes to the WM PEIS include: a more detailed description of the decisions to be made by DOE (Section 1.7.3 of Volume I, which also includes a discussion of decision criteria from former Section 1.8); a statement clarifying DOE's compliance with applicable State and local laws and a narrative on relevant DOE orders (Section 1.4 of Volume I); a more comprehensive discussion of site treatment plans, pollution prevention, and other DOE actions and programs (Section 1.8.2 of Volume I); a discussion of privatization (Section 1.7.4 of Volume I); a discussion of safeguards and security (Section 4.3.12 of Volume I); and information which explains why the No Action alternatives for some waste types may appear to have smaller potential impacts than other alternatives (Sections 6.2.3, 6.16, and 8.3.1 of Volume I). DOE has also made other changes suggested by commenters to improve readability, including a short Readers' Guide at the beginning of Volume I, well-known examples to demonstrate waste volumes, and a table for converting waste volumes to both cubic feet and cubic yards. The Final WM PEIS includes an updated list of preparers in Chapter 13.

As modified, the WM PEIS focuses on waste management sites (those required to treat, store, or dispose of existing wastes and wastes that will be generated in the future as a result of DOE nuclear weapons stockpile stewardship and research programs). While this document does not analyze environmental restoration alternatives, Appendix B of the WM PEIS does contain information on the anticipated waste loads generated as a result of environmental restoration

activities (see Section 1.7) and a qualitative discussion of the extent to which those waste loads may affect waste management alternatives.

1.4 Waste Types Considered in the WM PEIS

DOE is responsible for managing large inventories of LLMW, LLW, TRUW, HLW, and HW. DOE manages each of these waste types separately because they contain different components, have different levels of radioactivity, and must meet different regulatory requirements. Updated information on waste volumes for LLW, LLMW, and TRUW at DOE's sites is included in Appendix I of this WM PEIS. DOE addressed the management of spent nuclear fuel in a separate programmatic environmental impact statement and its subsequent Records of Decision (see text box on page 12).

DOE defines its radioactive wastes based partially on how they are derived. Thus, waste types may share certain characteristics; for example, transuranic elements can be found in LLMW, LLW, TRUW, and HLW.

In addition, the wastes within each category come from diverse sources and can have different characteristics. Thus, some wastes within a waste type may need to be managed much differently from other wastes within that same waste type. For example, LLMW and LLW are categorized as either alpha or non-alpha waste, depending on whether the waste contains transuranic radionuclides with half-lives greater than 20 years and with alpha particle activity of between 10 and 100 nanocuries per gram. Because of the long-term health risks associated with the long-lived transuranic radionuclides, regulatory requirements mandate different treatment or disposal processes for alpha and for non-alpha waste. TRUW is an alpha waste with activity greater than 100 nanocuries per gram. There are typically two categories of LLMW, LLW, and TRUW—"contact-handled" (CH) and "remote-handled" (RH). The difference between the two categories is due to the concentration of radioactive materials. RH waste typically requires additional shielding and containment to protect workers and the public. Most LLMW, LLW, and HW can be disposed of by shallow burial provided that they are first treated and then placed in a properly regulated disposal facility. LLMW, HLW, HW, and some TRUW are all subject to the requirements of the Resource Conservation and Recovery Act (RCRA).

Types of Radioactivity

There are four principal types of radiation: alpha particles, beta particles, gamma rays, and neutrons. Alpha particles can be stopped by a sheet of paper and will not penetrate skin; but materials that emit alpha particles are harmful if inhaled or ingested. Beta radiation can pass through skin or an inch of water but not through a thin sheet of aluminum, plywood, or steel. Gamma rays and neutrons are the most penetrating radiation and can pass through many materials, including the human body. In passing through the human body, gamma rays generally deposit less of their energy than alpha or beta particles, which are stopped in the body. Dense materials like lead are effective for absorbing gamma rays, while hydrogenous materials like water are effective in slowing down and stopping neutrons.

The following introductory sections define and discuss each of the waste types considered in this WM PEIS, current waste volumes, and the four categories of alternatives. Figure 1.4–1 and Table 1.4–1 identify sites where wastes are generated or stored for each waste type under the alternatives evaluated in the WM PEIS.

1.4.1 Low-Level Mixed Waste

Low-level mixed waste (LLMW) contains both hazardous and low-level radioactive components. The hazardous components in LLMW are subject to RCRA, whereas the radioactive components are subject to the Atomic Energy Act (AEA). LLMW is characterized as either CH or RH and as alpha or non-alpha.

Figure 1.4–1. Waste Management Sites.

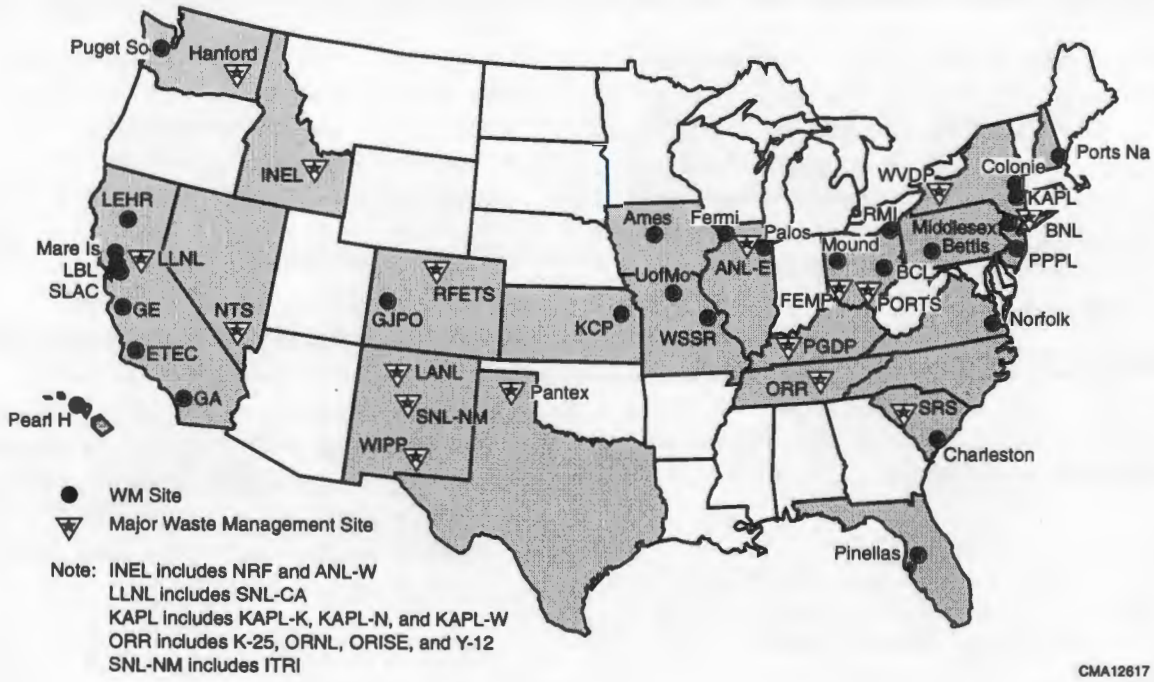


Table 1.4–1. Waste Management Sites

Sites	State	Symbol	Major Site[a]	Waste Type Managed				
				LLMW	LLW	TRUW	HLW	HW[b]
1 Ames Laboratory	IA	Ames		✓	✓			
2 Argonne National Laboratory-East	IL	ANL-E	✓	✓	✓	✓		✓
3 Battelle Columbus Laboratories	OH	BCL		✓				
4 Bettis Atomic Power Laboratory	PA	Bettis		✓	✓			
5 Brookhaven National Laboratory	NY	BNL	✓ c	✓	✓			
6 Charleston Naval Shipyard	SC	Charleston		✓	g			
7 Colonie	NY	Colonie		d				
8 Energy Technology Engineering Center	CA	ETEC		✓		✓		
9 Fermi National Accelerator Laboratory	IL	Fermi			✓			✓
10 Fernald Environmental Management Project	OH	FEMP	✓	✓	✓			
11 General Atomics	CA	GA		✓				
12 General Electric Vallecitos Nuclear Center	CA	GE		d	d			
13 Grand Junction Projects Office	CO	GJPO		✓				
14 Hanford Site	WA	Hanford	✓	✓	✓	✓	✓	✓
Idaho National Engineering Laboratory	ID	INEL	✓	✓	✓	✓	✓	✓
15 Idaho National Engineering Laboratory	ID	INEL		e	e	e	e	e
16 Argonne National Laboratory-West	ID	ANL-W		e	e	e		
17 Naval Reactor Facility	ID	NRF			e			
18 Kansas City Plant	MO	KCP		✓	✓			✓
Knolls Atomic Power Laboratory	NY	KAPL		✓	✓			
19 Knolls Atomic Power Laboratory (Kesselring)	NY	KAPL-K		e	e			
20 Knolls Atomic Power Laboratory (Niskayuna)	NY	KAPL-N		e	e			
21 Knolls Atomic Power Laboratory (Windsor)	CT	KAPL-W		e	e			
22 Laboratory for Energy-Related Health Research	CA	LEHR		✓				
23 Lawrence Berkeley Laboratory	CA	LBL		✓	✓	✓		
Lawrence Livermore National Laboratory	CA	LLNL	✓	✓	✓	✓		✓
24 Lawrence Livermore National Laboratory	CA	LLNL		e	e	e		e
25 Sandia National Laboratories (California)	CA	SNL-CA		e	e			
26 Los Alamos National Laboratory	NM	LANL	✓	✓	✓	✓		✓
27 Mare Island Naval Shipyard	CA	Mare Is		✓	g			
28 Middlesex Sampling Plant	NJ	Middlesex		d				
29 Mound Plant	OH	Mound		✓	✓	✓		
30 Nevada Test Site	NV	NTS	✓	✓	✓	✓		
31 Norfolk Naval Shipyard	VA	Norfolk		✓	g			

Table 1.4–1. Waste Management Sites—Continued

Sites	State	Symbol	Major Site[a]	Waste Type Managed				
				LLMW	LLW	TRUW	HLW	HW[b]
Oak Ridge Reservation	TN	ORR	✓	✓	✓	✓		✓
32 K-25 Site	TN	K-25		e	e			e
33 Oak Ridge Institute for Science and Education	TN	ORISE			e			
34 Oak Ridge National Laboratory	TN	ORNL		e	e	e		e
35 Y-12 Plant	TN	Y-12		e	e			e
36 Paducah Gaseous Diffusion Plant	KY	PGDP	✓	✓	✓	✓		
37 Palos Forest (Site A/Plot M)	IL	Palos		d	d			
38 Pantex Plant	TX	Pantex	✓c	✓	✓			✓
39 Pearl Harbor Naval Shipyard	HI	Pearl H		✓	g			
40 Pinellas Plant	FL	Pinellas		✓	✓			
41 Portsmouth Gaseous Diffusion Plant	OH	PORTS	✓	✓	✓			
42 Portsmouth Naval Shipyard	ME	Ports Nav		✓	g			
43 Princeton Plasma Physics Laboratory	NJ	PPPL		✓	✓			
44 Puget Sound Naval Shipyard	WA	Puget So		✓	g			
45 RMI Titanium Company	OH	RMI		✓	✓			
46 Rocky Flats Environmental Technology Site	CO	RFETS	✓	✓	✓	✓		
Sandia National Laboratories	NM	SNL-NM	✓c	✓	✓	✓		✓
47 Sandia National Laboratories (New Mex)	NM	SNL-NM		e	e	e		e
48 Inhalation Toxicology Research Institute	NM	ITRI		e	e			
49 Savannah River Site	SC	SRS	✓	✓	✓	✓	✓	✓
50 Stanford Linear Accelerator Center	CA	SLAC			✓			
51 University of Missouri	MO	UofMO		✓		✓		
52 Waste Isolation Pilot Plant	NM	WIPP	✓			f		
53 Weldon Spring Site Remedial Action Project	MO	WSSR		d	d			
54 West Valley Demonstration Project	NY	WVDP	✓c	✓	✓	✓	✓	
Total sites			17	37	27	16	4	11

Notes: ✓ = the facility is included in the indicated group. A site is listed under a waste type if it currently manages or is expected to manage that type of waste in the future. Joint DOE/Navy Nuclear Propulsion Program sites are: Bettis, Charleston, KAPL-K, KAPL-N, KAPL-W, Mare Is, Norfolk, NRF, Pearl H, Ports Nav, and Puget So. Former FUSRAP (Formerly Utilized Sites Remedial Action Program) sites are Colonie and Middlesex.

[a] "Major" sites are those that are the focus of the WM PEIS because they meet one or more of the following criteria: (1) they are candidates to receive wastes generated offsite; (2) they are candidates to host disposal facilities; (3) they manage HLW; or (4) they were included to be consistent with the Federal Facility Compliance Act process.

[b] Sites analyzed in the WM PEIS are those 11 sites that generated more than 90% of DOE's HW for the year 1992. Other DOE sites also manage HW but were not evaluated. Naval Nuclear Propulsion Program sites were not considered in the WM PEIS analysis for HW.

[c] Although this site is designated as a major site, none of the alternatives would result in wastes from other sites being shipped to this site for treatment or disposal.

[d] The site is included in the table because it is listed in data sources for LLMW; however, no programmatic waste management decision would be applicable to the site. Since it is managed as an environmental restoration site, it is excluded from the WM PEIS alternatives and waste totals.

[e] For evaluating candidate sites for waste management facilities in this WM PEIS: ANL-W and NRF have been combined with INEL; ITRI has been combined with SNL-NM; K-25, ORISE, ORNL, and Y-12 have been combined under ORR; SNL-CA has been combined with LLNL; and KAPL-K, KAPL-N, and KAPL-W have been combined under KAPL.

[f] TRUW is not currently stored or managed at WIPP. WIPP is a planned disposal site and is included because of its potential to treat TRUW.

[g] Naval shipyards may generate small quantities of LLW; however, they are not reported in the WM PEIS.

LLMW results from a variety of activities, including the processing of nuclear materials used in nuclear weapons production and energy research and development activities. The WM PEIS evaluates management of approximately 82,000 cubic meters (m^3) of LLMW that are currently stored and an estimated 137,000 cubic meters that are expected to be generated over the next 20 years (excluding LLMW that could be generated as a result of environmental restoration activities; see Table 1.7–1), for a total of approximately 219,000 cubic meters. While commercial and DOE facilities are currently insufficient to treat DOE's entire inventory of LLMW, some commercial treatment capacity does exist, and with sufficient incentives, it is assumed that commercial capacity could increase to meet demand. This WM PEIS addresses the treatment and disposal of LLMW; storage of LLMW is not addressed because RCRA prohibits storage of untreated waste except to facilitate proper recovery, treatment, or disposal. The WM PEIS addresses the transportation impacts associated with moving LLMW to treatment, storage, and disposal sites.

1.4.2 Low-Level Waste

Low-level waste (LLW) includes all radioactive waste that is not classified as HLW, spent nuclear fuel (fuel discharged from nuclear reactors), TRUW, uranium and thorium mill tailings or waste from processed ore. It does not contain HW constituents. Most LLW consists of relatively large amounts of waste materials contaminated with small amounts of radionuclides, such as contaminated equipment (e.g., gloveboxes, ventilation ducts, shielding, and laboratory equipment), protective clothing, paper, rags, packing material, and solidified sludges. LLW is further categorized as CH or RH and as alpha or non-alpha on the basis of the types and levels of radioactive emissions. However, most LLW contains short-lived radionuclides and generally can be handled without additional shielding or remote handling equipment. DOE has an inventory of approximately 67,500 cubic meters of LLW in storage, and approximately 1,440,000 cubic meters are expected to be generated during the next 20 years (excluding LLW that could be generated as a result of environmental restoration

Contact- and Remote-Handled Wastes

Radioactive waste is classified as either "contact-handled" (CH) or "remote-handled" (RH). LLMW, LLW, and TRUW can be composed of either CH or RH waste. All HLW is RH waste.

***Contact-handled** wastes are those with radiation levels less than or equal to 200 millirem per hour at the surface of a waste container and can be safely handled by direct contact.*

***Remote-handled** wastes are those with radiation levels exceeding 200 millirem per hour at the surface of a container. Such material must be handled remotely, by using such means as robots, and must have special shielding in treatment, storage, and disposal facilities.*

A millirem (one-thousandth of a rem) is a unit of measure of absorbed ionizing radiation used to assess the biological effects of a given dose of any type of radiation.

Various low-level, mixed, and hazardous waste.

activities), for a total of approximately 1,500,000 cubic meters. This WM PEIS also addresses the transportation impacts associated with moving LLW to treatment, storage, and disposal sites.

1.4.3 Transuranic Waste

TRUW is waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years (atomic number greater than 92), except for (a) HLW, (b) waste that DOE has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by 40 CFR 191, or (c) waste that the U.S. Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.[1] TRUW is generated during research, development, nuclear weapons production, and spent nuclear fuel reprocessing.

Metric Units

Volumes in this document are given in the metric unit of cubic meters (m^3). One cubic meter is equal to approximately 35 cubic feet, or 264 gallons.

TRUW, some of which also contains hazardous chemicals, has radioactive elements such as plutonium, with lesser amounts of neptunium, americium, curium, and californium. These radionuclides generally decay by emitting alpha particles. Like LLMW and LLW, TRUW also contains radionuclides that emit gamma radiation, requiring TRUW to be managed as either CH or RH. Approximately half of the TRUW analyzed is mixed waste containing both radioactive elements and hazardous chemicals regulated under RCRA.

[1] LLW and LLMW may also contain these transuranic isotopes, but with concentrations less than 100 nanocuries per gram of waste.

Spent Nuclear Fuel

"Spent nuclear fuel" is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

Initially, the management of spent nuclear fuel was to be analyzed in this WM PEIS. However, spent nuclear fuel has been analyzed in a separate PEIS—"Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement"—published in April 1995. The impacts of managing spent nuclear fuel are included in the cumulative impacts of this WM PEIS.

DOE has approximately 68,000 cubic meters of stored TRUW that can be retrieved and expects to generate about 64,000 cubic meters over the next 20 years (excluding TRUW that could be generated as a result of environmental restoration activities), for a total of about 132,000 cubic meters. DOE is currently proceeding with plans for TRUW disposal at a proposed geologic repository called the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. To evaluate whether to dispose of TRUW at WIPP and what level of treatment is needed for WIPP to perform as designed, DOE is preparing the WIPP Disposal Phase Supplemental EIS (SEIS-II) (draft issued Nov. 1996). Therefore, this WM PEIS addresses only the selection of DOE sites for treatment and storage facilities for TRUW. It also addresses the transportation impacts associated with moving TRUW to treatment, storage, and disposal sites.

1.4.4 High-Level Waste

High-level waste (HLW) is the highly radioactive waste resulting from reprocessing spent nuclear fuel and irradiated targets from reactors. HLW is liquid before it is treated and solidified. Some of its elements will remain radioactive for thousands of years. HLW is also a mixed waste if it contains hazardous components that are regulated under RCRA. DOE has or will have generated about 378,000 cubic meters of HLW stored in large tanks.

Access to waste panel 1 in WIPP's underground facility. Continuous air monitors in foreground.

High-level waste tanks at SRS.

DOE is proceeding with plans to treat HLW by processing it into a solid form that would not be readily dispersible into air or leachable into groundwater or surface water. This treatment process is called vitrification. The environmental impacts of vitrifying HLW have been analyzed in previous DOE environmental impact statements. Vitrification would generate approximately 21,600 canisters from the current inventory of HLW. Canisters are assumed to vary in volume between 0.85 cubic meter and 1.26 cubic meters. DOE plans to dispose of the HLW canisters in a geologic repository. This WM PEIS addresses only the storage of treated HLW prior to its ultimate disposal in such a repository. It also addresses the transportation impacts associated with moving HLW to storage sites.

1.4.5 Hazardous Waste

Hazardous waste (HW) is defined under RCRA as a solid waste, or a combination of solid wastes, that may (a) significantly contribute to an increase in mortality because of its quantity, concentration, or physical, chemical, or infectious characteristics or (b) pose a potential hazard to human health or the environment when improperly treated, stored, or disposed of. RCRA defines a "solid" waste to include solid, liquid, semisolid, or contained gaseous material.

The quantities and types of HW generated by DOE's activities vary considerably and include acids, metals, solvents, paints, oils, rags contaminated with hazardous cleaning compounds, and other hazardous materials that are byproducts of routine maintenance, degreasing, and machine shop operations. Almost 99% of DOE's HW is wastewater and is treated at DOE sites. The remaining 1%, predominantly solvents and cleaning agents, is treated at commercial facilities. The WM PEIS evaluates the treatment of the 1% of HW that is not wastewater (Chapter 10, Volume I).

*Quantities of Waste**

***Low-Level Mixed Waste**. The WM PEIS addresses approximately 82,000 cubic meters of LLMW that are currently stored and an estimated 137,000 cubic meters that are expected to be generated over the next 20 years (100,000 cubic meters has about the same volume as a seven-story building the size of a football field).*

***Low-Level Waste**. Approximately 67,500 cubic meters of LLW are stored, and an estimated 1,440,000 cubic meters are expected to be generated over the next 20 years.*

***Transuranic Waste**. Approximately 68,000 cubic meters are retrievably stored, and an estimated 64,000 cubic meters are expected to be generated over the next 20 years.*

***High-Level Waste**. Approximately 378,000 cubic meters of HLW are stored and, when treated through vitrification, will generate approximately 21,600 HLW canisters.*

***Hazardous Waste**. Approximately 69,000 cubic meters of nonwastewater HW are expected to be generated in the next 20 years.*

** Volumes do not include environmental restoration wastes.*

Over the next 20 years, DOE expects to generate approximately 69,000 cubic meters of nonwastewater HW. The WM PEIS addresses only the impacts of treating HW and the impacts associated with moving HW to treatment sites.

1.5 Decisions

Table 1.5–1 summarizes decisions DOE needs to make with respect to the treatment, storage, or disposal of these five types of waste. The alternatives describe the roles of the different sites where waste management facilities could be located.

1.6 Decision Criteria

Table 1.6–1 lists factors and criteria DOE used to evaluate alternatives in order to select a preferred alternative for each waste type considered in the WM PEIS. DOE also considered public comments in evaluating each of the alternatives.

1.7 Environmental Restoration Wastes

The term "environmental restoration" (ER) refers to the remediation of contaminated media and facilities at DOE sites. Contaminated media consist of contaminated soils, water, debris, and buildings; the volumes of such materials can be large at some sites. DOE continues to pursue environmental restoration at its sites; however, environmental restoration is not included in the scope of the WM PEIS. The decisions DOE must make about environmental restoration generally are not programmatic but instead are site specific.

Certain wastes generated during environmental restoration activities will be transferred to the waste management program for further treatment or

Table 1.5–1. Decisions DOE Will Make Based on Evaluations in the WM PEIS

Decisions	Type of Waste and Whether DOE Will Decide on Basis of WM PEIS (Yes or No)				
	Low-Level Mixed Waste	Low-Level Waste	Transuranic Waste	High-Level Waste	Hazardous Waste
Where to treat?	YES LLMW could be treated at 1 to 37 DOE sites.	YES LLW volume reduction and treatment could be conducted at 1 to 11 DOE sites. Minimum treatment could occur at all sites.	YES TRUW could be treated at 3 to 16 DOE sites.	NO HLW will be treated at 4 DOE sites where it was generated.	YES HW could be treated at DOE sites, or DOE could rely on commercial treatment.
Where to store?	NO LLMW will be stored at sites where generated until treatment and disposal.	NO LLW will be stored at sites where generated until treatment and disposal.	YES TRUW could be stored at 3 to 16 sites, pending final disposition.	YES HLW canisters containing treated HLW could be placed into storage at 1 to 4 DOE sites.	NO HW sent to commercial facilities will be stored for less than 90 days unless there is a permitted storage facility.
Where to dispose of?	YES LLMW could be disposed of at 1 to 16 DOE sites.	YES LLW could be disposed of at 1 to 16 DOE sites.	NO Separate evaluation of Waste Isolation Pilot Plant (WIPP) Disposal Phase is being prepared.	NO Separate evaluations to be prepared pursuant to the Nuclear Waste Policy Act as amended.	NO Commercial HW disposal facilities will continue to be used.

disposal. These wastes are referred to as ER transferred wastes. The volume of ER transferred waste depends on the extent of environmental restoration at a site, which then depends on several factors, including decisions regarding the use of the site in the future and the amount of cleanup necessary to permit that use; the balance between containment and removal strategies at a site; and the availability of commercial or DOE facilities to treat or dispose of waste. Current ER waste estimates are derived from a base-case scenario for environmental response actions at DOE sites.

Of the total volume of contaminated material from more than 10,000 contaminated areas at DOE sites (estimated to be approximately 58 million cubic meters), approximately 90% is contaminated soils. *In situ* remediation activities—such as capping contaminated soils in a landfill or entombing processing facilities, buildings, and reactors—would generate relatively small volumes of waste requiring further management.

However, environmental restoration activities that involve removing contaminants from environmental media can produce HW, LLW, LLMW, and TRUW. Although DOE has made preliminary estimates about how much of each of these wastes environmental restoration may generate at a particular site, it has almost no information on how chemical or radiological contaminants vary within each of these broad types of environmental restoration wastes. Without this basic information on the nature and composition of these wastes, DOE cannot determine the facilities needed to manage them or the impacts that the operation of those facilities might have on the environment.

Potential impacts of the addition of ER transferred waste on the WM PEIS alternatives are determined by such factors as waste management facility capacity, operational costs, and risks to workers and offsite populations. At most DOE sites, the treatment of ER transferred wastes is not expected to affect comparisons regarding the WM PEIS alternatives. Management of ER transferred

Table 1.6–1. Factors and Criteria DOE Uses in WM PEIS Decision Making

Factor	Criterion
• Consistency	Favors alternatives that are consistent with other complexwide studies using methodologies that allow valid comparisons across sites.
• Cost	Favors alternatives that have the potential to minimize overall cost for implementation of selected waste management strategies.
• Cumulative impact	Favors selection of alternatives and sites that minimize adverse cumulative environmental impacts.
• DOE mission	Favors alternatives that further the Department's mission to safely and efficiently treat, store, and ultimately dispose of wastes.
• Economic dislocation	Favors alternatives that tend to minimize economic dislocation, such as job losses.
• Environmental impact	Favors selection of alternatives and sites that would minimize adverse environmental impacts.
• Equity	Favors alternatives that distribute waste management facilities in ways that are considered equitable.
• Human health risk	Favors alternatives that reduce human health risk to both workers and the public. Human health risks depend not only on the magnitude of releases of radionuclides and hazardous chemicals but also on parameters such as population surrounding the sites, the hydrogeology of disposal sites, and the number of vehicle accidents that are expected to occur during transportation of waste.
• Implementation flexibility	Favors alternatives that maximize DOE's ability to modify activities at selected sites as circumstances change (e.g., to potentially manage large volumes of ER waste).
• Mitigation	Favors alternatives that increase DOE's ability to mitigate adverse impacts and that reduce the cost of mitigation.
• Regulatory compliance	Favors alternatives that comply with regulatory requirements, DOE Orders, and commitments made under the Federal Facility Compliance Act or with States and other regulators.
• Regulatory risk	Considers the potential for changes in statutes and regulations when evaluating alternatives and siting options.
• Site mission	Favors alternatives that are consistent with site capabilities and feasible for each waste type, particularly capacities and availability of technologies for treatment, storage, and disposal.
• Transportation	Favors alternatives that balance the amount of transportation needed to transport wastes to the sites considered in the alternatives with potential environmental risks, health risks, vehicle accidents, public concerns, mission needs, and costs.

waste could be accomplished by using available operational capacity for up to 30 years at waste management facilities, providing additional waste management facilities, or upgrading the planned facilities to accept increased amounts of wastes. Table 1.7–1 provides estimates of the volumes of transferred wastes that would be treated at waste management facilities. Because DOE does not have sufficient information about the ER transferred wastes, it cannot evaluate their impacts in the same manner as the impacts of wastes evaluated in the WM PEIS. DOE does not have enough information on the volume or contaminant composition of these wastes to perform an analysis of the impacts of treating, storing, or disposing of these wastes.

Appendix B and the cumulative impact analysis describe the DOE Environmental Restoration Program, provide estimates of waste volumes, and identify the potential effects of the addition of ER transferred waste on the WM PEIS analysis. Assumptions and uncertainties involved in the analysis are also provided.

1.8 Pollution Prevention Program Plan

Pollution prevention is defined as the use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and wastes into land, water, and air. To demonstrate DOE's commitment to pollution prevention, the Secretary of Energy has established goals, to be achieved by December 31, 1999, that will reduce DOE's routine generation of radioactive, mixed, and hazardous wastes and will reduce total releases and transfers of toxic chemicals by at least 50%.

Table 1.7–1. Estimated Waste Volumes Requiring Treatment or Disposal at Waste Management Facilities[a]

Waste Type and Activity	Environmental Restoration Transferred Waste (m^3)	Waste Management Waste (m^3)
LLMW	200,000	219,000
LLW	1,900,000	1,500,000
TRUW	80,000	132,000

[a] No HLW or HW requiring treatment or disposal in waste management facilities will be generated as a result of environmental restoration activities.

To provide a conservative analysis of DOE's future waste management program, the projections of waste volumes given in Chapters 6–10 did not assume that pollution prevention practices would significantly reduce current waste generation. However, Appendix G estimates how DOE's departmentwide reduction of 50% in annual generation of waste from DOE's pollution prevention practices may affect waste loads, costs, and human health impacts.

2 Alternatives

In this WM PEIS, the term "alternative" refers to a configuration of sites for treating, storing, or disposing of a specific waste type. Analysis of the range of reasonable configurations provides information on their potential environmental impacts that can be compared by decision makers. The alternatives analyzed in this WM PEIS for each waste type fall within four broad categories: the no action alternative and the decentralized, regionalized, and centralized alternatives.

2.1 Four Categories of Alternatives

No Action Alternative: This alternative involves using only currently existing or, in the case of HW, planned waste management facilities at DOE sites, or commercial vendors. In the NEPA process a no action alternative, or "status quo" alternative, may not necessarily comply with applicable laws and regulations, but it provides an environmental baseline against which the impacts of other alternatives can be compared.

Decentralized Alternatives: These alternatives involve managing waste where it is or will be generated. Unlike the no action alternative, the decentralized alternatives may require the siting, construction, and operation of new facilities or the modification of existing facilities. Under the decentralized alternatives, waste management facilities would be located at a larger number of sites than under the regionalized or centralized alternatives.

Regionalized Alternatives: These alternatives involve transporting wastes to a number of sites (fewer than the number of sites considered for the decentralized alternatives but greater than the number of sites considered for the centralized alternatives). In general, sites with the largest volumes of a given waste were considered as regional sites for treatment, storage, or disposal. DOE evaluated two or more regionalized alternatives for all waste types.

Centralized Alternatives: These alternatives involve transporting wastes to one or two sites for treatment, storage, or disposal. As was the case for the regionalized alternatives, those sites that have the largest volumes of a given waste were generally considered as sites for centralized management.

These four broad categories of alternatives encompass the range of reasonable alternatives available to DOE for siting facilities to manage the five waste types considered in this WM PEIS. Commercial or private facilities could potentially be used within each

NEPA Regulations

The Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR Parts 1500–1508) require Federal agencies to evaluate all reasonable alternatives to the proposed action in an environmental impact statement (EIS). An agency must provide sufficient information for each alternative so that reviewers may evaluate the comparative merits of those alternatives.

For alternatives that were eliminated from detailed study, the agency must briefly discuss the reasons for their elimination. Further, the agency must identify its preferred alternative or alternatives, if one exists, in the draft EIS, and the agency must identify the preferred alternative in the final EIS unless another law prohibits the expression of such a preference. After completing the final EIS, the agency prepares a Record of Decision that announces the decision it made and identifies the alternative it considered to be environmentally preferable.

What Is Privatization?

For purposes of this WM PEIS, privatization refers to having a private entity operate, maintain, and decommission a waste management facility on a DOE site for the exclusive use of DOE. The private entity is reimbursed by DOE on a competitive basis. Privatization also includes the construction and subsequent operation of a waste management facility (including financing and obtaining necessary permits) by a private entity on a DOE site.

What Is Commercialization?

For purposes of this WM PEIS, a "commercial" waste management facility is defined as one that is owned or operated by a private entity (or a state) and that treats, stores, or disposes of waste from a variety of sources for a fee. DOE routinely uses commercial facilities for disposal of some of its LLMW and LLW.

alternative. The programmatic decisions that DOE ultimately makes are not necessarily limited to one of the four categories of alternatives. For example, DOE could select a hybrid alternative that would incorporate actions from one or more of the four categories of alternatives analyzed. Furthermore, under each category of alternatives, there are many possible combinations for the number and location of sites for management facilities. To narrow these combinations to a reasonable range for meaningful analyses, DOE selected representative alternatives under each category. Table 2.1–1 presents the alternatives that are analyzed for each of the waste types considered in the WM PEIS.

2.2 Developing the WM PEIS Alternatives

To determine those sites that would be reasonable locations for waste management facilities, DOE identified the sites with the largest waste volumes and the ones where transportation requirements would be minimized. The impacts of waste management facilities were then analyzed at those sites.

Other criteria were used to select additional sites. Waste characteristics, specialized treatment requirements, and existing facilities were taken into consideration. Some wastes that require special treatment were analyzed separately, and treatment sites were selected for analysis on the basis of volumes requiring special treatment rather than on total volumes.

Table 2.1–1. Number of Alternatives Analyzed by Waste Type

Alternatives	LLMW	LLW	TRUW	HLW*	HW	Total
No Action	1	1	1	1	1	**5**
Decentralized	1	1	1	1	1	**5**
Regionalized	4	7	3	2	2	**18**
Centralized	1	5	1	1	0	**8**
Total	**7**	**14**	**6**	**5**	**4**	**36**

* HLW alternatives are analyzed both in terms of final disposal beginning in 2015 and final disposal beginning at some later date. However, the decision of when HLW disposal will begin is not part of the WM PEIS. A separate NEPA document will be prepared for the HLW geologic repository.

2.3 WM PEIS Preferred Alternatives

The site profiles at the end of this Summary briefly describe the roles each site may play in the national waste management programs for each waste type under the preferred alternatives. No decisions will be made until at least 30 days after publication of the WM PEIS. DOE will make separate decisions on each waste type beginning early in calendar year 1997.

DOE selected its preferred alternatives after considering the analyses presented in the WM PEIS, the decision criteria presented in Table 1.6–1 and all of the comments submitted on the Draft WM PEIS. Table 2.3–1 summarizes the preferred alternatives for all of the major sites analyzed in the WM PEIS, and Tables 2.3–2 through 2.3–6 identify the waste management activities that each of the major sites would conduct under the preferred alternative. The preferred alternatives for each waste type are as follows.

Treatment of LLMW: A number of the Department's sites (generally sites with small amounts of LLMW) would send their LLMW to other sites for treatment. The sites that would receive these wastes and treat them under the DOE's preferred alternative are Hanford, INEL, ORR, and SRS. ANL-E, FEMP, LLNL, LANL, Pantex, PORTS, RFETS, and SNL-NM would treat LLMW onsite.

DOE's preferred alternative is a combination of parts of the Decentralized Alternative and several Regionalized Alternatives as shown in Table 2.3–1. The potential environmental impacts of all alternatives for treatment of LLMW evaluated in the WM PEIS are small. DOE's preferred alternative is generally consistent with the Site Treatment Plans prepared under the FFCAct; these plans include the use of commercial facilities to treat some LLMW. DOE realizes that the compliance orders issued by State and Federal regulators on the basis of these Site Treatment Plans establish the requirements for treatment of DOE's LLMW.

Disposal of LLMW: The Department's preferred alternative at this time is to send its LLMW to regional disposal sites after it is treated. After consultations with stakeholders, the Department intends to select two or three sites from the following six: Hanford, INEL, LANL, NTS, ORR, and SRS.

The six sites named above are those at which DOE already has established LLW or LLMW disposal operations and, except for NTS and LANL, each has relatively large LLMW volumes for disposal. Because these six sites would have more than adequate capacity for the amounts of LLMW the Department will need to dispose of, there is no need for additional candidate sites. Fewer than the six sites would provide adequate capacity at a substantially lower overall cost. Relying on only one disposal site, however, would require the most transportation of the waste, and would be operationally inflexible if disposal activities were interrupted.

While all six current disposal sites remain candidates for future disposal operations and the potential health and environmental impacts of regionalized disposal are small, further consideration of various factors may affect the DOE's site preferences. For example, hydrological characteristics indicate that disposal at sites with high rainfall, such as ORR and SRS, would require mitigation costs that would not be needed at more arid sites. Preliminary cost analyses indicate that regional disposal at ORR, LANL, and INEL may not be as cost effective as disposal at SRS, NTS, and Hanford.

Because of these sometimes contravening factors and the permanence associated with disposal decisions, it is prudent to further evaluate costs and discuss all pertinent aspects of potential configurations with stakeholders before identifying two or three preferred sites for disposal. The Department will notify the public which specific sites it prefers for disposal of LLMW by publishing a notice in the *Federal Register* and by other means. DOE will not issue a Record of Decision selecting any regional disposal sites for LLMW sooner than 30 days after publication of its preferred sites in the *Federal Register*.

Table 2.3–1. Summary of Preferred Alternatives

Waste Type	Decision	ANL	BNL	FEMP	Hanford	INEL	LLNL	LANL	NTS	ORR
LLMW	Treatment	D	R1[a]	D	R1	R4	D	D	R1[a]	R2
	Disposal[b]	R	R	R	R	R	R	R	R	R
LLW	Treatment	R3	R3	R3	R3	R3	R3	R3	R3	R3
	Disposal[b]	R	R	R	R	R	R	R	R	R
TRUW	Treatment	D			D	R3	D	D	D	R1
HLW	Storage				D	D				
HW	Treatment	N	-	-	N	N	N	N	-	N

Waste Type	Decision	PGDP	Pantex	PORTS	RFETS	SNL-NM	SRS	WVDP	WIPP
LLMW	Treatment	R2	D	D	D	D	R1	R1[a]	
	Disposal[b]	R	R	R	R	R	R	R	
LLW	Treatment	R3	R3	R3	R3	R3	R3	R3	
	Disposal[b]	R	R	R	R	R	R	R	
TRUW	Treatment	D	**		D	R1	R1	D	*
HLW	Storage						D	D	
HW	Treatment	-	N	-	-	N	N	-	

Notes: N = No Action; D = Decentralized; R1, R2, R3, R4 = Regionalized; - = site not analyzed as a major generating site; * = no impacts from treatment or storage; ** = the very small amount of TRUW at Pantex would be shipped to LANL for treatment and storage. A blank cell indicates that the waste type is not found at the site.
[a] Wastes from these sites (BNL, NTS, and WVDP) are shipped offsite to regional treatment centers.
[b] DOE prefers to further narrow its configuration of LLMW and LLW disposal sites to two to three sites. The selection of sites would be made following consultation with regulatory authorities, State and Tribal governments, and other interested stakeholders.

Table 2.3–2. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLMW

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
Ames	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
ANL-E	Treatment	Onsite		Some waste may be shipped to regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
BCL	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]

Table 2.3–2. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLMW—Continued

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
Bettis	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
BNL	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Charleston	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
ETEC	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
FEMP	Treatment	Onsite[d]		Some waste may be shipped to regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
GA	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
GJPO	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
Hanford	Treatment	Onsite	Regional treatment site[b]	
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
INEL	Treatment	Onsite	Regional treatment site[b]	Some INEL waste may be shipped to another regional treatment site[b]
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
KCP	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
KAPL	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LEHR	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LBL	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LLNL	Treatment	Onsite		Some waste may be shipped to regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LANL	Treatment	Onsite		
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
Mare Island	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Mound	Treatment	Onsite[e]		Regional treatment site[b,e]
	Disposal	Offsite		Regional disposal site[c]
NTS	Treatment	Offsite		Regional treatment site[b]
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
Norfolk	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]

Table 2.3–2. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLMW—Continued

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
ORR	Treatment	Onsite	Regional treatment site[b]	
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
PGDP	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Pantex	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
Pearl Harbor	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Pinellas	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
PORTS	Treatment	Onsite[f]		Regional treatment site[b,f]
	Disposal	Offsite		Regional disposal site[c]
Ports Nav	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
PPPL	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Puget So	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
RMI	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
RFETS	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
SNL-NM	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
SRS	Treatment	Onsite	Regional treatment site[b]	Some SRS waste may be shipped to another regional treatment site
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
UofMO	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
WVDP	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]

Note: A blank cell indicates that a site either does not receive LLMW from other sites or does not ship LLMW to other sites.

[a] A site is listed if it currently manages LLMW or is expected to manage it in the future.

[b] The regional treatment sites would be Hanford, INEL, ORR, or SRS, depending upon which site is shipping waste. The configuration analyzed in the WM PEIS for Hanford, INEL, ORR, and SRS is not exactly the same as those in the Site Treatment Plans; under the Site Treatment Plans:

- Hanford receives LLMW from BCL;
- INEL receives LLMW from Bettis, Charleston, ETEC, KAPL, LBL, LLNL, Mare Island, NTS, Norfolk, Pearl Harbor, PORTS, Puget So, SRS, and UofMO;
- ORR receives LLMW from ANL-E, BNL, FEMP, INEL, LBL, Mound, NTS, PGDP, PORTS, RMI, and WVDP; and
- SRS receives LLMW from Bettis, Charleston, KAPL, and Norfolk.

The evaluation of impacts at each of the major sites under the Preferred Alternative provides similar results as the configurations specified in the Site Treatment Plans. DOE realizes that the Site Treatment Plans, unless modified by the appropriate regulatory agency, establish the requirements for treatment of DOE's LLMW.

[c] The selection of two or three regional disposal sites will be made following further consultation with regulatory agencies, State and Tribal Governments, and other interested stakeholders.

[d] Site Treatment Plan indicates some waste may be treated onsite.

[e] Site Treatment Plan indicates some waste may be treated offsite at ORR.

[f] Site Treatment Plan indicates some waste may be treated offsite at INEL and ORR.

Table 2.3–3. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLW

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
Ames	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
ANL-E	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Bettis	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
BNL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Fermi	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
FEMP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Hanford	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
INEL	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
KCP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
KAPL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
LBL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
LLNL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
LANL	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
Mound	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
NTS	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
ORR	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
PGDP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Pantex	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Pinellas	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]

Table 2.3–3. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLW—Continued

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
PORTS	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
PPPL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
RFETS	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
RMI	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
SNL-NM	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
SRS	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
SLAC	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
WVDP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]

Note: A blank cell indicates that a site either does not receive LLW from other sites or does not ship LLW to other sites.
[a] A site is listed if it currently manages LLW or is expected to manage it in the future.
[b] The selection of two or three regional disposal sites will be made following further consultation with regulatory agencies, State and Tribal governments, and other interested stakeholders.

Table 2.3–4. Waste Management Activities Under the Preferred Alternative for Treatment and Storage of TRUW

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to[c]
ANL-E	Treatment	Onsite		
	Storage	Onsite		
ETEC	Treatment	Onsite		
	Storage	Onsite		
Hanford	Treatment	Onsite		
	Storage	Onsite		
INEL	Treatment	Onsite	RFETS	
	Storage	Onsite	RFETS	
LANL	Treatment	Onsite	Pantex, SNL-NM	
	Storage	Onsite	Pantex, SNL-NM	
LBL	Treatment	Onsite		
	Storage	Onsite		

Table 2.3–4. Waste Management Activities Under the Preferred Alternative for Treatment and Storage of TRUW—Continued

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to[c]
LLNL	Treatment	Onsite		
	Storage	Onsite		
Mound	Treatment	Onsite		
	Storage	Onsite		
NTS	Treatment	Onsite		
	Storage	Onsite		
ORR[b]	Treatment	Onsite/offsite	SRS	CH-TRUW to SRS
	Storage	Onsite/offsite	SRS	CH-TRUW to SRS
Pantex	Treatment	Offsite		LANL
	Storage	Offsite		LANL
PGDP	Treatment	Onsite		
	Storage	Onsite		
RFETS	Treatment	Onsite/offsite		INEL
	Storage	Onsite/offsite		INEL
SNL-NM	Treatment	Offsite		LANL
	Storage	Offsite		LANL
SRS[b]	Treatment	Onsite/offsite	ORR	RH-TRUW to ORR
	Storage	Onsite/offsite	ORR	RH-TRUW to ORR
UofMO	Treatment	Onsite		
	Storage	Onsite		
WVDP	Treatment	Onsite		
	Storage	Onsite		

Notes: CH-TRUW = contact-handled TRUW; RH-TRUW = remote-handled TRUW. A blank cell indicates that a site either does not receive TRUW from other sites or does not ship TRUW to other sites.
[a] A site is listed if it currently manages TRUW or is expected to manage it in the future.
[b] Under the Preferred Alternative, ORR is a regional treatment center for RH-TRUW, and SRS is a regional treatment center for CH-TRUW.
[c] Storage of treated TRUW pending final disposition.

Table 2.3–5. Waste Management Activities Under the Preferred Alternative for Storage of Treated HLW

Generating Site[a]	Stores Waste at	Receives Waste	Ships Waste to[b]
Hanford	Hanford		
INEL	INEL		
SRS	SRS		
WVDP	WVDP		

Note: A blank cell indicates that a site either does not receive HLW from other sites or does not ship HLW to other sites.
[a] A site is listed if it currently manages HLW or is expected to manage it in the future.
[b] Storage pending ultimate disposition.

Table 2.3–6. Waste Management Activities Under the Preferred Alternative for Treatment of HW

Generating Site[a]	Treats Waste at	Receives Waste	Ships Waste to
ANL-E	Offsite commercial facility		Offsite commercial treatment facility
Fermi	Offsite commercial facility		Offsite commercial treatment facility
Hanford	Offsite commercial facility		Offsite commercial treatment facility
INEL	Organic HW onsite, other HW at offsite commercial facility		Offsite commercial treatment facility
KCP	Offsite commercial facility		Offsite commercial treatment facility
LANL	Offsite commercial facility		Offsite commercial treatment facility
LLNL	Offsite commercial facility		Offsite commercial treatment facility
ORR	Organic HW onsite, other HW at offsite commercial facility		Offsite commercial treatment facility
Pantex	Offsite commercial facility		Offsite commercial treatment facility
SNL-NM	Offsite commercial facility		Offsite commercial treatment facility
SRS	Offsite commercial facility		Offsite commercial treatment facility

Note: A blank cell indicates that a site either does not receive HW from other sites or does not ship HW to other sites.
[a] Sites analyzed in the WM PEIS are those 11 sites that generated more than 90% of DOE's HW in 1991.

Treatment of LLW: Each site with LLW would treat its waste onsite. Each site would perform minimum treatment on its wastes to prepare them for disposal, although DOE would allow each of its sites the flexibility to perform additional treatment if it would decrease costs and requirements for transportation by significantly reducing the volume of LLW requiring disposal. The potential environmental impacts of all alternatives for treatment of LLW evaluated in the WM PEIS are small. The impacts of DOE's preferred alternative for LLW are identified in Regionalized Alternative 3 as shown in Table 2.3–1, under which the potential impacts associated with minimum treatment of LLW at each site were analyzed, assuming regionalized disposal, as discussed below.

Disposal of LLW: The Department's preferred alternative at this time is to send its LLW to regional disposal sites after it is treated. After consultations with stakeholders, the Department intends to select two or three sites from the following six: Hanford, INEL, LANL, NTS, ORR, and SRS.

The six sites named above are those at which DOE already has established LLW disposal operations and, except for NTS, each has large waste volumes for disposal. Because these six sites would have more than adequate capacity for the amounts of LLW the Department will need to dispose of, there is no need to establish additional sites. Fewer than the six sites would provide adequate capacity at a substantially lower overall cost. Relying on only one disposal site, however, would require the most transportation of the waste, with correspondingly higher traffic accident fatalities, and would be operationally inflexible if disposal activities were interrupted.

While all six current disposal sites remain candidates for future disposal operations and the potential health and environmental impacts of regionalized disposal are small, further consideration of various factors may affect the DOE's site preferences. For example, hydrological characteristics indicate that disposal at sites with high rainfall, such as ORR and SRS, would require mitigation

costs that would not be needed at more arid sites. However, a disposal configuration that included at least one eastern site and one western site would require less transportation and produce fewer fatalities from traffic accidents than an eastern-only or western-only configuration. Preliminary cost analyses indicate that regional disposal at ORR, LANL, and INEL may not be as cost effective as disposal at SRS, NTS, and Hanford.

Because of these sometimes contravening factors and the permanence associated with disposal decisions, it is prudent to further evaluate costs and discuss all pertinent aspects of potential configurations with stakeholders before identifying two or three preferred sites for disposal. The Department will notify the public which specific sites it prefers for disposal of LLW by publishing a notice in the *Federal Register* and by other means. DOE will not issue a Record of Decision selecting any regional disposal sites for LLW sooner than 30 days after publication of its preferred sites in the *Federal Register*.

Treatment and Storage of TRUW: Most of the DOE's sites with TRUW would treat and store it onsite. Five sites would ship TRUW to other sites for treatment under the preferred alternative: Pantex would ship its very small amount of TRUW to LANL for treatment; RFETS would ship some of its TRUW to INEL for treatment; ORR would send its CH-TRUW to SRS for treatment; SRS would send its RH-TRUW to ORR for treatment; and SNL-NM would send its small amount of TRUW to LANL for treatment. This preference assumes that WIPP will require treatment to the waste acceptance criteria the Department has proposed to EPA for this geologic repository. DOE's preference could change if WIPP requires a different level of treatment. The Department would store its TRUW where it is treated pending a decision on its disposal or other disposition.

DOE's preferred alternative is a combination of parts of the Decentralized Alternative and several of the Regionalized Alternatives as shown in Table 2.3–1. It provides for cost-effective management of TRUW, poses low potential risks to the public, and has relatively small environmental impacts. DOE's preference is consistent with the preferred alternative identified in the *Waste Isolation Pilot Plant Disposal Phase Draft Supplemental Environmental Impact Statement* (WIPP SEIS-II).

Storage of HLW: The Department's preferred alternative at this time is to store its HLW where the waste is treated pending a decision on its disposal or other disposition. Because it is impractical to ship liquid HLW for treatment, DOE had previously decided that each of the four sites with HLW (Hanford, INEL, SRS, and WVDP) will treat its own waste onsite.

The potential impacts of DOE's preferred alternative are presented under the Decentralized Alternative for HLW. This alternative minimizes the transportation of treated HLW, makes use of existing storage capacity at WVDP and SRS, and would cost less than regionalized or centralized storage. The potential environmental impacts of all alternatives for HLW evaluated in the WM PEIS are small.

Treatment of HW: DOE's preferred alternative for HW is the No Action Alternative, which means the Department would continue to use commercial facilities to treat most of its non-wastewater HW. The transportation and environmental impacts are low for all of the alternatives for HW evaluated in the WM PEIS; however, the No Action Alternative costs less than the Decentralized or Regionalized Alternatives for HW treatment.

3 Analysis

To evaluate the potential environmental impacts of the alternatives, DOE first identified the characteristics, quantity, and special requirements (e.g., handling requirements) of each waste type. To frame the analysis within reasonable bounds and to make the analytical process more manageable, DOE developed and applied specific assumptions to the alternatives. DOE then determined the health risks, environmental impacts, and costs of implementing each alternative for each waste type. Figure 3.1–1 depicts this framework.

3.1 The Analytical Process

The management impacts of the five waste types were evaluated using an analytical process with three phases, as shown in Figure 3.1–2, for each of the alternatives. This three-phase approach was applied in the analysis of treatment, transportation, storage, and disposal activities.

In Phase I, DOE made certain assumptions concerning the physical, chemical, and radiological characteristics of the waste streams and the volume of each waste type. The physical, chemical, and radiological characteristics of the thousands of inventoried waste streams were aggregated into a smaller number of waste treatability groups for each waste type (e.g., 9 treatability groups for LLW, 23 for LLMW, and 19 for TRUW). Generic treatment system designs were developed for each of the treatability groups by using currently accepted treatment technologies.

Conceptual treatment facilities were then modeled that could process the volume of waste.

Figure 3.1–1. Waste Management System.

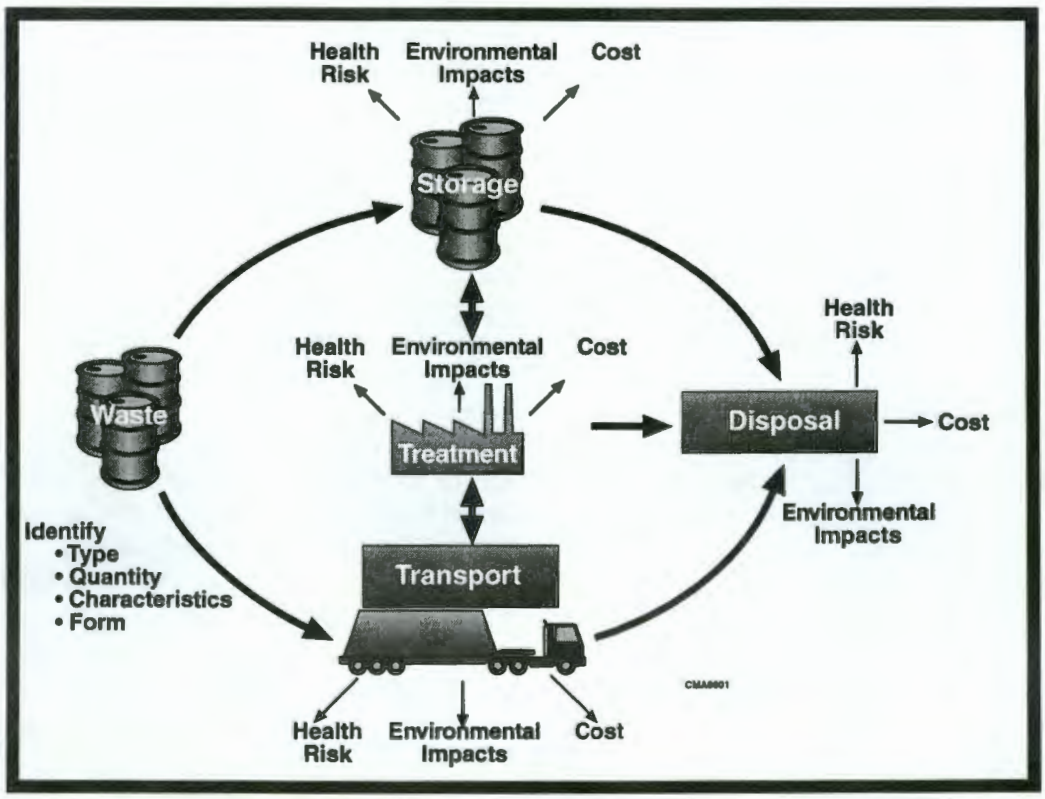
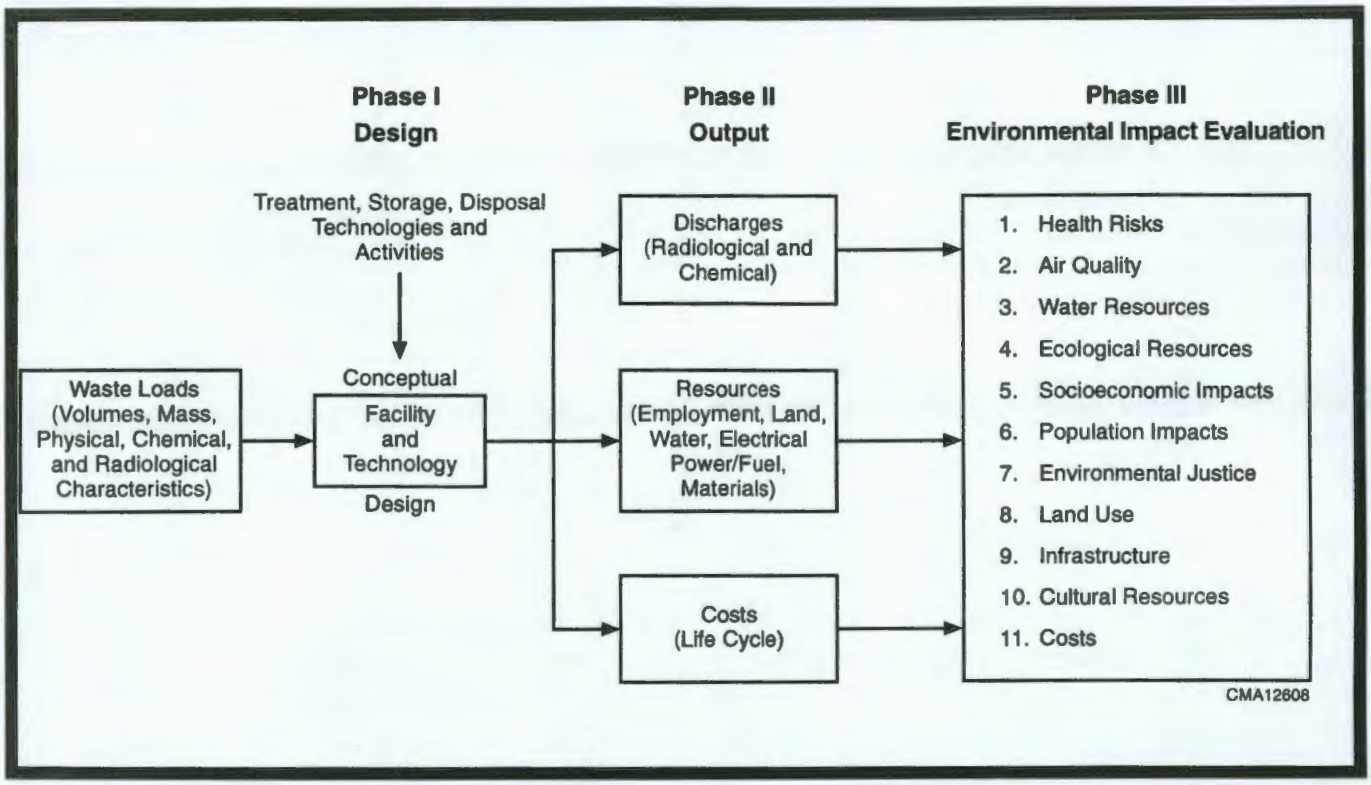


Figure 3.1-2. WM PEIS Analytical Process.



Initially the waste types were grouped into six physical categories on the basis of common engineering criteria. DOE then used standard radiological profiles for each site and made assumptions about the concentrations of contaminants in each treatability group on the basis of available data. Hazardous constituents were assigned to the treatability groups by using an average composition for all DOE sites. The assumptions for both radioactive and hazardous constituents vary by waste type assigned.

To develop conceptual facilities for the analysis, DOE considered all types of waste management facilities needed to process and transport each waste type and also examined the various technologies available for managing the specific type of waste.

The generic waste management facilities were assumed to be placed at selected locations on a DOE site—an existing waste management location or the geographic center of the DOE site—so that actual environmental data could be used in the analysis (e.g., data regarding distance to receptors and prevailing winds). The use of a specific location permitted the analysis of impacts by providing actual environmental settings for a facility; placement of facilities at sites was done only for analysis purposes. Decisions regarding the actual location of waste management facilities at DOE sites will not be made on the basis of this WM PEIS, but will be the subject of site-specific NEPA reviews.

In Phase II, the engineering features of the conceptual facility and the waste volumes "processed" through the facility formed the basis for the estimates of resources required, effluents released, and cost. In Phase III, Environmental Impact Evaluation, the releases, resources, and costs became the input for evaluating health risks, environmental impacts, and socioeconomic impacts.

To conduct the analysis, DOE had to define the "affected environment." The affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." DOE described the affected environment to establish the baseline conditions at each of the major sites before evaluating the components of the WM PEIS alternatives. The baseline can then be compared with the level of impacts directly related to a given alternative. Because of the national scope of this WM PEIS, DOE not only examined specific site characteristics but also examined broad regions of influence surrounding the sites, as well as the interconnecting roadway and rail corridors between sites. The WM PEIS analyzes the environmental impacts of operating waste management facilities for 10 years. Although the facilities could operate for up to 30 years, DOE expects that most of the annual impacts after 10 years of operation would be similar to or less than those predicted by the WM PEIS. The remainder of this section highlights the analysis performed for each of the impact areas considered.

3.2 Types of Impacts

Ten types of environmental impacts were evaluated in the WM PEIS: Health Risk, Air Quality, Water Resources, Ecological, Economic, Population, Environmental Justice, Land Use, Infrastructure, and Cultural Resources. Costs were also evaluated.

3.2.1 Health Risks

Health risk impacts can result from exposure to radiation and chemicals and from physical trauma (i.e., accidents) associated with constructing and operating treatment and disposal facilities or transporting waste. The WM PEIS evaluates risks associated with activities that occur over a 20-year period (10 years of construction followed by 10 years of operations).

Waste Treatability Groups

- ***Aqueous liquids**. Primarily water with organic content less than 1% (such as wastewater)*
- ***Organic liquids**. Liquids and slurries with organic content greater than 1% (such as solvents)*
- ***Organic and inorganic sludge and particulates**. Solid and semisolid material other than debris (such as sludge from treatment plants, resins, and solids less than 1-centimeter-diameter particle size)*
- ***Soils**. Contaminated soils (such as contaminated earth requiring remediation)*
- ***Debris**. Solid material exceeding 1-centimeter-diameter particle size that is either (1) manufactured, (2) plant or animal matter, or (3) discarded natural or geologic material*
- ***Other**. Special waste streams (such as batteries, laboratory packs, reactive metals, and toxic metals, which include mercury, lead, and beryllium)*

This basic framework analysis was used for four waste types: LLMW, LLW, TRUW, and HW. For purposes of the WM PEIS analysis, HLW is assumed to have been treated (vitrified) before it would be stored. The WM PEIS only addresses the environmental consequences of storing and transporting vitrified HLW.

For routine operations involving treatment, health effects were evaluated for the offsite population, the onsite worker population not involved in treatment, and waste management workers directly involved in treatment. Risks were quantified using two approaches: analysis of *population* health risk impacts and analysis of *individual* health risk impacts.

Population health risks focus on the *total number* of people in each population who would experience adverse health impacts if a particular alternative is implemented. These impacts include fatalities from physical hazards, cancer fatalities, cancer incidences, and genetic effects.

Individual impacts focus on the *probability* that the "maximally exposed individual" (MEI) within each receptor population would experience an adverse health impact. These impacts include the probabilities of a cancer fatality, cancer incidence, and genetic effects. Because the focus is on the MEI, the risk is presented as a probability (e.g., one-in-one-million chance) of that individual experiencing an adverse health impact, rather than the total number of impacts for an affected population.

Health risks resulting from disposal were evaluated for LLMW and LLW. The analysis considered risk to workers handling the treated waste, risk to an onsite "hypothetical farm family" living 300 meters from the center of the disposal facility, and risk to a hypothetical "intruder" into the disposal facility after the facility has been closed. The risks to the hypothetical farm family were estimated over a 10,000-year period because the maximum exposure would occur in the future after the disposal unit breaks down and potential contaminants leak into groundwater. The 10,000-year period was selected for the analysis to maintain consistency with the "Guidelines for Radiological Performance Assessment of DOE Low-Level Radioactive Waste Disposal Sites" that existed at the time the WM PEIS analysis was initiated. The guidance for performance assessments has since been changed; current guidance suggests that a 1,000-year time period should be used in the performance

Maximally Exposed Individual

In keeping with standard risk assessment methodology, DOE analyzed the impacts to a "maximally exposed individual." The MEI is the hypothetical person within the receptor group who has the highest exposure. This individual is assumed to be located at the point of maximum concentration of contaminants 24 hours per day, 7 days per week, for the 10-year period of treatment operations analyzed in the WM PEIS.

Hypothetical Farm Family and Intruder

The "hypothetical farm family" is an imaginary family assumed to live 300 meters downgradient of the center of a waste disposal unit. The family engages in farming activities, such as growing and consuming its own crops and livestock, and uses groundwater for watering the crops and animals. This is an estimated maximum exposure scenario taking place in the future at a time when institutional controls no longer exist. The scenario is analyzed to determine potential maximum exposures from ingestion of contaminated groundwater.

The hypothetical "intruder" is an imaginary adult who drills a well directly through a disposal unit to the groundwater. As a result of the drilling, contaminated soil from within the unit is brought to the surface, where it mixes with the top layers of the surface soil. The individual farms the land and eats the crops. The intruder scenario occurs after the failure of institutional control over the disposal facility. This scenario is consistent with the analysis required for disposal facilities under DOE Order 5820.2A.

assessments for waste disposal conducted to satisfy the requirements of DOE Order 5820.2A.

In addition to risks from construction and routine operations, health impacts from potential treatment and storage facility accidents were also evaluated. Data in safety analysis reports and site EISs were used as indicators of the consequences for a range of storage facility accidents of varying probabilities. For LLMW, LLW, TRUW, and HW treatment, the accident analysis focused on thermal treatment (specifically, incineration), because there is a significant amount of incineration data available, impacts of accidents associated with incineration are thought to be representative of and to encompass those accidents associated with other treatment technologies, and the public is very interested in incineration technology.

Transporting the wastes for treatment, storage, and disposal may affect the health of the public along the transportation route and the truck drivers or rail crew. Impacts evaluated included radiation exposure during normal operations, accidents in which the waste containers are assumed to open, exposure to vehicle exhaust during transport, and physical injury from vehicle accidents.

3.2.2 Air Quality Impacts

DOE evaluated air quality impacts at each proposed management site on the basis of estimated increases in emissions of the six criteria air pollutants, hazardous air pollutants (which include radionuclides), and toxic air pollutants when applicable. Pollutant emission estimates were made for construction and for operations and maintenance (O&M) activities of the waste facilities.

Criteria air pollutants can be emitted from construction equipment or from vehicles that workers use to drive to waste management facility construction sites. Both are considered to be "mobile sources" and thus subject to certain regulations. Criteria air pollutants can also be emitted during operation and management of LLMW, LLW, HW, and TRUW facilities (considered "stationary sources") and by vehicles that are driven by workers to the waste management facility or used to transport waste (mobile sources). DOE evaluated air quality impacts for these pollutants at each site by comparing estimated releases for each alternative with the allowable emission limits.

For all wastes except HLW and HW, DOE also evaluated impacts from radionuclide emissions by comparing the dose to the offsite MEI with the 10-millirem-per-year standard under the National Emission Standards for Hazardous Air Pollutants. Concentrations of hazardous or toxic air pollutants were compared with Federal, State, or local air quality standards and guidelines.

3.2.3 Water Resources Impacts

DOE analyzed the impacts on onsite water resources from management activities. DOE evaluated the effects on water availability from constructing and operating waste management facilities. Increases of greater than 1% over the current water use were identified and the impacts analyzed.

DOE also evaluated the impacts to groundwater quality caused by the migration of radionuclides and chemicals that leach from disposal facilities over time. DOE calculated concentrations of radionuclides and hazardous components at a hypothetical well located

Major Types of Air Pollutants

***Criteria Air Pollutants**: carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxide (NO_2), lead (Pb), ozone (O_3), and particulate matter less than or equal to 10 microns in diameter (PM_{10})*

***Hazardous Air Pollutants**: 189 hazardous substances (including radionuclides) whose emissions are regulated by the Clean Air Act*

***Toxic Air Pollutants**: Other toxic compounds regulated by EPA and State or local governments*

300 meters from the center of the disposal facility and compared these to drinking water standards.

3.2.4 Ecological Resources Impacts

DOE analyzed the effects of both construction site clearing (to build waste management facilities) and of airborne releases of contaminants from these facilities on ecological resources. DOE also considered the effects of accidental spills of waste during transportation. Sites where proposed construction would disturb more than 1% of the available management area were identified.

Although DOE intends to use the WM PEIS as a tool to help select sites for waste management, it will not select the specific location for a waste management facility at a site on the basis of this WM PEIS. Specific locations will be selected on the basis of subsequent sitewide or project-specific NEPA reviews. Potential impacts to sensitive species or habitats at particular locations within a site would be analyzed in those reviews.

3.2.5 Economic Impacts

DOE estimated the effects of expenditures for waste management activities on the local and national economies. Local economic effects were determined on the basis of direct expenditures at each site for construction, O&M, and decontamination of waste management facilities. The region of influence (ROI), where local effects were evaluated, consists essentially of the counties of residence of site employees. The local economy at each site was represented by employment, personal income, and industry data for the ROI counties. Local increases in jobs and personal income were considered to be substantial benefits in cases where the increases were 1% or more above the 1990 baseline. Transportation expenditures were considered at the national level only.

3.2.6 Population Impacts

The analysis also examined the potential for the waste management alternatives to cause the types of social impacts that could result when any large industrial or public works project attracts workers and their families to an area. Potential population changes in the ROI were estimated by using the direct labor requirement to calculate potential worker migration into the region.

3.2.7 Environmental Justice

Federal agencies have been directed by Executive Order to incorporate considerations of environmental justice into their missions. As such, Federal agencies are specifically directed to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations.

To perform this assessment for the WM PEIS, DOE used a geographic information system and Census Bureau data at the tract level to identify minority and low-income populations within 50 miles of the 17 major sites. Native American lands within 50 miles of any site were also identified and mapped. DOE then reviewed the potential health risks and environmental impacts associated with alternatives for the five waste types. The potential inequities from the waste management alternatives were analyzed in terms of the proportion of minority and low-income populations that reside within the 50-mile zone of impact at each site. Only in cases where a specific impact was high near a particular site would there be a potential for disproportionately high and adverse impacts to minority or low-income groups. Sites where risks or environmental impacts were estimated to be potentially high or adverse are identified.

3.2.8 Land Use Impacts

DOE examined the impacts on land use that could result from the alternatives for each waste type by comparing the acreage required for new management facilities with the acreage either designated for waste operations or suitable for development at a site. Suitable land is the total site acreage, minus the acreage required for existing structures, known cultural resource areas, sensitive habitats (including

wetlands and wildlife management areas), prohibitive topographic (surface) features, and surface waters. Where the acreage comparison showed a 1% or greater land requirement (of the designated or suitable land area) for new facilities, further evaluation of impacts was conducted. Available site development plans were also used to identify potential conflicts among the proposed facilities required under each alternative and plans for future site uses.

INEL central facilities area.

3.2.9 Infrastructure Impacts

DOE evaluated the impacts on site infrastructure by comparing requirements for water, wastewater treatment, and electrical power that result from implementing the WM PEIS alternatives with existing onsite capacities. Site transportation infrastructure and offsite infrastructure impacts were evaluated by using estimates of increased population resulting from the proposed activities as an indicator of increased demand on the community infrastructure.

ORR Y-12 Plant looking west.

Impacts were considered possible where increases in onsite infrastructure requirements were 5% or greater. Major impacts were considered possible where new requirements caused system capacity to be approached or exceeded. Therefore, any increase of 5% or greater that caused the total site use rate to exceed 90% of available capacity, was considered to have the potential to cause a major infrastructure impact.

Savannah River Site.

Site transportation infrastructure impacts and offsite community infrastructure impacts were evaluated indirectly by comparing new site employment to existing site employment as an indicator of increased stress on site transportation systems and offsite infrastructure. New site employment of less than 5% of current employment was considered likely to have negligible or minor impacts. Site employment increases from 5% to less than 15% were considered to have the potential to cause moderate impacts, and increases of 15% or greater were considered to have the potential to cause major impacts.

3.2.10 Cultural Resources Impacts

Cultural resources, including prehistoric, historic, Native American, and paleontological resources, may be affected at sites where waste management facilities are proposed to be built. However, the impacts of the construction of waste management facilities on cultural resources cannot be effectively analyzed at the programmatic level because the extent of those impacts depends upon their specific location at a site. These impacts will be examined in sitewide or project-specific NEPA reviews.

3.2.11 Geology and Soils Impacts

As indicated in Chapter 4, Affected Environment, DOE's review of the geology and soils at the 17 major sites indicated that it is unlikely that impacts to these resources would affect the selection of alternatives for any waste type. While geology and soils are important determinants of where on a particular site a facility could be located, such determinations are not being made at the programmatic (i.e., Departmentwide) level. Exact locations of facilities and impacts to geology and soils will be addressed in sitewide or project-level NEPA reviews.

3.2.12 Noise Impacts

Noise from construction and operation of waste management facilities and increased vehicle traffic may cause adverse impacts. Noise impacts, however, are especially dependent on the technology employed and the siting, which the WM PEIS does not specify. Therefore, noise impacts cannot be evaluated. Exact locations of facilities and related noise levels will be addressed in sitewide or project-level NEPA reviews.

3.2.13 Costs

DOE evaluated estimated costs for building and operating waste management facilities and for transportation from both a life-cycle and process perspective, using 1994 dollars.

DOE evaluated facility costs for four phases representing the life cycle of a facility and its operations over a 20-year period: construction, preoperations, O&M, and decontamination and decommissioning.

The only exception was HLW, which was costed by using a two-phased life-cycle approach (construction and O&M) for the storage facilities.

Examples of life-cycle costs include:

- Costs for preoperation activities: technology and site adaptation, permitting, plant setup, and related conceptual design
- Facility construction costs: building construction, equipment purchase and installation, construction and project management
- Operations and maintenance costs: annual operations costs for labor and materials, equipment, utilities, and overhead
- Decontamination and decommissioning costs: facility decontamination and demolition, post-closure, and environmental monitoring

For process costs, DOE also analyzed costs for treatment, storage, and disposal activities. Treatment costs include costs to build and operate treatment facilities and common support facilities. For most waste types, current storage capacity was assumed to be sufficient, except for the No Action Alternative, where DOE estimated the costs to build and operate sufficient storage capacity. Disposal costs include costs to build and operate front-end administration and receiving facilities and the actual disposal units. Transportation costs include the costs associated with the movement of the waste among sites. Transportation costs were evaluated for both truck and rail shipments.

Low-Level Mixed Waste

At a Glance:
Low-Level Mixed Waste

No Action Alternative:

- Continue treatment at existing facilities with indefinite storage.
- Does not include disposal and does not comply with RCRA.

Decentralized Alternative:

- Treatment at all 37 sites and disposal at 16.

Four Regionalized Alternatives:

- Treatment at 11, 7, or 4 sites with disposal at 12, 6, or 1 site(s).

Centralized Alternative:

- Treatment and disposal at one site.

Preferred Alternative:

- Sites with small amounts would send their waste to Hanford, INEL, ORR, or SRS for treatment. Eight major sites would treat onsite.
- Regionalized disposal at two or three sites to be selected after consultation with stakeholders from among the following six sites: Hanford, INEL, NTS, LANL, ORR, and SRS.

LLMW Data and Major Assumptions:

- 37 sites generate or store LLMW.
- DOE will need to manage an estimated 219,000 cubic meters of LLMW over the next 20 years.
- All LLMW treatment facilities would be designed to treat waste to meet RCRA requirements.
- New facilities would be constructed during a 10-year period; LLMW currently in inventory and newly generated would be treated during the 10-year period following construction of facilities.
- Wastewater treatment would continue at every site.
- No waste acceptance criteria were imposed on disposal sites.

What Did We Learn From the Results?

- Risks from LLMW action alternatives are generally low, with the greatest risks occurring for workers from physical accidents normally expected in any industrial activity.
- Costs range from $5.2 billion for the No Action Alternative to $12.3 billion for the Decentralized Alternative.
- Limits on radionuclides and hazardous constituents as well as other waste acceptance criteria would be required for disposal at most sites.

4 Low-Level Mixed Waste

- *LLMW contains both radioactive and hazardous components.*
- *LLMW is generated, projected to be generated, or stored at 37 DOE sites as a result of research, development, production, testing, and dismantlement of nuclear weapons.*
- *DOE will need to manage an estimated 219,000 cubic meters of LLMW over the next 20 years.*
- *DOE must select treatment and disposal sites for LLMW.*

4.1 Analysis

The challenge in managing LLMW arises from its dual nature—it contains RCRA-classified hazardous components (or characteristics) and is radioactive. Because of the complex regulatory requirements governing the management of LLMW, DOE must define a waste management system focused on treating and disposing of LLMW and minimizing the amount in storage.

LLMW is generated, projected to be generated, or stored at 37 DOE sites. According to DOE estimates, 219,000 cubic meters of LLMW will need to be managed over the next 20 years. Figure 4.1–1 presents the estimated total volume of LLMW from waste management activities at each of the 37 sites and illustrates its distribution across the country at the 16 major LLMW sites analyzed in the WM PEIS. WIPP, the 17th major site, will manage only TRUW.

In addition to analyzing the impacts from treatment and disposal, DOE analyzed the transportation impacts associated with each alternative. Both truck and rail transportation were analyzed by using routing models following the general principle of minimizing transportation time and shipping distance. The routes were selected to be consistent with existing routing practices and all applicable regulations and guidelines; however, because the routes were determined for the purposes of risk assessment, they do not necessarily represent actual routes that DOE would use to transport waste in the future.

4.2 Alternatives

DOE analyzed seven alternatives for CH LLMW within the four categories of alternatives: no action, decentralized, regionalized, and centralized. Treatment and disposal activities vary by alternative and by site. Table 4.2–1 illustrates by site where LLMW would be treated and disposed of under each alternative.

The LLMW analysis considered treatment and disposal separately, first focusing on treatment and then using treatment residues (waste remaining after treatment) as the input volumes for the disposal analysis. Each alternative was developed to assess environmental impacts, health risks, and costs associated with the range of LLMW treatment and disposal options, and to provide input for programmatic decisions about where to locate LLMW treatment and disposal facilities.

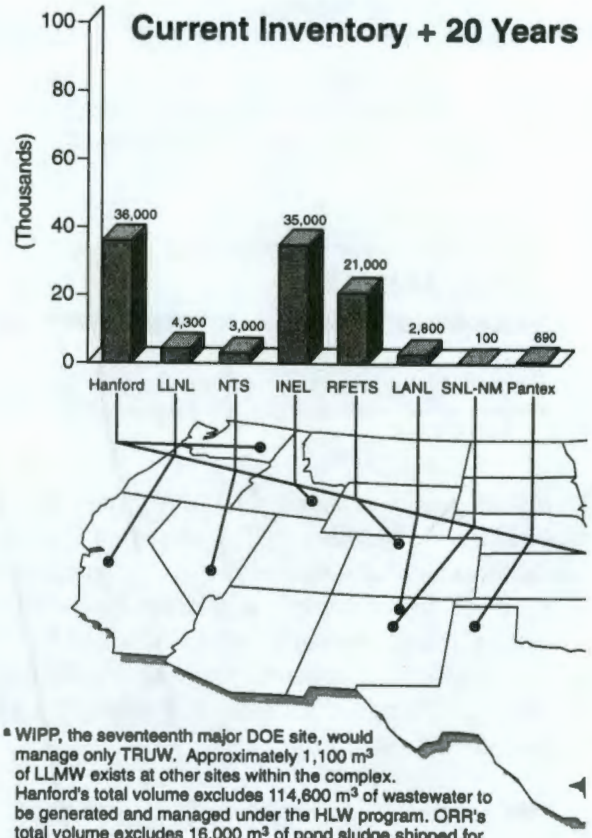
Although alpha LLMW is not a concern to workers or the public as a source of external radiation, precautions must be taken when treating alpha LLMW in order to minimize the likelihood of inhalation or ingestion of radionuclides that emit alpha particles. Alpha LLMW exists at 10 sites. Sites where alpha LLMW would be treated or disposed of are indicated in Table 4.2–1 by the alpha symbol (α).

Remote-handled waste requires special handling facilities for treatment and disposal. Under all alternatives, RH LLMW would be treated and disposed of at the same four sites where the majority of RH LLMW is located: Hanford, INEL, ORR, and SRS.

LLMW Volumes

DOE Sites	Total Volumes (m^3)
1. Ames	0.4
2. ANL-E	160
3. BCL	0.1
4. Bettis	48
5. BNL	190
6. Charleston	3
7. ETEC	17
8. FEMP	2,600
9. GA	43
10. GJPO	1.5
11. Hanford	36,000
12. INEL	35,000
13. KCP	0.8
14. KAPL	220
15. LEHR	7
16. LBL	280
17. LLNL	4,300
18. LANL	2,800
19. Mare Is	52

Figure 4.1–1 LLMW Total

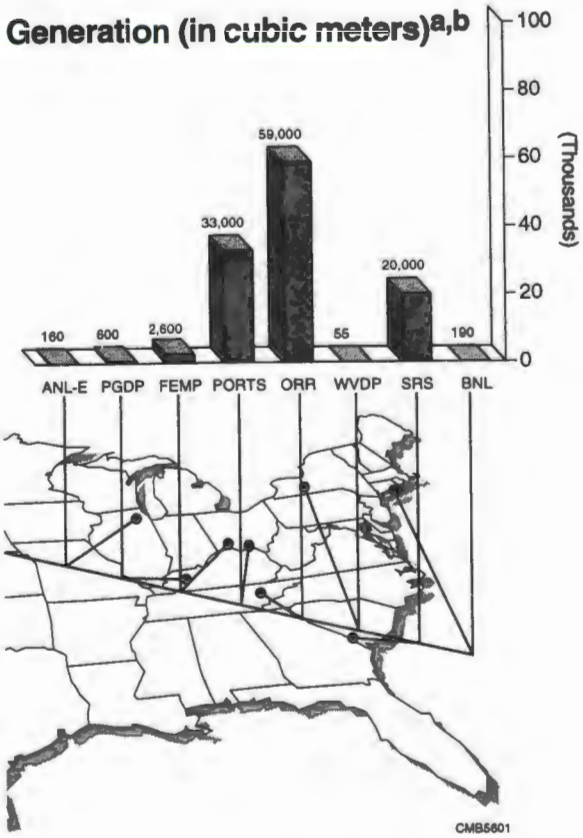


[a] WIPP, the seventeenth major DOE site, would manage only TRUW. Approximately 1,100 m^3 of LLMW exists at other sites within the complex. Hanford's total volume excludes 114,600 m^3 of wastewater to be generated and managed under the HLW program. ORR's total volume excludes 16,000 m^3 of pond sludge shipped for commercial disposal.

[b] Updated inventories and waste generation rates are summarized in Appendix I.

Source: DOE (1994).

Volumes at the 16 Major Sites.



LLMW Volumes—Continued*

DOE Sites	Total Volumes (m^3)
20. Mound	80
21. NTS	3,000
22. Norfolk	5
23. ORR	59,000
24. PGDP	600
25. Pantex	690
26. Pearl H	6
27. Pinellas	0.02
28. PORTS	33,000
29. Ports Nav	1
30. PPPL	0.02
31. Puget So	230
32. RMI	30
33. RFETS	21,000
34. SNL-NM	100
35. SRS	20,000
36. UofMO	2
37. WVDP	55
Total	**219,000**

*Estimated LLMW volumes from waste management activities include current inventory plus 20 years of anticipated generation. Waste volumes used for WM PEIS analysis may vary from latest estimates. Waste volumes at individual sites have been rounded to one or two significant figures. Updated inventories and waste generation rates are summarized in Appendix I, "Update of Site-Specific Waste Volumes for LLW, LLMW, and TRUW."

4.2.1 No Action Alternative

The No Action Alternative provides a baseline for the analysis by considering treatment of LLMW at sites with facilities that are currently capable of treating waste to meet the EPA's hazardous waste LDRs. The No Action Alternative also analyzes the indefinite storage of the waste on site at all LLMW sites. Three sites are currently capable of treating LLMW to meet LDRs: INEL, ORR, and SRS. Other sites may experience impacts from the construction of expanded storage, onsite shipping, or certification facilities (where the waste would be examined, characterized, and certified for shipment).

Under this alternative, no new treatment facilities would be built. The No Action Alternative would not comply with RCRA because all the waste would not be treated to meet LDRs and would be placed in storage for an indefinite period of time rather than in disposal facilities.

4.2.2 Decentralized Alternative

The Decentralized Alternative considers treatment of waste to meet RCRA requirements at all 37 LLMW sites. For purposes of this analysis, DOE examined the impacts from treatment at the 16 major LLMW sites. Two of these 16 sites (BNL and SNL-NM) have relatively small amounts of LLMW (less than 200 cubic meters). Most of the other 21 sites that are not major sites have less than 200 cubic meters of LLMW; therefore, DOE assumed that their health and environmental impacts would be similar to those seen at BNL and SNL-NM. However, costs were calculated by using data from all 37 sites.

4.2.3 Regionalized Alternatives

Consolidation of LLMW for treatment and disposal was considered under the four LLMW regionalized alternatives. The regionalized alternatives were

Table 4.2–1. Low-Level Mixed Waste Alternatives

Alternatives	Number of Sites		ANL-E	BNL	FEMP	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	Pantex	PORTS	RFETS	SNL-NM	SRS	WVDP
	T	D																
No Action	3	0	S	S	S	S	TS	S	S	S	TS	S	S	S	S	S	TS	S
Decentralized	37	16	TD	TD	TD	TD	TDα	TDα	TDα	TDα	TD	TD	TD	TD	TDα	TD	TDα	TD
Regionalized 1	11	12			TD	TD	TDα	TDα	TDα	Dα	TD	TD	TD	TD	TDα		TDα	
Regionalized 2	7	6				TD	TDα	TDα		Dα	TD			T	Tα		TDα	
Regionalized 3	7	1				T	Tα	T		Dα	T			T	Tα		Tα	
Regionalized 4	4	6				TD	TDα	Dα		Dα	TD						TDα	
Centralized	1	1				TDα												

Notes: T = treatment to meet land disposal restrictions; D = disposal; S = indefinite storage. A blank indicates that a site does not treat, store, or dispose of waste under the alternative specified. All sites have wastewater treatment capability as needed. Remote-handled (RH) wastes would be treated and disposed on site at Hanford, INEL, ORR, and SRS in all alternatives except No Action. RH waste is stored under No Action. Facilities with the α symbol treat or dispose of contact-handled (CH) alpha waste in addition to non-alpha waste.

LLMW sampling at ORR.

developed to include a reasonable range of intermediate levels of consolidation for treatment and disposal. Regionalized Alternative 1 considers treatment of wastes at 11 sites and disposal at 12 (the 11 treatment sites and NTS). Regionalized Alternative 2 analyzes the impacts of treatment at seven sites with disposal at six sites. Under this alternative, two of the treatment sites (RFETS and PORTS) are not considered for disposal, and NTS is considered for disposal only. Regionalized Alternative 3 analyzes the same seven treatment sites as Regionalized Alternative 2, but it considers disposal only at NTS. Regionalized Alternative 4 considers treatment at four sites—Hanford, INEL, ORR, and SRS—and disposal at six sites (the four treatment sites plus LANL and NTS).

4.2.4 Centralized Alternative

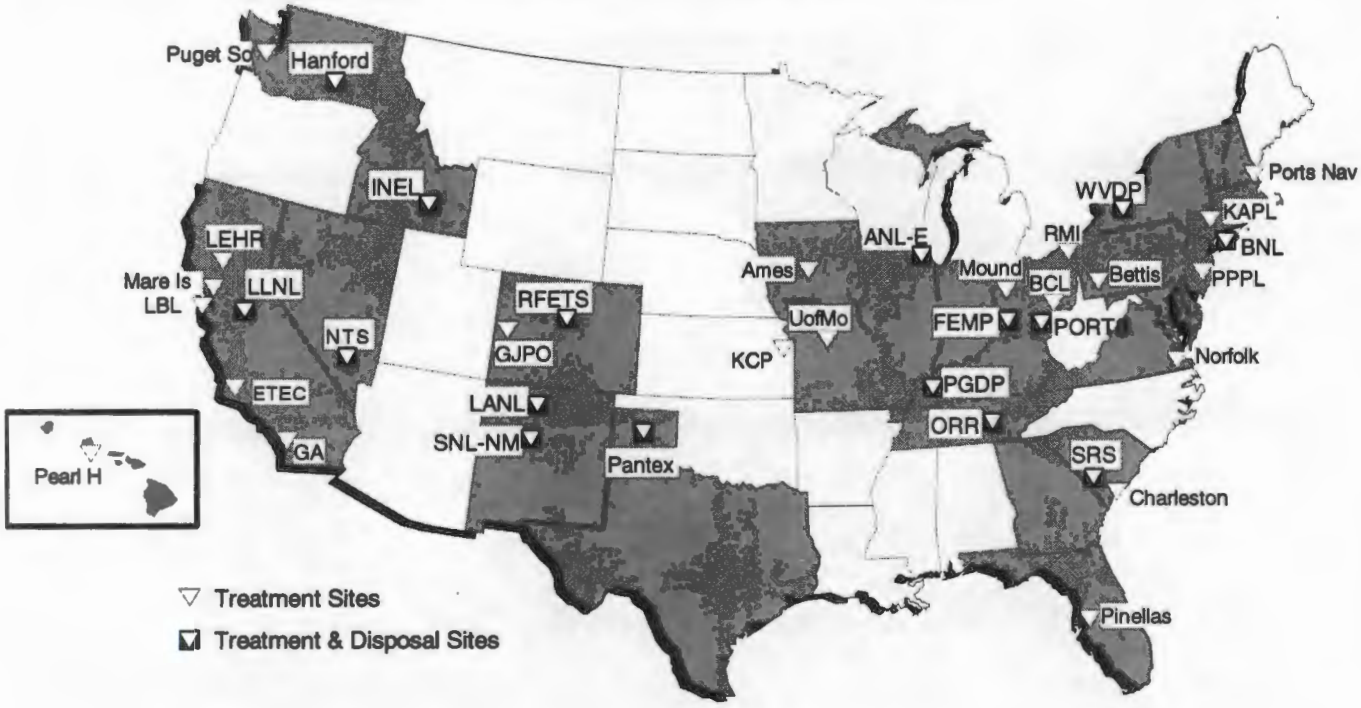
The Centralized Alternative considers LLMW treatment and disposal at a single site within the complex, the Hanford Site. However, other sites around the country may experience impacts from the construction of facilities where the waste would be examined, characterized, certified, and prepared for shipment. The impacts of centralizing disposal at NTS were also analyzed under Regionalized Alternative 3.

4.2.5 Rationale for Treatment and Disposal Alternatives

The seven LLMW treatment alternatives were developed to cover the range of reasonable alternatives. Up to 37 sites as illustrated in Figure 4.2–1 are available for treatment (the centralized and decentralized alternatives, respectively). DOE identified four intermediate alternatives for treating LLMW at 4 to 11 sites (the regionalized alternatives). To develop the variations of the regionalized alternatives, DOE focused on the sites where the largest volumes of LLMW are located. Alpha CH and all RH LLMW would be sent to the closest facility capable of treating those wastes. For all alternatives, DOE assumed that some treatment capabilities would be available at every site for initial treatment of onsite aqueous liquids by means of techniques such as evaporation, neutralization, precipitation, filtration, coagulation, or limited solidification.

The regionalized alternatives consider the impacts of consolidating treatment to meet LDRs at selected sites. Regionalized Alternative 1 considers treatment at 11 sites. This alternative was developed by identifying the location of most of DOE's LLMW and looking for optimal site groupings.

Figure 4.2–1. Locations of the 37 LLMW Sites.



Note: Maps display CH LLMW. RH LLMW is treated and disposed of onsite at the Hanford site, INEL, ORR, and SRS.

Under Regionalized Alternatives 2 and 3, seven sites are considered as potential treatment locations. DOE chose the six sites with the highest waste volumes, and then added LANL. Because a large volume of TRUW at LANL may be reanalyzed and subsequently reclassified as alpha LLMW on the basis of its radionuclide concentration, the volume of LLMW at LANL might significantly increase.

Regionalized Alternative 4 consists of the sites with the three highest volumes (Hanford, INEL, and ORR), as well as SRS, which is the sixth largest in terms of volume. SRS was chosen because it has large volumes of alpha LLMW and TRUW, some of which eventually may be reclassified as LLMW. In addition, an incinerator with an annual LLMW treatment capacity of 8,200 cubic meters of LLMW is scheduled for SRS.

In the Centralized Alternative, all LLMW would be shipped to Hanford for treatment. Hanford currently has the second largest volume of LLMW. However, as Hanford's HLW is treated, a substantial portion of the resulting waste would become LLMW, thereby making the Hanford Site the largest LLMW site.

Candidate disposal sites were selected to reflect the reasonable range of alternatives. However, unlike the treatment analysis, the disposal analysis did not evaluate every site for disposal. Instead, 16 candidate sites were selected as the reasonable upper limit on the basis of screening performed by DOE in coordination with the States under the Federal Facility Compliance Act (FFCAct). The screening applied three exclusionary criteria to the 37 sites with LLMW: (1) sites could not be within a designated 100-year floodplain, (2) sites could not be located

within 61 meters of a seismic fault, and (3) sites had to have sufficient area for a 100-meter buffer zone between the disposal facility and the site boundary. Sites were also removed for other technical and practical reasons.

The Decentralized Alternative looked at disposal at all 16 candidate sites, and the Centralized Alternative looked at disposal at one site—Hanford. Hanford was analyzed because it is expected to have the largest volume of LLMW.

DOE analyzed two of the intermediate alternatives—disposal at 12 sites and at 6 sites—as regionalized alternatives. To define these regionalized alternatives, DOE selected the 11 sites with the largest volume of LLMW and added NTS because it has an LLMW disposal facility with a pending permit. The alternative defined for LLMW disposal included the six sites with currently operating LLW disposal facilities—Hanford, INEL, LANL, NTS, ORR, and SRS. NTS was considered as the single disposal site in Regionalized Alternative 3 to provide a comparison and an alternative to the single disposal location selected under the Centralized Alternative.

4.3 Impacts of Managing LLMW

Although some factors, such as cost, exhibited clear trends across the LLMW alternatives, most did not. Rather, the analysis of the impacts revealed sensitivities at particular sites regardless of the alternative.

When reviewing the impacts and cost identified for the No Action Alternative, it is important to realize that the results for indefinite storage are based on the initial 20 years of that indefinite period. This is consistent with the period of analysis for the other alternatives; however, the analysis of the No Action Alternative does not present the expected impacts from storage beyond this 20-year time frame. The longer-term storage impacts and costs are likely to exceed those for the first 20 years, not only as a result of routine indefinite storage operations, but also from degradation of facilities and containers. This differs from the effects predicted for the action alternatives for management of the 20-year forecast of LLMW, where direct risks to workers and the offsite population, and other impacts and costs, are greatly reduced following disposal. The No Action Alternative does not reduce or avoid impacts and costs; rather, it extends impacts and costs for an indefinite period of time.

The following discussion focuses on the impact areas that would be affected by the management of LLMW under the WM PEIS alternatives, identifying trends when appropriate and highlighting noteworthy findings at particular sites.

4.3.1 Health Risks

Risks at sites treating or disposing of LLMW are principally to workers involved in managing LLMW, rather than to noninvolved workers or the public, primarily as a result of physical hazards associated with industrial operations (see Table 4.3–1). As the number of treatment and disposal sites decreases,

Toxic Substances Control Act incinerator at ORR treats LLMW and PCB-contaminated wastes.

Table 4.3–1. Some of the Projected Risks to Workers and the Public From Managing LLMW

Alternative	Number of Sites		Treatment Worker Physical Hazard Fatalities	Treatment Worker Cancer Fatalities	Offsite Population Cancer Fatalities	Disposal Worker Physical Hazard Fatalities	Disposal Worker Cancer Fatalities	Truck[a] Radiation Fatalities	Truck[b] Non-Radiation Fatalities	Rail Radiation Fatalities	Rail Non-Radiation Fatalities
	T	D									
No Action[c]	3	-	2	1	*	NA	NA	NA	NA	NA	NA
Decentralized	37	16	4	1	*	*	1	*	*	*	*
Regionalized 1	11	12	4	1	*	*	1	*	*	*	*
Regionalized 2	7	6	3	1	*	*	1	*	*	*	*
Regionalized 3	7	1	3	1	*	*	*	*	1	*	*
Regionalized 4	4	6	3	1	*	*	1	*	*	*	*
Centralized	1	1	3	1	*	*	*	*	1	*	*

Notes: T = treatment; D= disposal; * = greater than 0 but less than 0.5; NA = not applicable.
[a] Fatalities are from radiation-induced cancer.
[b] Greatest number of fatalities are from physical hazards such as traffic accidents that occur within a 10-year analysis period.
[c] Treatment results under the No Action Alternative include the risks from only the first 20 years of indefinite storage of LLMW.

facilities at the remaining sites become larger and the number of total physical injuries decreases, reflecting an economy of scale due to fewer total workers. There are no notable national trends for offsite population risks from treatment; however, some sites could require alternate organic treatment technologies to minimize risks from thermal treatment of LLMW containing tritium. Under the No Action Alternative, treated waste would be stored indefinitely, with relatively large, potentially adverse consequences.

For disposal, concentrations of some radionuclides and chemicals in the groundwater near disposal facilities could exceed applicable standards at several sites. This would occur in the absence of waste acceptance criteria and other controls, thereby demonstrating the need for performance-based waste acceptance criteria if the sites were selected to manage LLMW. Pretreatment of chemicals and careful management of radionuclide concentrations and waste forms may be required to assure acceptable water quality and to reduce possible human exposures. Intruder risks (see text box, page 32) are generally higher at sites where the waste would have both high radioactivity and long-lived radionuclides. Intruder radiation exposure risks generally decrease with time, reflecting the decay of short-lived radionuclides. Treatment facility accident risks were low under all alternatives, with no sites experiencing cancer fatalities equal to or greater than one in the exposed worker or offsite populations over the 10-year period analyzed. Transportation risks were also low under all alternatives, reflecting relatively low transportation requirements. Table 4.3–1 presents projections of some risks for the LLMW alternatives.

4.3.2 Air Quality Impacts

The management of LLMW would not cause air quality standards to be approached or exceeded at most sites. However, centralization of treatment at Hanford and disposal at NTS could cause adverse air quality impacts requiring special emission control measures for criteria air pollutants. Vehicular emissions during construction at RFETS could require additional control measures to reduce emissions to acceptable levels if waste at these sites were stored, treated, or disposed of on site. Emissions of hazardous air pollutants, including radionuclides, were estimated to be below the applicable standards at every site.

4.3.3 Water Resources Impacts

Impacts to water availability tend to decrease as the LLMW management facilities are centralized. Major impacts on water availability from increased use at the sites are unlikely, although there is the potential for adverse impacts at LLNL Site-300, under all alternatives analyzed.

4.3.4 Economic and Population Impacts

Nationwide, the largest economic benefits resulting from LLMW management would occur under the Decentralized Alternative and generally decrease as the alternatives become more centralized. The greatest economic benefit at any site occurs when LLMW is managed at that site. The greatest number of new jobs created by LLMW management would occur in the region containing Hanford under the Centralized Alternative and in the region containing INEL under Regionalized Alternative 4. The national economy would not be affected by total project expenditures for the construction, operation, or transportation associated with any of the LLMW alternatives. No region would experience a population increase of 1% or greater.

4.3.5 Infrastructure Impacts

Although no offsite infrastructure impacts are expected to occur, proposed LLMW activities would affect the onsite infrastructure at 14 sites. Nine sites would experience increased requirements for water, wastewater treatment, or electrical power of 5% or more of current system capacity. The greatest increases would occur at RFETS under the Decentralized Alternative and Regionalized Alternative 1 and at Hanford under the Centralized Alternative, when waste is consolidated for treatment and disposal at these sites. Construction of additional storage under the No Action Alternative would also impact RFETS and INEL. However, only the projected volume of wastewater at Hanford (under the Centralized Alternative) is estimated to exceed the existing treatment capacity. Onsite transportation infrastructure would be affected at 12 sites because of site employment increases of 5% or more above current levels.

4.3.6 Costs

Costs decrease as the number of treatment and disposal sites decreases, ranging from $12.3 billion under the Decentralized Alternative to $5.2 billion under the No Action Alternative. Transportation costs are much lower than facility costs, making shipment to facilities at another site generally less expensive than building a new facility at that site. Table 4.3–2 provides the estimated cost to manage LLMW for each of the LLMW alternatives over the next 20 years.

4.3.7 Ecological Resources, Environmental Justice, Land Use, and Cultural Resources Impacts

The WM PEIS analysis did not reveal significant differences among the alternatives in these four impact areas, nor did it reveal any major impacts under any alternative. However, impacts to ecological and cultural resources depend to some degree on the treatment and disposal technologies selected and their location at each site and would be evaluated in site- or project-specific NEPA reviews. An assessment of potential environmental justice concerns from management of LLMW indicated that minority and low-income populations near the LLMW sites would not experience disproportionately high and adverse health risks or environmental impacts under any of the LLMW alternatives. Land use is not a good criterion for differentiating among alternatives because the alternatives do not use much land when compared with the amount available at every site.

Table 4.3–2. LLMW Estimated Life-Cycle Costs (Billions of 1994 Dollars)

Alternative	Number of Sites		Total (Including Truck Transport)	Transportation Costs	
	T	D		Truck	Rail
No Action[a]	3	0	5.2	0	0
Decentralized	37	16	12.3	0.001	0.0007
Regionalized 1	11	12	11.0	0.004	0.002
Regionalized 2	7	6	9.5	0.02	0.005
Regionalized 3	7	1	8.4	0.06	0.02
Regionalized 4	4	6	8.4	0.006	0.005
Centralized	1	1	7.7	0.03	0.01

Notes: T = treatment; D = disposal.
[a] Costs under the No Action Alternative include those from only the first 20 years of indefinite storage.

Low-Level Waste

At a Glance: Low-Level Waste

No Action Alternative:

- Disposal at six sites under current arrangements. Sites use existing treatment facilities.

Decentralized Alternative:

- Disposal at 16 sites. A minimum level of treatment at each site is assumed.

Seven Regionalized Alternatives:

- Disposal at 12, 6, or 2 sites. In three alternatives, treatment to reduce volumes is also assumed, with treatment at 11, 7, or 4 regional sites.

Five Centralized Alternatives:

- Disposal at one site (either Hanford or NTS). In three alternatives, treatment to reduce volumes is also assumed.

Preferred Alternative:

- Each site would conduct minimum treatment onsite.
- Regional disposal at two or three sites to be selected after consultations with stakeholders from among the following six sites: Hanford, INEL, LANL, NTS, ORR, and SRS.

LLW Data and Major Assumptions:

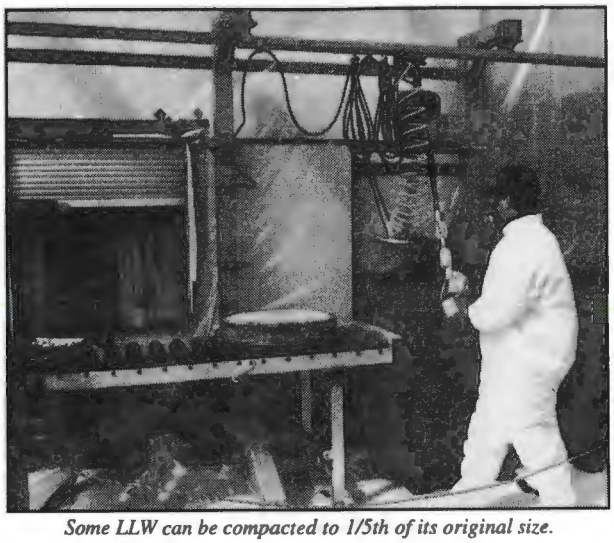
- LLW is currently generated, projected to be generated, or stored at 27 DOE sites.
- DOE will need to manage 1.5 million cubic meters of LLW over the next 20 years.
- New facilities would be constructed during a 10-year period; LLW currently in inventory and newly generated would be treated during the 10-year period following construction.
- Wastewater treatment would continue at every site.
- No waste acceptance criteria were imposed on disposal sites.

What Did We Learn from the Results?

- At a national level, costs, risks, and impacts would be greater for volume reduction than for minimum treatment.
- Centralized disposal would result in transportation of large amounts of waste with commensurately greater risk of both traffic accidents and radiation exposure. Rail transport has slightly lower risks than truck transport.
- Costs decrease as the number of treatment and disposal sites decreases.
- Radionuclide limits would be required for disposal at some sites.

5 Low-Level Waste

- *LLW is material that is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct tailings.*
- *DOE will need to manage an estimated 1.5 million cubic meters of LLW over the next 20 years.*
- *LLW is currently generated, anticipated to be generated, or stored at 27 DOE sites as a result of nuclear weapons production and dismantlement, reactor operations, and research.*
- *DOE must select treatment and disposal sites for LLW.*



Some LLW can be compacted to 1/5th of its original size.

5.1 Analysis

The character of the waste is as important as waste volume in determining the potential impacts resulting from LLW management. LLW can contain many different radionuclides in many combinations and can exist in many forms, ranging from dilute liquids to activated metal equipment.

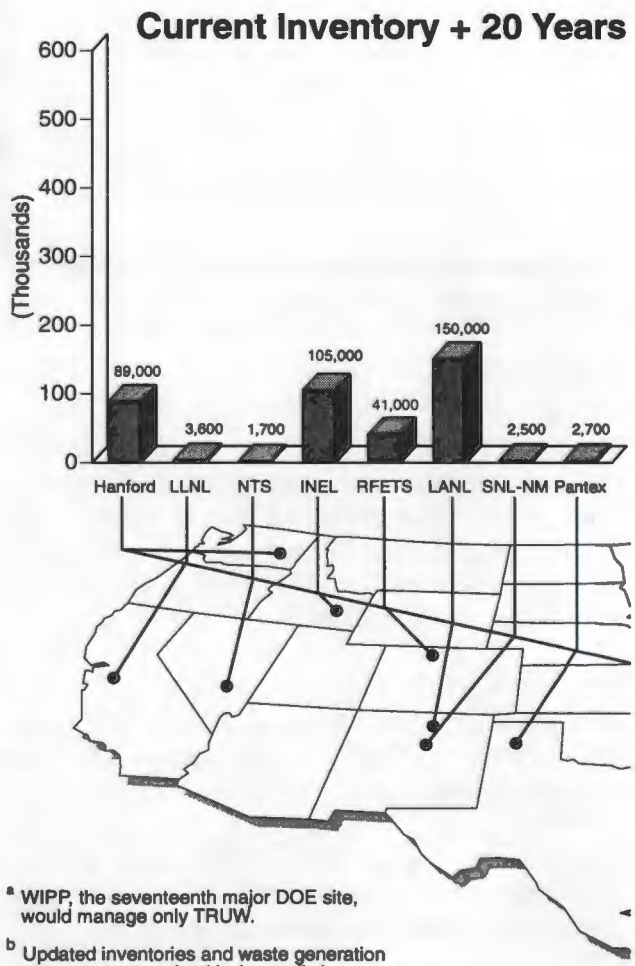
Approximately 1.5 million cubic meters of LLW is generated, anticipated to be generated, or stored at 27 DOE sites. Although 27 sites manage LLW, seven sites generate more than 80% of it—Hanford, INEL, LANL, ORR, PGDP, PORTS, and SRS. Figure 5.1–1 presents the total estimated volumes at all 27 sites. The distribution of LLW at the 16 major sites is illustrated by the bar chart and map.

DOE also has responsibility for two other types of LLW: commercially generated greater-than-Class-C (GTCC) waste and special-case waste. GTCC LLW is so named because it is more highly radioactive than Class C waste according to a classification system developed by the U.S. Nuclear Regulatory Commission; GTCC LLW is not suitable for near-surface disposal and will likely need to be disposed of in a geologic repository. Additionally, within the LLW (as well as LLMW and TRUW) category, there are wastes whose characteristics require special considerations and different management from that of most LLW. These wastes are special-case wastes. As detailed analyses are conducted, management plans for each waste stream would be established. These analyses could determine that some LLW streams currently managed as special cases meet the waste acceptance criteria for a disposal facility, and these waste streams would no longer be considered special case notwithstanding their earlier designation. Because programs for management of special-case and GTCC LLW have not been fully defined, these LLW groups are excluded from the WM PEIS analysis and will be addressed in separate NEPA reviews or in a supplement to the WM PEIS.

LLW Volumes

DOE Sites	Total Volumes (m^3)
1. Ames	110
2. ANL-E	6,700
3. Bettis	12,000
4. BNL	5,600**
5. Fermi	1,500
6. FEMP	0
7. Hanford	89,000
8. INEL	105,000
9. KCP	23
10. KAPL	19,000
11. LBL	1,300
12. LLNL	3,600
13. LANL	150,000

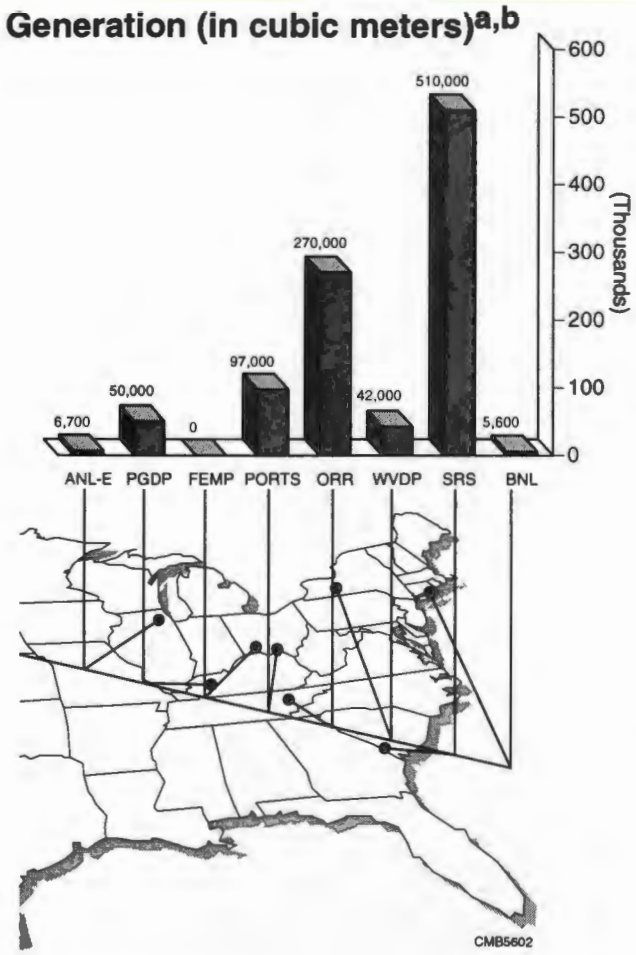
Figure 5.1–1. LLW Total



[a] WIPP, the seventeenth major DOE site, would manage only TRUW.

[b] Updated inventories and waste generation rates are summarized in Appendix I.

Volumes at the 16 Major Sites.



LLW Volumes (Continued)*

DOE Sites	Total Volumes (m^3)
14. Mound	38,000
15. NTS	1,700**
16. ORR	270,000**
17. PGDP	50,000
18. Pantex	2,700**
19. Pinellas	1,300
20. PORTS	97,000
21. PPPL	220
22. RMI	51,000
23. RFETS	41,000
24. SNL-NM	2,500
25. SRS	510,000
26. SLAC	2,500
27. WVDP	42,000**
Total	**1,500,000**

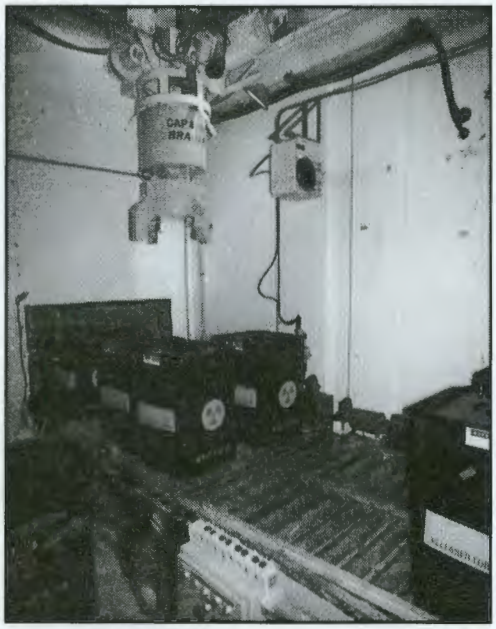
*Estimated LLW volumes from waste management activities include current inventory plus 20 years of anticipated generation. Waste volumes used in the WM PEIS analysis may vary from latest site estimates.

**Updated inventories and waste generation rates are summarized in Appendix I, "Update of Site-Specific Waste Volumes for LLW, LLMW, and TRUW."

DOE evaluated two treatment strategies for LLW:

- Minimum Treatment, defined as the least amount of treatment required prior to either onsite disposal or transport to another site for disposal. Minimum treatment includes solidification of liquids and fines (powdered material) and packaging.

- Volume Reduction, which reduces the overall volume of LLW by means of a variety of treatment techniques. Volume reduction can be achieved with several technologies, including thermal destruction, compaction or supercompaction, size reduction, evaporation and concentration. For disposal, DOE evaluated the impacts associated with both shallow land burial and engineered disposal facilities.



LLW in 270-liter, square cement-filled drums to be stored in specially designed aboveground vaults.

DOE analyzed transportation impacts associated with each alternative. Both truck and rail transportation were analyzed by using routing models that incorporate general principles of minimizing distance and transportation time. The routes were selected to be consistent with existing practices and all applicable regulations and guidelines; however, because the routes were determined for the purposes of risk assessment, they do not necessarily represent actual routes that DOE would use to transport waste in the future.

5.2 Alternatives

The WM PEIS considers 14 alternatives for treatment and disposal of LLW within the four categories of alternatives: No Action, Decentralized, Regionalized, and Centralized. Treatment and disposal activities vary by alternative and by site. Each of the 14 alternatives was developed in order to estimate health risks, environmental impacts, and costs associated with the range of treatment and disposal options available to DOE and to provide information for decisions about where to locate LLW treatment and disposal facilities. Table 5.2–1 shows the sites where LLW would be treated and disposed of under each alternative.

5.2.1 No Action Alternative

The No Action Alternative provides a baseline for the analysis that approximates the current DOE program. Under the No Action Alternative, LLW would be treated at existing facilities and shipped to one of six DOE disposal sites. Today, most DOE LLW disposal occurs at NTS and Hanford. The six sites now operating have sufficient designated area for the proposed LLW disposal; thus, no new sites would be necessary.

5.2.2 Decentralized Alternative

The Decentralized Alternative considers disposal of LLW at 16 sites following its minimum treatment at all 27 sites with LLW.

5.2.3 Regionalized Alternatives

Regionalized Alternative 1 considers disposal at 12 sites, after minimum treatment at all sites. Regionalized Alternative 2 analyzes the impacts resulting from disposal at the same 12 sites after volume reduction at 11 of these sites. In addition to the Decentralized Alternative, Regionalized Alternatives 1 and 2 are the only alternatives that propose disposal at FEMP, LLNL, Pantex, and PGDP.

The remainder of the regionalized alternatives (Regionalized Alternatives 3 through 7) consolidate most LLW treatment and disposal at eight sites: Hanford, INEL, LANL, NTS, ORR, PORTS, RFETS, and SRS. Although the sites are the same for

Table 5.2–1. Low-Level Waste Alternatives

Alternative	Number of Sites		ANL-E	BNL	FEMP	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	Pantex	PORTS	RFETS	SNL-NM	SRS	WVDP
	T	D																
No Action	10*	6				TD	TD	D	T	D	TD	T			T		TD	
Decentralized		16	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Regionalized 1		12			D	D	D	D	D	D	D	D	D	D	D		D	
Regionalized 2	11	12			TD	TD	TD	TD	TD	D	TD	TD	TD	TD	TD		TD	
Regionalized 3		6				D	D	D		D	D						D	
Regionalized 4	7	6				TD	TD	TD		D	TD			T	T		TD	
Regionalized 5	4	6				TD	TD	D		D	TD						TD	
Regionalized 6		2				D											D	
Regionalized 7		2								D							D	
Centralized 1		1				D												
Centralized 2		1								D								
Centralized 3	7	1				TD	T	T			T			T	T		T	
Centralized 4	7	1				T	T	T		D	T			T	T		T	
Centralized 5	1	1				TD												

Notes: T = treat. "Treat" in the context of LLW means volume reduction by means of thermal organic destruction, size reduction, and compaction followed by solidification. Sites carry out "minimum treatment" under all alternatives, which consists of solidification of liquids and "fines" (powdered material), packaging, and shipment. D = Dispose. Each of the 6-site disposal cases uses the same sites; each of the 12-site disposal cases uses the same 12 sites. A blank indicates that neither treatment nor disposal is proposed for this site under the alternative specified.
*Ten sites use existing facilities for volume reduction. Three sites (LBL, RMI, and Mound) not listed as major sites above include volume reduction facilities.

most of the regionalized alternatives, impacts at the sites vary because of the use of different treatment technologies and volumes of waste received from other sites. For example, Regionalized Alternatives 3 and 4 would dispose of waste at the same six sites. However, under Regionalized Alternative 3, DOE would conduct only minimum treatment before disposal, whereas under Regionalized Alternative 4, DOE would use volume reduction techniques in addition to minimum treatment prior to disposal. Because PORTS and RFETS would become waste consolidation sites for volume reduction before disposal under Regionalized Alternative 4, they would have a greater potential to impact the environment than they would under the minimum treatment proposed in Regionalized Alternative 3, although both alternatives propose the same six sites for disposal.

Regionalized Alternative 5 considers volume reduction at four sites and disposal at six, compared with volume reduction at seven sites under Regionalized Alternative 4. Regionalized Alternatives 6 and 7 each consider disposal at two sites after minimum treatment: Hanford and SRS under Regionalized Alternative 6, and NTS and SRS under Regionalized Alternative 7.

5.2.4 Centralized Alternatives

DOE analyzed disposal at one site under the centralized alternatives. Five alternatives were considered. Centralized Alternatives 1 and 2 would dispose of LLW at Hanford and NTS, respectively, after minimum at all DOE sites. Centralized Alternative 3 evaluates disposal at Hanford after volume reduction treatment at seven sites. In Centralized Alternative 4, NTS would be the single disposal site after volume reduction at the same seven sites considered under Centralized Alternative 3. Centralized Alternative 5 considers both the consolidation of LLW for volume reduction and disposal at Hanford.

NTS disposal facility.

5.2.5 Rationale for Defining Treatment and Disposal Alternatives

DOE generally identified sites as candidates for locating LLW treatment facilities if the sites had large volumes of LLW. In addition, the alternatives were formulated to consolidate LLW for treatment and disposal at locations that minimized transportation by shipping to the closest available treatment or disposal site. DOE used the same treatment (volume reduction) and disposal locations for LLW as those identified for the LLMW alternatives in Chapter 6 of Volume I.

The number of disposal sites considered covers a reasonable range of sites—from 1 to 16. The 16 candidates are those also under consideration for LLMW.

5.3 *Impacts of Managing LLW*

Some impacts illustrated clear trends across the alternatives; others reveal sensitivities at particular sites regardless of the alternative. The following discussion focuses on the impacts that would be affected by the management of LLW under the alternatives, identifying trends when appropriate and highlighting noteworthy findings at particular sites.

5.3.1 Health Risks

The greatest risk posed by the management of LLW is to workers involved in management activities, primarily as a result of physical hazards. Radiation exposure risks to noninvolved workers and the public are a function of the treatment technology and site characteristics. The highest risks to the public are projected to occur as a result of volume reduction treatment of tritium-contaminated waste at FEMP, Hanford, LLNL, ORR, and PORTS. The greatest potential consequences for facility accidents would occur at sites treating waste with higher concentrations of radionuclides; only LLNL, LANL and Hanford, however, have estimates of potential fatalities exceeding one under any alternative. Concentrations of radionuclides in the groundwater near disposal facilities might exceed applicable standards at several sites in the absence of waste acceptance criteria and other controls; accordingly, DOE would need to implement performance-based waste acceptance criteria at those sites if they were selected. Management of radionuclide concentrations and waste forms could be required to assure acceptable water quality and acceptable human health risks. Transportation risks from both traffic accidents and radiation exposure are estimated to be greatest under the centralized alternatives, which involve the largest number of vehicle miles traveled. Travel by rail rather than truck for bulk shipments could reduce transportation risk. Table 5.3–1 presents selected estimates of the risks of LLW management.

Table 5.3–1. Some of the Projected Risks to Workers and the Public From Managing LLW

Alternative	Number of Sites		Treatment Worker Physical Hazard Fatalities	Treatment Worker Cancer Fatalities	Offsite Population Cancer Fatalities	Disposal Worker Physical Hazard Fatalities	Disposal Worker Cancer Fatalities	Truck[a] Radiation Fatalities	Truck[b] Non-Radiation Fatalities	Rail[a] Radiation Fatalities	Rail Non-Radiation Fatalities
	T	D									
No Action	10[c]	6	3	1	*	4	3	5	12	1	1
Decentralized		16	2	1	*	6	2	*	1	*	*
Regionalized 1		12	2	1	*	6	3	*	1	*	*
Regionalized 2	11	12	4	1	1	4	2	*	1	*	*
Regionalized 3		6	2	1	*	5	3	2	3	*	*
Regionalized 4	7	6	4	2	*	4	2	2	3	*	*
Regionalized 5	4	6	4	2	*	4	2	2	4	*	*
Regionalized 6		2	2	1	*	6	2	4	10	1	1
Regionalized 7		2	2	1	*	6	1	4	10	1	1
Centralized 1		1	2	1	*	1	3	16	37	2	3
Centralized 2		1	2	1	*	1	2	15	38	2	3
Centralized 3	7	1	4	1	*	1	2	15	35	2	3
Centralized 4	7	1	4	1	*	*	2	14	37	2	2
Centralized 5	1	1	4	2	*	1	2	15	37	2	3

Notes: T = treat; D = dispose; * = greater than 0 but less than 1. "Treat" in the context of LLW means volume reduction by means of thermal organic destruction, size reduction, and compaction followed by solidification. All sites do "minimum treatment" under all alternatives, which consists of solidification of liquids and "fines" (powdered material), packaging, and shipment.

[a] Fatalities are from radiation-induced cancer.

[b] Greatest number of fatalities are from physical hazards such as traffic accidents that occur within the 10-year analysis period (20-year analysis period for No Action).

[c] Ten sites use existing facilities for volume reduction. Three sites (LBL, Mound, and RMI) not listed as major sites above, also have volume reduction facilities.

5.3.2 Air Quality Impacts

The management of LLW would not cause the air quality standards to be approached or exceeded at most sites. However, decentralized treatment and disposal at BNL or centralized disposal at NTS could cause adverse air quality impacts (from construction equipment and vehicular emissions), thereby requiring additional control measures for criteria pollutants. Emissions of radionuclides were estimated to be below the applicable standards at every site.

5.3.3 Water Resources Impacts

Major impacts to water availability from increased water use at the sites are unlikely, although there is the potential for adverse impacts at LLNL Site-300 and the WVDP. Potential water quality effects from disposal are discussed in Section 5.3.1.

5.3.4 Economic and Population Impacts

Total jobs in the regional economies for waste management activities could exceed 1% of the regional baseline at six of the 16 major sites under one or more alternatives, with the largest proportion at Hanford (approximately 3.3%) under Centralized Alternative 5. None of the alternatives would affect the national economy. Regions surrounding five sites would experience population increases exceeding 1%, with the largest being the region surrounding INEL with a 3% increase under Regionalized Alternative 5.

Integration of remote sensing and computer technology is used for nonintrusive characterization of waste sites.

5.3.5 Infrastructure Impacts

Although proposed activities would affect the onsite infrastructure at 13 of the major sites, no infrastructure impacts are expected offsite. New requirements for wastewater treatment or electrical power for proposed LLW facilities would equal or exceed 5% of current system capacity at seven sites. The most significant increases would be at the WVDP under the Decentralized Alternative, at INEL under Regionalized Alternative 5 when volume reduction and disposal are consolidated at that site, and at Hanford (centralized alternatives). However, only Hanford and the WVDP would approach or exceed system capacity. Twelve sites would have site employment increases of 5% or more of current site employment during construction, which could lead to traffic increases that would affect the onsite transportation infrastructure.

5.3.6 Costs

Costs decrease as the numbers of treatment and disposal sites decrease, ranging from approximately $16.8 to $11.1 billion for minimum treatment, and $19.8 to $15.3 billion for volume reduction. The increased cost of volume reduction more than offsets the cost savings from reducing the volume of waste disposed of. Transportation costs are substantially lower than facility costs, making shipment to available facilities at another site generally less expensive than building new onsite facilities. Table 5.3–2 provides the estimated costs to manage LLW under each of the WM PEIS alternatives over the 20-year analysis period.

Table 5.3–2. LLW Estimated Life-Cycle Costs (Billions of 1994 Dollars)

Alternatives	Number of Sites		Total (Including Truck Transportation)	Transport Costs	
	T	D		Truck	Rail
No Action	10*	6	18.1	0.07	0.14
Decentralized		16	16.8	0.05	0.02
Regionalized 1		12	16.4	0.06	0.02
Regionalized 2	11	12	19.5	0.06	0.02
Regionalized 3		6	14.9	0.23	0.07
Regionalized 4	7	6	19.8	0.22	0.07
Regionalized 5	4	6	19.7	0.34	0.08
Regionalized 6		2	13.0	0.65	0.17
Regionalized 7		2	13.9	0.67	0.18
Centralized 1		1	12.2	2.46	0.44
Centralized 2		1	11.1	2.25	0.43
Centralized 3	7	1	18.2	2.34	0.43
Centralized 4	7	1	17.3	2.15	0.43
Centralized 5	1	1	15.3	2.45	0.43

Notes: T = treat; D = dispose. "Treat" in the context of LLW means volume reduction by means of thermal organic destruction, size reduction, or compaction followed by solidification. All sites do "minimum treatment" under all alternatives, which consists of solidification of liquids and "fines" (powdered material), packaging, and shipment. Each of the 6-site disposal alternatives uses the same sites; each of the 12-site disposal alternatives uses the same 12 sites.
* Ten sites use existing facilities for volume reduction. Three sites (LBL, Mound, and RMI) not listed as major sites above include volume reduction facilities.

5.3.7 Ecological Resources, Environmental Justice, Land Use, and Cultural Resources Impacts

The WM PEIS did not reveal significant differences among the alternatives in these four impact areas, nor did it reveal any major impacts under any alternative. However, impacts to ecological and cultural resources depend to a large degree on the technologies and the location of waste management activities at each site and would be evaluated after sites have been selected for LLW management. Assessment of potential environmental justice concerns from management of LLW indicated that, with the exception of low-income populations at PORTS, minority and low-income populations near the LLW sites would not experience disproportionately high and adverse health risks or environmental impacts under any of the LLW alternatives. Land use is not a good criterion for differentiating among alternatives because the alternatives do not use much land when compared with the amount available at each site.

At a Glance:

Transuranic Waste

No Action Alternative:

- Continue storage in existing facilities.

Decentralized Alternative:

- Sites with small amounts would transport to 10 largest sites for storage until disposal at WIPP.

Three Regionalized Alternatives:

- Contact-handled TRUW would be treated at three or five sites and remote-handled TRUW would be treated at two sites, and then transported to WIPP for disposal.
- Two levels of treatment are evaluated. One alternative examines treatment to an intermediate level and two to more stringent levels to meet RCRA land disposal restrictions (LDRs).

Centralized Alternative:

- Contact-handled TRUW would be transported to WIPP for treatment to meet LDRs and for disposal. Remote-handled TRUW would be transported to ORR and Hanford for treatment to meet LDRs and then to WIPP for disposal.

Preferred Alternative:

- Nine major sites would treat and store their own waste onsite.
- Regional treatment and storage at INEL, ORR, and SRS.

TRUW Data and Major Assumptions:

- TRUW is managed, or may be managed in the future, at 17 DOE sites, including WIPP.
- DOE will need to manage approximately 132,000 cubic meters of TRUW over the next 20 years.
- All TRUW is assumed to be mixed waste.
- For the transportation analysis, WIPP is assumed to be the geologic repository.
- Disposal impacts were not evaluated.
- New facilities would be constructed during a 10-year period; waste in storage and newly generated waste would be treated during the 10 years following construction.
- Characterization facilities would be constructed at each site before shipment.

What Did We Learn From the Results?

Transportation risks and costs were roughly equivalent for all alternatives involving shipment to WIPP.

6 Transuranic Waste

- *TRUW is generated during weapons and other research and development, nuclear weapons production and dismantlement, and fuel reprocessing. It contains elements with atomic numbers greater than that of uranium, which has an atomic number of 92.*
- *DOE will need to manage approximately 132,000 cubic meters of TRUW over the next 20 years.*
- *TRUW is managed, or may be managed in the future, at 13 of the major sites and at four other sites.*
- *Although approximately 60% of TRUW contains both radioactive and hazardous components, DOE assumes that all TRUW is mixed waste for purposes of the WM PEIS analysis.*
- *DOE must select sites for the treatment and storage of TRUW.*

TRUPACT-II demonstration containers show how transuranic wastes will be shipped.

6.1 Analysis

Transuranic waste is waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, per gram of waste, with half-lives greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary has determined, with concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or (c) waste that NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61. The radioactive nuclides in TRUW emit alpha radiation, which can be contained by minimal shielding but can severely damage lung tissue if inhaled. TRUW requires long-term isolation from the environment. It is produced during research and development, nuclear weapons production, and fuel reprocessing. TRUW contains traces of plutonium, neptunium, americium, curium, and californium. For the purpose of analysis, DOE assumed that all TRUW is mixed waste (containing both radioactive and hazardous components), subject to both radioactive and hazardous waste regulations.

The radiological profiles at each site were assigned uniformly to each waste stream on the basis of the volume of the waste stream at the site. These radiological profiles identify the radionuclides likely to be encountered on the basis of a knowledge of the process that generates the waste and some limited sampling of stored TRUW. These profiles ultimately determine risk and impacts. TRUW is also categorized as either CH or RH. DOE analyzed CH and RH TRUW separately in the WM PEIS to account for their different handling and treatment requirements.

DOE plans to dispose of its TRUW generated by defense activities (and retrievably stored since 1970) at a geologic repository called WIPP, located near Carlsbad, New Mexico. TRUW generated and managed before 1970 is being addressed as part of DOE's environmental restoration program. Disposal of TRUW cannot begin until DOE

meets a series of regulatory requirements imposed under the Waste Isolation Pilot Plant Land Withdrawal Act. Before shipment for disposal, all TRUW will be required to meet waste acceptance criteria (WAC) that will be established by DOE in consultation with EPA and the State of New Mexico. The WAC for WIPP are not yet final, and treatment (such as reducing the potential for gas generation in the repository) could be required to dispose of waste at WIPP.

Table 6.1–1 lists the 13 major sites that have or are expected to generate or manage TRUW. Four other sites, ETEC, LBL, Mound, and UofMo, also have TRUW. The environmental impacts and costs for each waste management alternative considered in the WM PEIS were fully evaluated for all TRUW sites except ETEC, LBL, Mound, SNL-NM, UofMO, and WVDP. For these six sites, the volumes of TRUW were included in the estimated waste volumes for treatment or storage at regionalized or centralized facilities, but impacts were not analyzed because volumes were small. Since publication of the Draft WM PEIS, DOE issued updated information on TRUW volumes. Appendix I of the Final WM PEIS addresses how more recent TRUW data may affect the alternatives in the WM PEIS. Part of this more recent information is the addition of "small-quantity" sites that have or are expected to generate or store TRUW. The TRUW volumes at these small-quantity sites constitute less than 1% of the total TRUW inventory and would not affect the evaluation of the TRUW alternatives.

Figure 6.1–1 presents the estimated total volume of TRUW from waste management activities at the 16 sites that have TRUW currently. TRUW is not currently present at WIPP.

6.2 Alternatives

The TRUW analysis considered six alternatives for both CH TRUW and RH TRUW. Treatment and storage activities vary by alternative and by site. Table 6.1–1 shows the sites where TRUW would be treated and stored under each alternative.

Each of the alternatives was developed to evaluate the health risk, environmental impacts, and costs associated with the range of treatment and storage alternatives available to DOE and to provide input for a decision about where to locate TRUW treatment and storage facilities.

The analysis includes alternatives where TRUW would be treated to LDR levels. Although the WIPP

Table 6.1–1. Transuranic Waste Alternatives

Alternative	CH Treat	RH Treat	Treat Stand	ANL-E	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	RFETS	SNL-NM[d]	SRS	WIPP	WVDP[d]
No Action	11	5	WIPP-WAC	TS	TS	TS	TS	TS	S	TS	S	TS	S	TS		S
D	16	5	WIPP-WAC	TS	TS	TS	TS	TS	TS	TS	T	TS	T	TS		T
R-1	5	2	Reduced gas		TS[a]	TS	TS			TS[b]		TS		TS		
R-2	5	2	LDRs		TS[a]	TS	TS			TS[b]		TS		TS		
R-3	3	2	LDRs		TS[a]	TS				TS[b]				TS		
C	WIPP	2	LDRs		TS[c]					TS[b]					T	

Notes: D = Decentralized Alternative; R-1 = Regionalized Alternative 1; R-2 = Regionalized Alternative 2; R-3 = Regionalized Alternative 3; C = Centralized Alternative; T = treatment to one of three standards: process to current planning basis WIPP-WAC; shred and grout to reduce potential for gas generation in the repository (Reduced Gas); or treat to meet LDRs by means of thermal organic destruction and complete treatment train; S = storage after treatment under No Action and Decentralized Alternatives or storage of current inventory under No Action Alternative. A blank indicates that a site would not treat, store, or dispose of waste under the alternative specified.

[a] Hanford would treat both CH and RH waste.

[b] ORR would treat RH waste only.

[c] Hanford would treat RH waste only.

[d] Small waste volumes at SNL-NM and WVDP; impacts not analyzed.

Land Withdrawal Act amendments contained in the 1997 Defense Authorization Act render the RCRA LDRs inapplicable to waste to be disposed of at WIPP, LDR-treatment alternatives are reasonable alternatives for management activities and practices.

6.2.1 No Action Alternative

Under the No Action Alternative, DOE would continue to characterize, process, and package newly generated TRUW to meet current WIPP-WAC for storage at sites with existing or planned facilities. DOE would continue to store TRUW in existing storage facilities and would not ship TRUW for offsite storage or disposal. All sites are assumed to have adequate capabilities to package and store TRUW generated in the future. Eleven sites are projected to generate TRUW in the future, including five sites generating both CH and RH TRUW. The No Action Alternative does not assess the health risks, environmental impacts, or costs of removing TRUW from retrievable storage and repackaging it.

6.2.2 Decentralized Alternative

Under the Decentralized Alternative, DOE would, as needed, treat and package TRUW to meet the current planning basis WIPP-WAC at the 16 sites. After treatment, CH and RH TRUW would be shipped from the 6 sites with smallest amounts to the nearest of the 10 sites with the largest amounts of TRUW for storage prior to disposal. All TRUW would be shipped to WIPP for disposal.

6.2.3 Regionalized Alternatives

The regionalized alternatives consider the consolidation of TRUW for treatment and storage prior to its disposal at WIPP. Three regionalized alternatives were analyzed, with varying degrees of treatment at six and four sites and storage at those sites prior to disposal.

Under Regionalized Alternative 1, CH TRUW would be shipped from the 10 smallest generators to the 4 sites with the largest volumes of TRUW (Hanford, INEL, LANL, and SRS) for treatment and storage. In addition, RFETS would continue to treat its own waste, but would not receive waste from other sites. RH TRUW would be shipped from ANL-E, INEL, and LANL to Hanford or ORR for treatment and storage. At all six treatment sites, TRUW would be treated to an intermediate level to reduce its gas generation potential and shipped from those sites to WIPP for disposal. The six treatment sites proposed under this alternative have 95% of current and anticipated TRUW inventories.

Under Regionalized Alternative 2, DOE would use the same waste consolidation configuration as in Regionalized Alternative 1, except that TRUW would be treated to meet LDRs and then shipped to WIPP for disposal. With this alternative, DOE can compare the impacts of intermediate treatment under Regionalized Alternative 1 with the impacts of LDR treatment; the impacts from both Regionalized Alternatives 1 and 2 can be compared to the Decentralized Alternative to meet WIPP-WAC where 98% of the waste would be treated at the same six sites.

Regionalized Alternative 3 considers the consolidation of waste for treatment at four sites (Hanford, INEL, ORR, and SRS) where approximately 80% of the TRUW is already located or is expected to be generated. CH TRUW would be treated at Hanford, INEL, and SRS; RH TRUW would be treated at Hanford and ORR. Under this alternative, TRUW would be treated to meet LDRs and shipped to WIPP for disposal.

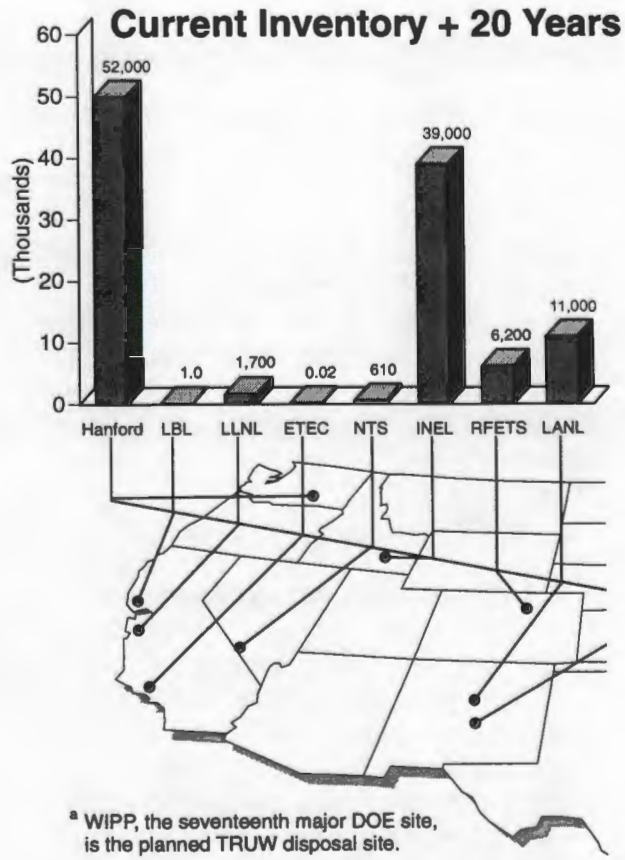
6.2.4 Centralized Alternative

Under the Centralized Alternative, DOE would ship all CH TRUW to WIPP for treatment to meet LDRs and for disposal. RH TRUW would be shipped to Hanford and ORR for treatment to meet LDRs and then shipped to WIPP for disposal.

TRUW Volumes

DOE Sites	Total Volumes (m^3)
1. ANL-E	1,300
2. ETEC	0.02
3. Hanford	52,000
4. INEL	39,000
5. LANL	11,000
6. LBL	1
7. LLNL	1,700
8. Mound	1,500
9. NTS	610

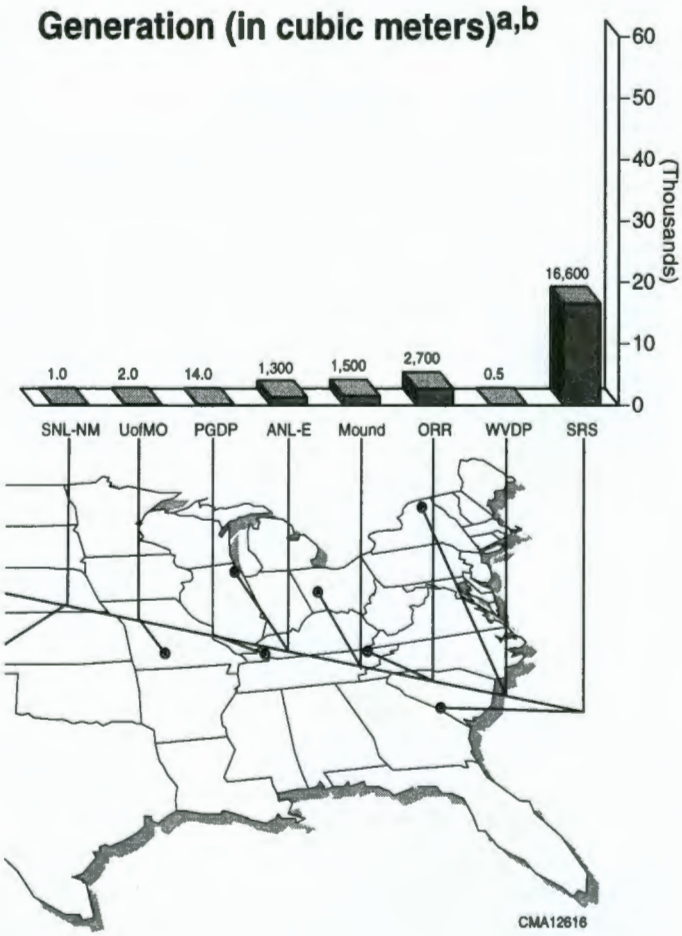
Figure 6.1–1. TRUW Total Volumes



[a] WIPP, the seventeenth major DOE site, is the planned TRUW disposal site.

[b] Updated inventories and waste generation rates are summarized in Appendix I. Different inventories provided in the WIPP SEIS II are also provided in Chapter 8.

at the 16 Major Sites.



*TRUW Volumes**
(Continued)

DOE Sites	Total Volumes (m^3)
10. ORR	2,700
11. PGDP	14
12. RFETS	6,200
13. SNL-NM	1
14. SRS	16,600
15. UofMO	2
16. WIPP	
17. WVDP	0.5
TOTAL	**132,000**

*Estimated TRUW volumes from waste management activities include current inventory plus 20 years of anticipated generation projected volume. Waste volumes used for the WM PEIS analysis may vary from latest site estimates. Updated inventories and waste generation rates are summarized in Appendix I, "Update of Site-Specific Waste Volumes for LLW, LLMW, and TRUW."

6.2.5 Rationale for Treatment and Storage Site Alternatives

TRUW alternatives were developed to cover the range of reasonable alternatives for treatment and storage sites. Thus, the Decentralized Alternative considers treatment and storage of TRUW at all 16 sites where TRUW is currently located, and the Centralized Alternative considers treatment and storage of all CH TRUW at one site and all RH TRUW at two sites. For the regionalized alternatives between these alternatives, DOE focused on the six sites where 95% of the waste is located or expected to be generated and on the four sites where approximately 80% of the waste is located or expected to be generated. Under these alternatives, DOE assumed that the waste from other generating sites would be shipped to the closest site for treatment.

In addition, DOE assumed that it would not be practical or reasonable for sites with small volumes of TRUW (number of sites having less than 15 cubic meters) to treat TRUW either to intermediate levels or to meet LDRs. Onsite treatment to meet current WIPP-WAC was considered feasible for all 16 sites, including the small-volume sites, under the Decentralized Alternative.

Most RH TRUW requires extensive treatment (but not necessarily to meet LDRs) before it can be shipped; therefore, consolidation of RH TRUW at one site for treatment was not considered. Thus, under the Centralized Alternative, DOE would treat RH TRUW at the two sites—Hanford and ORR—where approximately 85% of current and projected inventory would be located.

6.3 *Impacts of Managing TRUW*

Some impact areas illustrated clear trends across the alternatives, whereas others illustrated sensitivities at particular sites regardless of the alternative.

When reviewing the impacts and costs identified for the No Action Alternative, it is important to realize that the results for indefinite storage are based on

Mixed TRUW assay and shipping area.

the initial 20 years of that indefinite period. This is consistent with the period of analysis for all the alternatives; however, not shown are the impacts from storage expected beyond this 20-year time frame. The longer-term storage impacts and costs are likely to exceed those for the first 20 years, not only as a result of routine indefinite storage operations, but also from degradation of facilities and containers. This differs from the effects predicted for the action alternatives for management of the 20-year forecast of TRUW, where risks to workers and the offsite population, and other impacts and costs, are greatly reduced following disposal. The No Action Alternative does not reduce or avoid impacts and costs; rather it causes impacts and costs to be experienced every year for an indefinite period of time.

The following discussion focuses on the impact areas that would be affected by the management of TRUW under the alternatives.

6.3.1 Health Risks

Facility health risks over 20 years are principally to workers, with approximately three-fourths from physical accidents and one-fourth from radiological exposures. Twenty-year risks to the offsite population are less than a single fatality, except for one fatality in one regionalized alternative to meet LDRs utilizing thermal treatment. Estimated transportation fatalities range from five to seven

Table 6.3–1. Some of the Projected Risks to Workers and the Public From Managing TRUW

Alternative	Number of Sites		Treatment Standard	Treatment Worker Physical Hazard Fatalities	Treatment Worker Cancer Fatalities	Offsite Population Cancer Fatalities	Truck[a] Radiation Fatalities	Truck Non-Radiation Fatalities	Rail[a] Radiation Fatalities	Rail Non-Radiation Fatalities
	CH Treat	RH Treat								
No Action	11	5	WIPP-WAC	*	*	*	0	0	0	0
Decentralized	16	5	WIPP-WAC	2	1	*	4	3	1	*
Regionalized 1	5	2	Reduce Gas	3	1	*	3	3	1	*
Regionalized 2	5	2	LDRs	4	1	1	3	2	1	*
Regionalized 3	3	2	LDRs	3	1	*	3	3	1	*
Centralized	WIPP	2	LDRs	2	1	*	3	3	1	*

Notes: CH = contact-handled TRUW; RH = remote-handled TRUW; LDRs = land disposal restrictions; WIPP-WAC = Waste Isolation Pilot Plant Waste Acceptance Criteria; * = greater than 0 but less than 0.5.
[a] Fatalities are from radiation-induced cancer.
[b] Treatment results under the No Action Alternative include risks from only the first 20 years of indefinite storage of TRUW.

across all alternatives except for No Action, which does not involve transportation. Table 6.3–1 presents selected risk results for the TRUW alternatives.

6.3.2 Air Quality Impacts

The management of TRUW would not cause the air quality standards to be approached or exceeded at most sites; however, emissions of radionuclides were estimated to exceed applicable standards at LANL and WIPP in the alternatives involving thermal treatment to meet LDRs at these sites (Regionalized Alternative 2 and the Centralized Alternative). The exceedances at these sites could require additional control measures to reduce emissions to acceptable levels. Emissions of other hazardous air pollutants and criteria pollutants were estimated to be below the applicable standards and guidelines at all sites.

6.3.3 Economic and Population Impacts

The greatest benefit to the region surrounding any site occurs when TRUW is managed at that site. The most jobs as a percent of overall regional employment would occur in regions surrounding INEL and WIPP under Regionalized Alternative 3 and the Centralized Alternative, respectively. None of the TRUW alternatives would substantially affect the national economy, although some 1,900 to 12,000 jobs would be directly or indirectly created. No regions would experience population increases of 1% or more.

6.3.4 Infrastructure Impacts

No offsite infrastructure impacts are expected. Onsite infrastructure impacts on water use, wastewater treatment, and electrical power are comparable for the Decentralized and Regionalized

Alternatives, but are much greater at WIPP under the Centralized Alternative. Impacts generally increase as the intensity of treatment increases, with the greatest impacts at WIPP under the Centralized Alternative.

In addition, increases in site employment at Hanford, INEL, LANL, and WIPP could lead to traffic increases sufficient to affect onsite transportation infrastructure.

6.3.5 Costs

Costs increase as the level of treatment increases. Processing to meet WIPP-WAC and treatment to reduce gas generation cost about the same. Treatment to meet LDRs costs approximately 22% more except for the Centralized Alternative, which treats RH TRUW at only two sites. Transportation costs are substantially lower than facility costs, making shipment to available facilities at another site generally less expensive than building a new facility onsite. Table 6.3–2 provides the estimated costs to manage TRUW under each of the alternatives over 20 years.

6.3.6 Water Resources, Ecological Resources, Environmental Justice, Land Use, and Cultural Resources Impacts

Major impacts to these resources at the sites are unlikely from treatment of TRUW under any of the alternatives. However, ecological and cultural resources impacts would receive further site-specific studies prior to the siting of new facilities. Assessment of potential environmental justice concerns associated with TRUW management indicated no substantial potential for disproportionately high and adverse health risks or environmental impacts to minority and low-income groups living near INEL and WIPP. The potential at both sites could be mitigated by selection of an alternative treatment technology or employment of more efficient emissions controls.

Table 6.3–2. TRUW Estimated Life-Cycle Costs (Billions of 1994 Dollars)

Alternative	Number of Sites		Treatment Standard	Total (Including Truck Transport)	Transportation Costs	
	CH Treat	RH Treat			Truck	Rail
No Action	11	5	WIPP-WAC	1.7	0	0
Decentralized	16	5	WIPP-WAC	7.4	0.56	1.44
Regionalized 1	5	2	Reduce Gas	7.7	0.51	1.40
Regionalized 2	5	2	LDRs	9.0	0.45	1.24
Regionalized 3	3	2	LDRs	8.5	0.49	1.29
Centralized	WIPP	2	LDRs	7.9	0.51	1.33

Notes: CH = contact-handled TRUW; RH = remote-handled TRUW; LDRs = land disposal restrictions; WIPP-WAC = Waste Isolation Pilot Plant waste acceptance criteria.
[a] Costs under the No Action Alternative include those from only the first 20 years of indefinite storage. The costs of storage beyond 20 years are analyzed as part of the No Action Alternatives in the WIPP SEIS-II.

High-Level Waste

At a Glance: High-Level Waste

No Action Alternative:

- HLW canisters would be stored at Hanford, SRS, and WVDP until shipment to a geologic repository.

Decentralized Alternative:

- HLW canisters would be stored at all four sites generating canisters until shipment to a geologic repository.

Two Regionalized Alternatives:

- Canisters from WVDP would be transported to SRS or Hanford; canisters would be stored at Hanford, SRS, and INEL until shipment to a geologic repository.

Centralized Alternative:

- Canisters would be transported from WVDP, INEL, and SRS to Hanford; canisters would be stored at Hanford until shipment to a geologic repository.

Preferred Alternative:

- Each site would store its own immobilized waste onsite.

HLW Data and Major Assumptions:

- HLW is currently stored at Hanford, INEL, SRS, and WVDP.
- Approximately 378,000 cubic meters of HLW have been or will be generated. Treated HLW will require an estimated 21,600 canisters for packaging.
- The Glass Waste Storage Building for SRS (2,286 canisters) is the model used to analyze storage at Hanford and INEL.
- For transportation impacts analysis, DOE assumed the repository would be Yucca Mountain.
- The repository could accept 800 canisters per year.
- The WM PEIS evaluates canister storage. Treatment and disposal of HLW are not analyzed.
- Two sets of timing assumptions are analyzed—acceptance of canisters at the repository beginning in 2015 and acceptance beginning at some later date.

What Did We Learn From the Results?

- Although costs and risks are slightly higher for centralized storage at Hanford, differences from costs and risks at other sites are not significant. Alternatives are roughly equivalent from the standpoint of environmental impacts and costs.
- The acceptance rate of canisters by the repository controls the length of storage time.

7 High-Level Waste

- *HLW is highly radioactive waste that results from the reprocessing of spent nuclear fuel and of targets irradiated in nuclear defense, research, and production activities.*
- *Approximately 378,000 cubic meters of HLW have been or will be generated. Treated HLW will require an estimated 21,600 canisters for packaging.*
- *HLW will be treated and packaged for disposal in a licensed geologic repository.*
- *The WM PEIS analyzes the impacts of storing vitrified HLW.*
- *HLW is currently stored at Hanford, INEL, SRS, and WVDP.*
- *DOE must decide where to store the HLW canisters.*

7.1 Analysis

High-level waste is the highly radioactive material from the chemical reprocessing of spent nuclear fuel and of irradiated targets that contain fission products in concentrations sufficient to require permanent isolation.

Government operations from 1944 to the present have generated approximately 357,000 cubic meters of HLW with approximately 21,000 cubic meters to be generated in the future. Only four sites manage HLW—Hanford, INEL, SRS, and WVDP.

DOE is proceeding with plans to treat HLW by processing it into a solid form that cannot be readily dispersed into air, groundwater, or surface water. This process is called vitrification. When the existing inventory of HLW is vitrified, the vitrified material will fill an estimated 21,600 canisters. The WM PEIS only analyzes the impacts of storing this vitrified HLW.

Table 7.1–1. High-Level Waste Volumes and Projected Number of HLW Canisters

Site	HLW Volume (m^3)	Estimated Total Number of Canisters to Be Generated
Hanford	213,000	15,000
INEL	10,400	1,700
SRS	152,000	4,600
WVDP	2,200	340
Total	378,000	21,600

Table 7.1–1 shows the HLW inventory at Hanford, INEL, SRS, WVDP, and the projected total of vitrified HLW canisters that will be generated as a result of treating the entire HLW inventory.

Analysis of the impacts of HLW disposal in a repository is not within the scope of this WM PEIS, but those impacts will be analyzed in NEPA reviews relating to the geologic repository. Because Yucca Mountain is the only candidate repository site for HLW being studied at this time, DOE assumed this location in its analysis of the impacts of transporting HLW to a disposal facility.

Each alternative considered in this WM PEIS for storage of HLW canisters involves three major facilities and features: the canisters, the facilities for storage of canisters, and packages for transporting canisters to a geologic repository.

7.2 Alternatives

DOE analyzed five alternatives for HLW. Each of the alternatives was developed in order to estimate health risks, other environmental impacts, and

cost associated with the range of storage options and to provide information for a decision about where to store HLW. For each of the five alternatives, DOE assumed that a geologic repository would begin accepting DOE's HLW in 2015 at the rate of 800 canisters per year. For purposes of this analysis, DOE also evaluated an alternative that assumed that there would be a delay in acceptance of DOE's HLW by the repository until some time later than 2015, but at the same rate of acceptance of 800 canisters per year. Table 7.2–1 presents the alternatives in tabular form. Figure 7.2–1 shows the location of the HLW sites.

7.2.1 No Action Alternative

Under the No Action Alternative, only existing and approved HLW storage facilities would be used. Each site would store only those canisters produced at that site. Under this alternative, Hanford would run out of canister storage capacity before canisters could be sent to a geologic repository in 2015. Therefore, production of HLW canisters under the No Action Alternative would be phased because of both the lack of existing storage capacity at most of the sites and the assumed repository acceptance rate of 800 canisters per year.

7.2.2 Decentralized Alternative

Under the Decentralized Alternative, storage capacity equal to the anticipated total production of HLW canisters would be constructed at each site. This would allow each site to start vitrifying HLW as soon as treatment facilities were available. On the basis of the assumption that storage capacity at all four sites would be adequate until canister acceptance begins at the candidate repository in 2015, no delays in the vitrification of HLW would occur.

Table 7.2–1. High-Level Waste Alternatives

Alternative	Number of Storage Sites	Hanford	INEL	SRS	WVDP
No Action	4	S	S	S	S
Decentralized	4	S	S	S	S
Regionalized 1	3	S	S	S	
Regionalized 2	3	S	S	S	
Centralized[a]	1	S			

Note: S = storage. A blank cell indicates that there was no storage at a site under the specified alternative.

[a] Canisters generated at WVDP, SRS, and INEL prior to acceptance at the candidate repository in 2015 would be shipped to Hanford for storage. Canisters generated at SRS and INEL after 2015 would be shipped directly to the candidate repository. If acceptance of the DOE-managed HLW is delayed past 2015, then all HLW canisters would be shipped to Hanford for storage.

Typical high-level waste canister.

Figure 7.2–1. HLW Sites.

7.2.3 Regionalized Alternatives

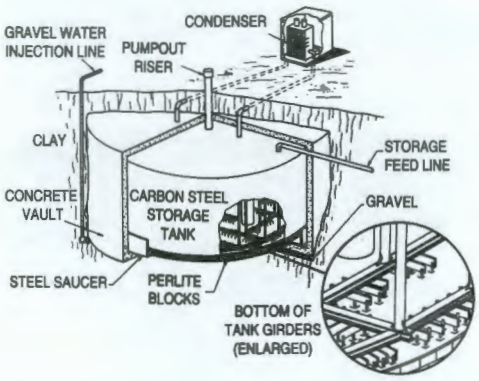
Two regionalized alternatives were analyzed for managing HLW canisters. Under Regionalized Alternative 1, the HLW canisters generated at WVDP would be taken in approved transportation casks to SRS for storage. Adequate storage capacity for HLW canisters would be provided at Hanford, INEL, and SRS until canisters were accepted at a geologic repository.

Under Regionalized Alternative 2, the canisters produced at WVDP would be transported to Hanford in approved transportation casks. Adequate storage capacity for HLW canisters would be provided at Hanford, INEL, and SRS until HLW canisters were accepted at a geologic repository.

7.2.4 Centralized Alternative

Under the Centralized Alternative, the canisters produced at INEL, SRS, and WVDP would be transported to Hanford in approved transportation casks for storage until a geologic repository began to accept the canisters.

Because the WM PEIS analyzed two different assumptions about when canisters would be accepted at a geologic repository, the alternative has two subalternatives. The WM PEIS assumed that HLW canisters generated before the repository would begin accepting HLW in 2015 would be shipped to Hanford for centralized storage. The remaining canisters generated at SRS and INEL after 2015 would be shipped directly to the repository. Because WVDP



HLW storage tank design.

Vitrification facility at SRS.

would generate all of its canisters before 2015, all 340 canisters would be shipped to Hanford.

For the second subalternative, in which acceptance at a geologic repository would be delayed beyond 2015, all canisters generated at WVDP, SRS, and INEL would be shipped to Hanford for storage before shipment to a geologic repository once it began accepting HLW.

7.2.5 Rationale for Storage Alternatives

The five storage alternatives were developed to cover the range of reasonable alternatives. From one to four sites are available for storage of HLW (the Centralized Alternative and Decentralized Alternative, respectively). DOE identified two intermediate alternatives, in which the relatively small amount of WVDP HLW is transported to either Hanford or SRS. To define the regionalized alternatives, DOE selected the site with the largest amount of HLW (Hanford) and the site where transportation would be minimized (SRS). INEL was eliminated from consideration as a Regionalized Alternative site because it has no existing or approved storage facilities.

Under the Centralized Alternative, all HLW would be shipped to Hanford for storage. Hanford was proposed because it has the greatest volume of HLW. The major variable is the total miles for transportation between HLW sites, the central storage site, and the geologic repository. Consolidating all HLW canisters at Hanford minimizes the transportation impacts required for Centralized storage, because the largest number of canisters (those produced at Hanford) would be shipped directly to the repository. WVDP was eliminated from consideration for the Centralized Alternative because it has the smallest volume of HLW (only 1.6% of the total HLW) and because storage of canisters from other sites would be inconsistent with the West Valley Demonstration Project Act.

Table 7.3–1. Some of the Projected Risks to Workers and the Public From Managing HLW

Alternative	Number of Sites Storing	Worker Physical Hazard Fatalities	Worker Cancer Fatalities	Truck Radiation Fatalities	Truck Non-Radiation Fatalities	Rail Radiation Fatalities[a]	Rail Non-Radiation Fatalities
No Action	4	1	2	3	2	*	*
Decentralized	4	1	3	3	2	*	*
Regionalized 1	3	1	3	3	2	*	*
Regionalized 2	3	2	3	3	2	*	*
Centralized	1	2	3	3	2	*	*

Notes: * = greater than 0 but less than 0.5.
[a] Fatalities are from radiation-induced cancer.

7.3 Impacts of Managing HLW

The impacts were evaluated across all of the alternatives to identify trends, compare alternatives, and help select DOE's preferred alternative. The following discussion focuses on the impact areas that would be affected by the management of HLW canisters under the alternatives.

It should be noted that the No Action Alternative for HLW does not provide enough canister storage capacity for all of the canisters that would be produced after treatment of HLW. Provision of adequate storage would lead to costs and impacts as great as shown for the other HLW alternatives.

7.3.1 Health Risks

Both fatalities and incidences of cancer for waste management workers are comparable under the Decentralized, Regionalized, and Centralized Alternatives and do not favor one alternative over another (see Table 7.3–1). Estimates of worker cancer fatalities from radiation exposure exceed fatalities from physical hazards. Transportation risks are approximately the same for all alternatives. Fatalities from facility accidents are less than one under each of the HLW alternatives.

7.3.2 Economic and Population Impacts

HLW storage facility construction and operations expenditures would minimally benefit the localeconomy at the four HLW sites because estimated job and personal income growth are well below 1% at all sites under all the alternatives. None of the HLW alternatives would affect the national economy, although 300 to 1,200 jobs would be directly or indirectly created. The regional population would remain relatively constant under all proposed alternatives and would not incur a major increase at any site.

7.3.3 Infrastructure Impacts

Proposed HLW activities have the potential for affecting the onsite infrastructure only at the Hanford Site, although the effects would be minor. No offsite infrastructure impacts are expected at any other site. Estimated new requirements for wastewater treatment at Hanford would increase current demand under all alternatives, except No Action. Employment increases

would not approach or exceed 5% of current site employment at any site. Traffic increases would be minimal during construction and would not affect the onsite transportation infrastructure.

7.3.4 Costs

The costs of storage and transportation remain relatively constant, at approximately $3 billion, under all alternatives except No Action. Costs do rise slightly when storage is centralized. Delay in disposing of the waste in a geologic repository causes the life-cycle costs to increase at a rate of 0.2% per year of delay. Table 7.3–2 presents the estimated costs for each of the alternatives.

7.3.5 Air Quality, Water Resources, Ecological Resources, Environmental Justice, Land Use, and Cultural Resources Impacts

The management of HLW canisters would not appreciably affect the air quality or water resources at any site. Operation of HLW storage facilities should not affect ecological resources because airborne emissions, liquid effluents, and loss of habitat are expected to be negligible. Additionally, no impacts to current land uses would result because under all alternatives, no site would need to use more than 1% of its suitable lands for storage facilities. Assessment of potential environmental justice concerns from management of HLW indicated that minority and low-income populations near the HLW sites would not experience disproportionately high adverse health risks or environmental impacts under any of the HLW alternatives. DOE would conduct additional site-specific analyses to assess cultural resource impacts.

Table 7.3–2. HLW Estimated Life-Cycle Costs (Billions of 1994 Dollars)

Alternatives	Number of Sites Storing	Total Cost (Including Transportation Costs)	Transportation Cost	
			Truck	Rail
No Action	4	1.5	0.4	0.6
Decentralized	4	2.7	0.4	0.6
Regionalized 1	3	2.7	0.4	0.6
Regionalized 2	3	2.7	0.4	0.6
Centralized	1	2.9	0.5	0.7

Hazardous Waste

At a Glance:
Hazardous Waste

No Action Alternative:

- Nonwastewater HW would continue to be transported to commercial facilities. Two DOE sites would treat organic materials.

Decentralized Alternative:

- Nonwastewater HW would continue to be transported to commercial facilities. Three DOE sites would treat organic materials.

Two Regionalized Alternatives:

- 50% of nonwastewater HW would be treated at five DOE sites; 50% would be treated at commercial facilities.
- 90% of nonwastewater HW would be treated at two DOE sites; 10% would be treated at commercial facilities.

Centralized Alternative:

- None.

Preferred Alternative:

- No Action (continue use of commercial facilities for nonwastewater HW treatment).

HW Data and Major Assumptions:

- HW is generated or exists at most sites.
- DOE will need to manage 69,000 cubic meters of RCRA-regulated hazardous waste over the next 20 years. Totals do not include wastewater.
- An analysis of RCRA HW shipped to commercial treatment from the 11 sites with the most HW in fiscal year 1992 provides a representative sample for comparing onsite DOE treatment with offsite commercial treatment.
- Wastewater HW will continue to be treated onsite.

What Did We Learn From the Results?

- Risks and impacts are similar for each alternative.
- Costs favor commercial treatment.

8 Hazardous Waste

- *HW is nonradioactive chemical waste.*
- *HW is generated or exists at about 45 sites.*
- *HW is generated as a result of research and development and as a byproduct of nuclear weapons production and dismantlement.*
- *Most nonwastewater DOE HW is treated commercially.*
- *DOE must decide whether to develop additional capacity of its own to treat HW.*

8.1 Analysis

Hazardous waste consists of nonradioactive chemical waste generated as a result of nuclear weapons production and other research and development activities. HW has been generated, or is anticipated to be generated, at most DOE sites. Although HW generation from the production of nuclear weapons has essentially stopped, many chemicals and chemical residues were left in containers and process lines. These wastes must be properly treated and disposed of to manage existing and future inventories.

Most of DOE's HW consists of wastewater, which by definition contains less than a 1% concentration of organic HW materials. Hazardous wastewater is generated as a result of operations such as metal cleaning, etching, and plating. Hazardous wastewater requires treatment before it can be safely discharged to the environment. DOE currently treats its hazardous wastewater at the sites that generate it and will continue to do so in the future because wastewater is not difficult to treat but is difficult and expensive to transport.

Nonwastewater HW consists of sludges, solids, and organic liquids (liquids containing higher concentrations of organic chemicals than wastewater). DOE currently ships most of this HW off site to commercial facilities for treatment, although two sites (ORR and INEL) have the capability to treat nonwastewater HW by thermal treatment. DOE needs to decide the extent to which it should continue its reliance on the commercial treatment of nonwastewater HW.

DOE estimates that more than 90% of the total HW (wastewater and nonwastewater) in a given year is generated by 11 DOE sites. Table 8.1–1 shows the quantities of HW at the 11 sites that generate the most HW. Table 8.1–1 shows waste volume generation per year. The focus of the alternatives is on these RCRA-defined wastes which total approximately 3,440 metric tons annually, and 69,000 for a 20-year period.

8.2 Alternatives

The WM PEIS considered four alternatives for treatment facilities within three general categories of alternatives: no action, decentralized, and regionalized (see Table 8.2–1). No centralized alternative was analyzed because DOE determined it would be an unreasonable alternative in light of the cost, risk, regulatory constraints, and practical considerations of attempting to centrally manage all of DOE's diverse HW.

Each of the alternatives was developed in order to estimate the human health risks, other environmental impacts, and costs associated with the range of HW treatment options available to DOE and to provide input for a decision about whether to continue to rely on offsite treatment of HW.

Table 8.1–1. Waste Management of HW at DOE's 11 Largest Generators (metric tons[a]/year)

DOE Site	Wastewater Treated Onsite[b]	Onsite Thermal Treatment and Fuel Burning[b]	Other Onsite Treatment[b]	Offsite Commercial Treatment[c]
ANL-E	0	0	2	206
Fermi	0	0	12	49
Hanford	0	0	140	303
INEL	33,000	35	80	160
KCP[d]	343,000	0	80	601
LANL	0	0	40	246
LLNL	250	0	230	629
ORR	624,000	66	14,600	207
Pantex	3,000	0	2,700	512
SNL-NM	130,000	0	0	153
SRS[d]	59,000	0	50	273
Total	1,192,250	101	17,934	3,339

[a] Metric ton = 1,000 kilograms = 2,205 lb. One metric ton of HW is approximately one cubic meter in volume.
[b] Based on 1991 data taken from biennial and annual reports (includes temporary storage volumes).
[c] Based on fiscal year (FY) 1992 manifests. Includes only RCRA-defined waste; an additional 6,600 metric tons of Toxic Substances Control Act (TSCA)-regulated HW, State-regulated HW, and environmental-restoration-generated HW was shipped to commercial treatment in FY 1992.
[d] Excludes wastewater treatment of groundwater at KCP and SRS.

Table 8.2–1. Hazardous Waste Alternatives

Alternative	Number of Sites Treating	ANL-E	Hanford	INEL	LANL	LLNL	ORR	Pantex	SNL-NM	SRS
No Action	2			T			T			
Decentralized	3			T			T			T
Regionalized 1	5		T	T	T		T			T
Regionalized 2	2			T			T			

Notes: T = treatment. A blank indicates that a site does not treat waste under the alternative specified.

8.2.1 No Action Alternative

Under this alternative, current operations would continue. Some of the HW that is currently being treated onsite at DOE facilities (i.e., thermal treatment of organic materials at ORR and INEL) would continue to be treated onsite, and other HW would continue to be treated at commercial facilities.

8.2.2 Decentralized Alternative

Under this alternative, DOE would continue thermal treatment at existing facilities at INEL, ORR, and SRS. In addition, the use of commercial facilities would continue as needed. Most wastes generated at the other major sites would also be sent to commercial facilities, except for wastes thermally treated or used as fuel at INEL, ORR, and SRS.

8.2.3 Regionalized Alternatives

Under Regionalized Alternative 1, 50% of the HW generated by the 11 major HW sites would be treated at five onsite treatment centers or "hubs" (Hanford, INEL, LANL, ORR, and SRS). Each regional hub would be permitted under RCRA, and onsite treatment facilities would be constructed for thermal treatment and organic removal and recovery. The hub sites would treat two-thirds of the HW received from other sites and send the other one-third to a commercial facility. For HW that could be thermally treated, two-thirds would be sent to the regional hubs from the generating sites, and the other third would be sent directly to commercial treatment facilities. Approximately 50% of the estimated 3,440 metric tons considered for onsite thermal treatment or offsite commercial treatment of HW would be treated at DOE HW facilities.

Under Regionalized Alternative 2, DOE would build facilities at INEL and ORR for organic treatment and deactivation/neutralization. Metal recovery and recycling, battery recycling, stabilization, and land disposal would continue to be provided by offsite commercial establishments. Approximately 90% of HW would be treated at DOE HW facilities.

8.2.4 Rationale for Treatment Alternatives

The alternatives selected were developed to cover the range of reasonable alternatives on the basis of three primary criteria: (1) the site's experience with HW treatment technologies, (2) the location of the site, and (3) the volume of the HW generated by site. As it was in the case of evaluating alternatives for the management of the radioactive waste types, consideration was given to avoiding the shipment of HW to DOE sites that do not generate HW. These criteria and considerations served to minimize the costs and impacts associated with the alternatives and sites selected.

The technologies evaluated for onsite treatment of HW are thermal treatment, burning as fuel, and deactivation. Of all the sites evaluated in the No Action Alternative, five of the sites—Hanford, INEL, LANL, ORR, and SRS—have operated or plan to operate thermal treatment units.

Regionalized Alternative 1 uses the five DOE sites with thermal treatment units, satisfying the criterion for technology experience. The location criterion is addressed in that the five sites are regionally distributed, which serves to minimize transportation of HW and its associated risks.

Regionalized Alternative 2 is based on using two sites for HW treatment. The two proposed sites, INEL and ORR, satisfy the technology experience criterion as discussed above, and their locations (western and eastern United States) require the least transportation of HW when compared with other two-site combinations. Onsite deactivation, or neutralization, also considered in this alternative, is planned for the two hubs.

8.3 Impacts of Managing HW

Impacts were evaluated across all of the alternatives to identify trends and compare alternatives. Some impact areas illustrated clear trends across the alternatives, whereas others illustrated sensitivities at particular sites regardless of the alternative.

The following discussion focuses on the impact areas that would be affected by the management of HW under the alternatives, identifying trends when appropriate and highlighting noteworthy findings at particular sites.

Interior of 709-G hazardous waste storage facility at SRS.

8.3.1 Health Risks

Incidences of cancer among the public for both routine operations at DOE facilities and facility accidents were found to be less than one for all alternatives. Noncancer risks to the offsite population and noninvolved workers were also low. However, noncancer risks for WM workers may be of concern under each of the alternatives evaluated.

Although DOE would treat more of its HW under the regionalized alternatives and send less to commercial facilities, DOE believes that worker risk is similar under treatment by DOE and commercial facilities. Therefore, there is no significant difference among the alternatives with regard to HW worker risk.

Waste oil shipment to TSCA incinerator at ORR.

Although HW can be transported both by truck and rail, truck transportation is the predominant method for shipping HW. The risk estimates include a fraction of a single fatality for each of the proposed HW alternatives from vehicle accidents and exposures associated with HW transportation.

8.3.2 Air Quality Impacts

The management of HW would not cause air quality standards to be approached or exceeded at most sites. No criteria pollutants would exceed standards at any site. However, regionalization of treatment facilities

at LANL and ORR would cause adverse air impacts that would require additional control measures for vinyl chloride. The exceedances at LANL and ORR primarily result from emissions from thermal treatment.

8.3.3 Costs

The No Action Alternative is the least costly of the alternatives, at an estimated $144 million, followed by the Decentralized Alternative at $183 million. Regionalized Alternative 1 is the most expensive, at $376 million, closely followed by Regionalized Alternative 2, at a cost of $318 million. Conversely, commercial treatment costs are highest under the No Action Alternative and lowest under Regionalized Alternative 2.

The fundamental differences among the alternatives involve transportation and costs. Table 8.3–1 presents a summary of the transportation and cost differences among the alternatives over the 20-year period of analysis.

8.3.4 Water Resources, Ecological Resources, Economic Impacts, Environmental Justice, Infrastructure, Land Use, and Cultural Resources

The impacts analyses for water, ecological, economic, population, infrastructure, cultural, and land use resources did not indicate significant impacts under any of the HW alternatives; therefore, these analyses do not reveal significant differences among alternatives. Assessment of potential environmental justice concerns from management of HW indicated that minority and low-income populations near the HW sites would not experience disproportionately high and adverse health risks or environmental impacts under any of the HW alternatives.

Table 8.3–1. Summary Comparison of the HW Alternatives

Alternative	Sites	Shipments		Costs[c]		
		Mileage[a]	Number[b]	Transport	Project Life-Cycle	Total
No Action	2	20	34	49	95	144
Decentralized	3	19	41	49	134	183
Regionalized 1	5	35	50	87	289	376
Regionalized 2	2	19	34	47	271	318

[a] Mileage in millions.
[b] Number of shipments in thousands.
[c] Cost in millions of dollars.

9.1 Analysis

Cumulative impacts are those impacts that result from the incremental impact of an action added to other past, present, and reasonably foreseeable actions in the future. Examples of impacts from past and present actions include those from contaminated sites, ongoing activities that result in waste generation, and waste management activities outside the scope of the WM PEIS. Both Council on Environmental Quality regulations and DOE regulations for implementing NEPA require DOE to assess cumulative impacts because significant impacts can result from several smaller actions that individually might not have significant impacts.

To conduct the cumulative impacts analysis, DOE first examined the combined impacts of siting waste management facilities for more than one waste type at each of the 17 major sites. **Combined impacts** are the subset of cumulative impacts resulting from the siting of multiple facilities for managing more than one waste type at a site. DOE then added the impacts of existing site conditions and reasonably foreseeable future actions at a site or in an area to these combined impacts to assess the cumulative impacts.

The combined and cumulative analysis considers the following impacts:

- Offsite population health risks
- Offsite MEI health risks
- Worker health risks
- Air quality exceedances
- Groundwater quality exceedances
- Impacts on resources and infrastructure
- Socioeconomic impacts

In addition, an analysis of both combined and cumulative transportation impacts is presented.

Impacts that are not considered for combined and cumulative effects include:

- Risks from accidents, because accidents are not certain to occur and, even if they were to occur, event-initiating accidents for each waste type would be independent of each other.
- Risks to individual waste management workers, because it is assumed that each waste-type worker is dedicated to that waste type and would not work simultaneously in another waste-type facility.
- Impacts to surface water resources, ecological resources, and cultural resources, because they are dependent on facility location and location-specific environmental factors.

Because the alternatives for the five waste types can be combined in many ways (for some sites there are thousands of possible combinations of alternatives), the combined impacts of placing multiple facilities at each site are presented in the form of minimum and maximum values for each of the combined impacts for each waste type. The values are then summed for each category of impacts to determine the combined minimum and maximum impacts for each site. Following the combined impacts analysis, the minimum and maximum impacts are considered together with the impacts of existing site actions, and reasonably foreseeable future actions at and near each of the 17 major sites. The cumulative impact assessment for these sites includes consideration of actions that DOE is taking or considering for spent nuclear fuel management, tritium supply and recycling, and the consolidation of nonnuclear functions. Other site-specific projects, such as vitrification of HLW at Hanford and SRS and the operation of WIPP, are also discussed for each of the 17 major sites where applicable.

Chapter 11 of the WM PEIS contains tables of combined and cumulative impacts showing the impact categories and the major elements that constitute the cumulative impacts (i.e., combined, existing, and other reasonably foreseeable future actions) for each

of the 17 major sites and for transportation impacts. These data allow the decision maker, when evaluating alternatives for a specific waste type such as LLMW, to consider the range of impacts that might occur at any site caused by implementation of alternatives for other waste types and other activities.

9.2 Results

The following discussion briefly summarizes the key results of the cumulative impacts analysis:

- Even though locating waste management facilities at sites would result in an increase in dose to offsite populations surrounding the sites, cumulative atmospheric radiological releases are not projected to exceed EPA standards except at LANL, as a result of treatment under Regionalized Alternative 2 for TRUW, and at WIPP, as a result of treatment under the Centralized Alternative for TRUW. The exceedance of the EPA standard for the Regionalized 2 and Centralized Alternatives for TRUW indicates that mitigation measures could be needed to achieve compliance if either of these two alternatives is chosen.

- Seven of the 17 sites (BNL, Hanford, INEL, LANL, NTS, ORR, and RFETS) could exceed one or more air pollutant standards as a result of maximum combined atmospheric emissions. Selection of waste management alternatives that result in locating waste management activities at these sites could require mitigation measures.

- Nine of the 17 sites (FEMP, Hanford, LANL, ORR, PGDP, PORTS, RFETS, SNL-NM, and SRS) could exceed one or more drinking water standards in groundwater as a result of disposal of LLMW or LLW on the site. Selection of alternatives for these two waste types at these sites would need to take into consideration potential cumulative groundwater quality impacts as well as potential mitigation measures.

- Nine of the 17 sites could require improvements to onsite water, wastewater, or electric power systems to accommodate requirements for increased capacity. At two sites (Hanford and WIPP), the increases are caused by waste management activities, while at three sites (INEL, NTS, and WVDP), either waste management or other planned future activities could require additional infrastructure. At four additional sites (ANL-E, FEMP, SNL-NM, and SRS), the requirements for additional infrastructure result from future activities other than waste management.

- Eight sites (Hanford, INEL, LANL, NTS, ORR, Pantex, SRS, and WIPP) could require mitigation measures to reduce offsite infrastructure and institution demands caused by possible employment increases resulting from waste management and other actions considered in the cumulative impacts analysis.

- The largest number of shipments to or from a single site would occur at NTS as a result of the shipments of LLMW and LLW and of shipments of HLW if Yucca Mountain is found to be suitable as a repository for HLW. A combined total of more than 295,000 truck shipments or more than 106,000 rail shipments of waste could occur at NTS, or about 118 truck shipments or 42 rail shipments per day (assuming receipt of shipments during 250 days per year).

- The transport of waste by truck is expected to result in a combined total of between 11 and 69 fatalities for the shipment of all waste types. Of these fatalities, about 6 to 23 would result from exposure of transport crew members and the population along transportation routes to the radioactive components in the waste. The remaining fatalities from truck transport would result from emissions and accidents independent of the waste cargo.

- The transport of LLMW, LLW, TRUW, and HLW by rail and HW by trucks is expected to result in a combined total of between two and six fatalities over the periods of analyses for these waste types. Of these fatalities, about one to three would result from the exposure of the train crew and the public to the radioactive components in the waste. The remaining fatalities for rail transport would result from train emissions and accidents independent of the waste cargo.

- Maximum combined health risks from the routine operation of waste management facilities are estimated to range from 0 to 6 worker radiation cancer fatalities and less than one radiation cancer fatality in the offsite populations at the 17 major sites.

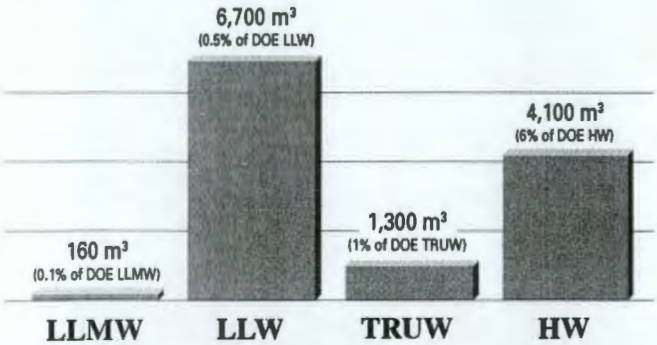
- Maximum cumulative health risks from the routine operation of waste management facilities and other facilities at the sites are estimated to range from 0 to 12 worker radiation cancer fatalities and less than two radiation cancer fatalities in the offsite populations at the 17 major sites.

Argonne National Laboratory-East

Argonne National Laboratory-East (ANL-E) is an outgrowth of the Metallurgical Laboratory established in 1942 as part of the Manhattan Project. This laboratory conducts research and development studies of nuclear and non-nuclear energy sources. ANL-E is located on 2.7 square miles, 22 miles southwest of Chicago in northeast Illinois.

ANL-E is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), and hazardous waste (HW) and, in some alternatives, LLMW and LLW from small sites. ANL-E currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the four waste types at ANL-E, are shown in the following chart. Also, how ANL-E relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at ANL-E include the storage of LLMW with the treatment of wastewater only; preparation of LLW for shipment off site for disposal; storage of TRUW; and the transport of HW off site for treatment. A waste minimization and pollution prevention strategic plan has been developed and is being implemented at ANL-E to reduce waste volumes.

Waste Management Alternatives at ANL-E

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	Treatment Off Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site (including shipments from small offsite facilities)	Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*4 subalternatives:* Minimum Treatment On Site; Disposal Off Site	*2 subalternatives:* Minimum Treatment On Site; Disposal Off Site
LLW	Disposal Off Site	Disposal On Site (including shipments from small offsite facilities)	*3 subalternatives:* Treatment Off Site; Disposal Off Site	*3 subalternatives:* Treatment Off Site; Disposal Off Site
TRUW	Treatment On Site	Treatment On Site	Treatment Off Site	Treatment Off Site
TRUW	Storage On Site	Storage On Site	Storage Off Site	Storage Off Site
HW	Treatment Off Site (commercial facilities)	Treatment Off Site (commercial facilities)	Treatment Off Site (DOE and commercial facilities)	Not Analyzed

= DOE's preferred alternatives.

ANL-E

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, ANL-E's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which ANL-E fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat ANL-E's LLMW on site under the Decentralized Alternative and consistent with ANL-E's proposed site treatment plan. DOE prefers to ship ANL-E's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat ANL-E's LLW on site. DOE prefers to ship ANL-E's LLW to one of 2 or 3 regional disposal sites.

Transuranic Waste: DOE prefers the Decentralized Alternative for onsite treatment and storage of ANL-E's TRUW.

Hazardous Waste: DOE prefers the No Action Alternative, where ANL-E would continue to use commercial facilities for HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for ANL-E under all of the alternatives that identified a role for this site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for ANL-E under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at ANL-E.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW, LLW, and TRUW shipments from ANL-E is estimated to be 1,660 truck or 710 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 132 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could substantially increase waste shipments leaving the site.

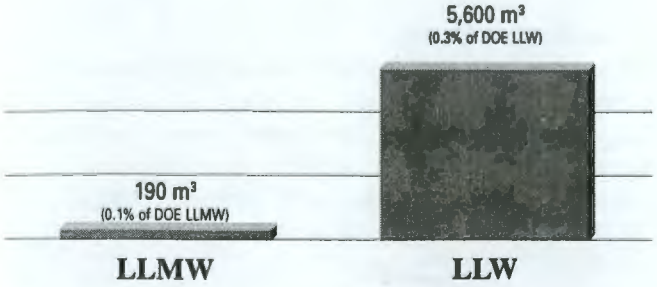
Site Summary

Brookhaven National Laboratory

Brookhaven National Laboratory (BNL) was established in 1946 to provide a multipurpose research and development laboratory capable of supporting the design and operation of large, complex research projects for fundamental scientific studies and basic and applied research. The laboratory provides research capabilities in the physical, biomedical, and environmental sciences and energy technologies for hundreds of users from universities, industry, and other government laboratories. BNL is located in New York on approximately 8.2 square miles, 60 miles east of New York City.

BNL is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW) and low-level waste (LLW). BNL is not considered a major generator of hazardous waste. BNL currently does not have an inventory of transuranic waste or high-level waste and is not expected to manage these waste types in the future.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the two waste types at BNL, are shown in the following chart. Also, how BNL relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at BNL include the storage of LLMW with the treatment of wastewater only and the preparation of LLW for shipment off site for disposal. A waste minimization and pollution prevention plan has been developed and is being implemented at BNL to reduce waste volumes.

Waste Management Alternatives at BNL

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	Treatment Off Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site	Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*4 subalternatives:* Minimum Treatment On Site	*2 subalternatives:* Minimum Treatment On Site
LLW			Disposal Off Site	Disposal Off Site
LLW	Disposal Off Site	Disposal On Site	*3 subalternatives:* Treatment Off Site	*3 subalternatives:* Treatment Off Site
LLW			Disposal Off Site	Disposal Off Site

= DOE's preferred alternatives.

BNL

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, BNL's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which BNL fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat BNL's LLMW under the Regionalized Alternative and consistent with BNL's proposed site treatment plan. Under this alternative, BNL's LLMW would be shipped off site for treatment. DOE prefers to ship BNL's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat BNL's LLW on site. DOE prefers to ship BNL's LLW to one of 2 or 3 regional disposal sites.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for BNL under all of the alternatives that identified a role for this site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for BNL under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at BNL.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW and LLW shipments from BNL is estimated to be 1,370 truck or 530 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 41 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

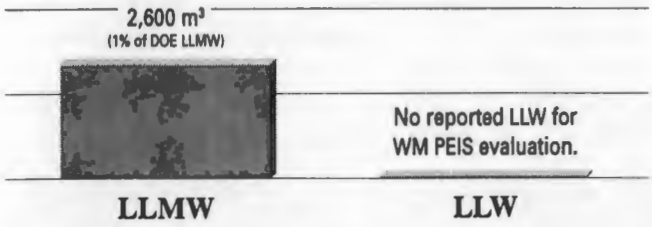
Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could substantially increase waste shipments leaving the site.

Fernald Environmental Management Project

The Fernald Environmental Management Project (FEMP) has been a major Department of Energy (DOE) site for more than 40 years, producing nuclear materials (primarily uranium metal and uranium compounds) for use at other DOE facilities. Since the late 1980s, the site's mission has focused on environmental restoration. FEMP is located on approximately 1.6 square miles, 17 miles northwest of Cincinnati, Ohio.

FEMP is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), and, in some alternatives, other sites' LLMW and LLW. FEMP is not considered a major generator of hazardous waste. FEMP currently does not have an inventory of transuranic waste or high-level waste and is not expected to manage these waste types in the future.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the two waste types at FEMP, are shown in the following chart. Also, how FEMP relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



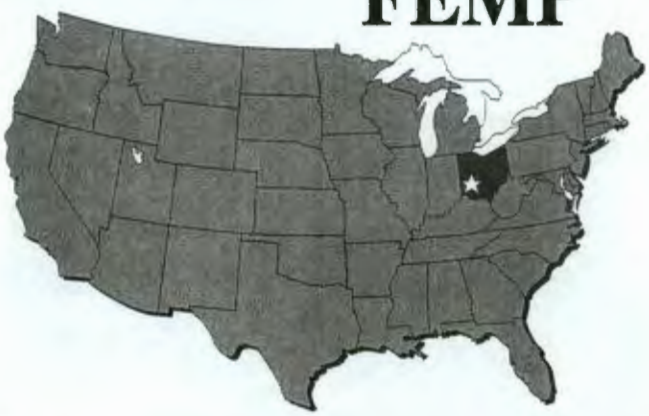
Current waste management activities at FEMP include the storage of LLMW with the treatment of wastewater only. FEMP has no LLW at this time. A waste minimization and pollution prevention plan has been developed and is being implemented at FEMP to reduce waste volumes.

Waste Management Alternatives at FEMP

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*1 subalternative:* Treatment On Site (including shipments from offsite facilities) Disposal On Site (FEMP LLMW only) Disposal Off Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site	*3 subalternatives:* Treatment Off Site Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 subalternatives:* Treatment On Site (Minimum treatment in 1 subalternative) Disposal On Site *3 subalternatives:* Minimum Treatment On Site	*2 subalternatives:* Minimum Treatment On Site Disposal Off Site
LLW	Disposal Off Site	Disposal On Site	Disposal Off Site *2 subalternatives:* Treatment Off Site Disposal Off Site	*3 subalternatives:* Treatment Off Site Disposal Off Site

= DOE's preferred alternatives.

FEMP



DOE's Preferred Alternatives

In the development of a national strategy for each waste type, FEMP's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which FEMP fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat FEMP's LLMW on site consistent with FEMP's site treatment plan. DOE prefers to ship FEMP's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: All LLW at FEMP is currently managed under the Environmental Restoration Program and was not analyzed in the WM PEIS.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for FEMP under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for FEMP under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at FEMP.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW shipments from FEMP is estimated to be 110 truck or 50 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 212 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded.

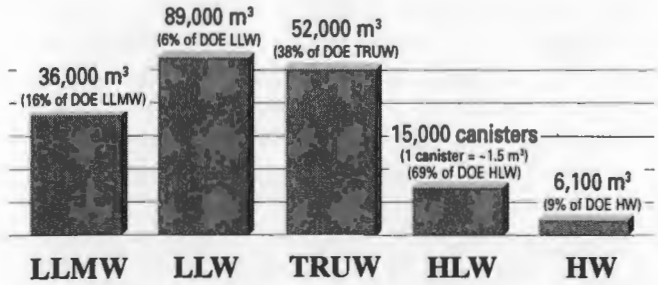
Site Summary

Hanford

The Hanford Site has played a major role in national security for more than 40 years, producing nuclear materials (primarily plutonium) for weapons manufacture, managing the resulting radioactive and hazardous waste, and performing a variety of missions related to research and development for advanced reactors, energy technologies, basic sciences, and waste disposal technologies. Today, Hanford is no longer a production facility but instead focuses solely on waste management and environmental restoration guided by the Hanford Federal Facilities Agreement and Consent Order (Tri-Party Agreement). Hanford encompasses about 560 square miles within the Columbia River Basin in southeastern Washington.

Hanford is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own and, in some alternatives, other sites' low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), high-level waste (HLW), and hazardous waste (HW).

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the five waste types at Hanford, are shown in the following chart. Also, how Hanford relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at Hanford include the storage of LLMW with the treatment of wastewater only, treatment and disposal of LLW on site, storage of TRUW on site, storage of HLW on site pending disposal in a geologic repository, and the transport of HW off site for treatment. A waste minimization and pollution prevention plan has been developed and is being implemented at Hanford to reduce waste volumes.

Waste Management Alternatives at Hanford

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site (including some offsite shipments)	*3 subalternatives:* Treatment On Site (including offsite shipments); Disposal On Site; *1 subalternative:* Treatment On Site (including offsite shipments); Disposal Off Site	Treatment On Site (including shipments from all DOE sites)
LLMW	Storage On Site	Disposal On Site		Disposal On Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*3 subalternatives:* Treatment On Site (minimum treatment in 2 subalternatives); Disposal On Site; *2 subalternatives:* Treatment On Site (including offsite shipments); Disposal On Site; *1 subalternative:* Minimum Treatment On Site; Disposal On Site (including shipments from all western DOE sites); *1 subalternative:* Minimum Treatment On Site; Disposal Off Site	*2 subalternatives:* Treatment On Site*; Disposal On Site (including shipments from all DOE sites); *2 subalternatives:* Treatment On Site*; Disposal Off Site; *1 subalternative:* Treatment On Site (including shipments from all DOE sites); Disposal On Site
LLW	Disposal On Site (including offsite shipments)	Disposal On Site		
TRUW	Treatment On Site	Treatment On Site	Treatment On Site (including offsite shipments)	Treatment On Site (RH only, including offsite shipments); Treatment Off Site (CH to WIPP, N.M.)
TRUW	Storage On Site	Storage On Site	Storage On Site	Storage On Site (RH only)
HLW	Storage On Site	Storage On Site	Storage On Site (possibly including offsite shipments)	Storage On Site (including offsite shipments)
HLW	*Pending* Disposal Off Site (geologic repository)	*Pending* Disposal Off Site (geologic repository)	*Pending* Disposal Off Site (geologic repository)	*Pending* Disposal Off Site (geologic repository)
HW	Treatment Off Site (commercial facilities)	Treatment Off Site (commercial facilities)	*1 subalternative:* Treatment On Site (organic only, including offsite shipments); Treatment Off Site (commercial facilities); *1 subalternative:* Treatment Off Site (DOE and commercial facilities)	Not Analyzed

*Minimum treatment in one subalternative, offsite shipments included in other subalternative.
RH = Remote-handled TRUW. CH = Contact-handled TRUW.
= DOE's preferred alternatives. DOE does not yet have site preferences for LLMW or LLW disposal.

Hanford

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, Hanford's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which Hanford fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers regionalized treatment of LLMW at Hanford. This alternative includes onsite treatment of Hanford's LLMW and could include treatment of some LLMW generated at other sites. LLMW activities at Hanford would be conducted in accordance with the Hanford Site's Tri-Party Agreement with the State of Washington and U.S. Environmental Protection Agency. Hanford could be selected as one of the regional disposal sites for LLMW.

Low-Level Waste: DOE prefers to treat Hanford's LLW on site. Hanford could be selected as one of the regional disposal sites for LLW.

Transuranic Waste: DOE prefers onsite treatment and storage of Hanford's TRUW.

High-Level Waste: DOE prefers onsite storage of Hanford's immobilized HLW pending disposal in a geologic repository.

Hazardous Waste: DOE prefers the No Action Alternative where Hanford would continue to use commercial facilities for HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated Hanford for potential impacts under all of the alternatives that identified a role for this site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for Hanford under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Health risks are principally to workers and could include physical hazard and latent cancer fatalities from waste management activities over the 20-year period of analysis. Collective worker health risk estimates are one fatality for LLMW, three fatalities for HLW, and up to four fatalities for LLW, depending on whether Hanford is selected as a disposal site. Less than one latent cancer fatality is estimated among the offsite population.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. To meet drinking water standards, performance-based waste acceptance criteria may be needed for onsite disposal of LLMW and LLW. No major impacts to ecological resources, land use, or environmental justice are expected. Increases to requirements for wastewater treatment under the preferred alternatives could lead to requirements for additional capacity and corresponding costs; no other major impacts to the infrastructure are estimated. Expenditures for WM activities could cause socioeconomic effects that include the benefits of increased regional employment and income as well as regional population growth that could alter community structure and stress available housing and community services. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the maximum total number of shipments of TRUW and HLW is estimated to be 18,400 truck or 8,140 rail shipments. The total number of shipments of LLMW and LLW to and from Hanford is dependent upon DOE's final selection of disposal sites for these wastes. Centralized disposal of LLW, which was analyzed in the WM PEIS, could result in approximately 242,000 to 257,000 truck shipments or 91,000 to 97,000 rail shipments to a single site; centralized disposal of LLMW could result in 7,500 to 9,600 truck shipments or 3,300 to 3,700 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 3,659 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

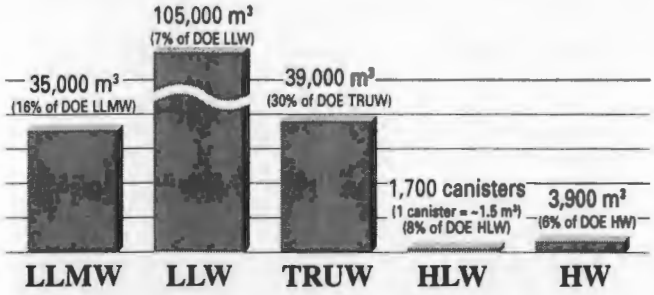
Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Wastewater treatment capacity could be exceeded, and the regional employment and community structure could be affected, as noted above. In addition, to meet drinking water standards, performance-based waste acceptance criteria may be needed for onsite disposal of LLMW and LLW. Waste management activities could greatly increase waste shipments entering or leaving the site.

Idaho National Engineering Laboratory

Idaho National Engineering Laboratory (INEL) has been a major Department of Energy (DOE) site for more than 40 years, building, testing and operating various nuclear facilities; managing the resulting radioactive and hazardous waste; and performing a variety of missions related to research and development for advanced reactors, naval nuclear propulsion systems, and waste disposal technologies. INEL occupies 890 square miles in the southeastern portion of Idaho, approximately 42 miles west of Idaho Falls.

INEL is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), high-level waste (HLW), and hazardous waste (HW) and, in some alternatives, other sites' LLMW, LLW, TRUW and HW. The WM PEIS includes waste volumes from Argonne National Laboratory-West and the Naval Reactor Facility in its evaluation of INEL as a candidate site for waste management facilities.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the five waste types at INEL, are shown in the following chart. Also, how INEL relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at INEL include the treatment and storage of LLMW on site, treatment and disposal of LLW on site, storage of TRUW on site, storage of HLW on site pending disposal in a geologic repository, and the transport of HW off site for treatment. A waste minimization and pollution prevention awareness plan has been developed and is being implemented at INEL to reduce waste volumes.

Waste Management Alternatives at INEL

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site	Treatment On Site	*3 subalternatives:* Treatment On Site (including offsite shipments); Disposal On Site	Treatment Off Site (except RH)
	Storage On Site	Disposal On Site	*1 subalternative:* Treatment On Site (including offsite shipments); Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*4 subalternatives:* Treatment On Site (minimum treatment in 2 subalternatives); Disposal On Site	*2 subalternatives:* Minimum Treatment On Site; Disposal Off Site
			1 subalternative: Treatment On Site (including offsite shipments)	*2 subalternatives:* Treatment On Site
	Disposal On Site	Disposal On Site	Disposal On Site	Disposal Off Site
			2 subalternatives: Minimum Treatment On Site	*1 subalternative:* Treatment Off Site
			Disposal Off Site	Disposal Off Site
TRUW	Treatment On Site	Treatment On Site	Treatment On Site (CH only, including offsite shipments); Treatment Off Site (RH only)	Treatment Off Site
	Storage On Site	Storage On Site	Storage On Site (CH only); Storage Off Site (RH only)	Storage Off Site
HLW	Storage On Site	Storage On Site	Storage On Site	Storage On Site
	Pending Disposal Off Site (geologic repository)	*Pending* Disposal Off Site (geologic repository)	*Pending* Disposal Off Site (geologic repository)	*Pending* Disposal Off Site (geologic repository)
HW	Treatment On Site (organic only)	Treatment Off Site (commercial facilities)	*1 subalternative:* Treatment On Site (organic only); Treatment Off Site (commercial facilities)	Not Analyzed
	Treatment Off Site (commercial facilities)		*1 subalternative:* Treatment On Site (organic only, including offsite shipments); Treatment Off Site	

RH = Remote-handled TRUW. CH = Contact-handled TRUW.

= DOE's preferred alternatives. DOE does not yet have site preferences for LLMW or LLW disposal.

INEL

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, INEL's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which INEL fits within each preferred waste management alterative are as follows.

Low-Level Mixed Waste: DOE prefers regionalized treatment of LLMW at INEL. This alternative includes onsite treatment of INEL's LLMW and could include treatment of LLMW generated at other sites. LLMW activities at INEL would be conducted in accordance with INEL's site treatment plan. INEL could be selected as one of the regional disposal sites for LLMW.

Low Level Waste: DOE prefers to treat INEL's LLW on site. INEL could be selected as one of the regional disposal sites for LLW.

Transuranic Waste: DOE prefers the Regionalized Alternative for treatment and storage of INEL's TRUW. This alternative could include treatment of TRUW received from RFETS.

High-Level Waste: DOE prefers onsite storage of INEL's immobilized HLW pending disposal in a geologic repository.

Hazardous Waste: DOE prefers the No Action Alternative where organic HW at INEL would continue to be treated on site. INEL would continue to use commercial facilities for all other HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated INEL for potential impacts under all of the alternatives that identified a role for this site. These impacts are discussed in Chapters 6 though 11. Results of the analyses for INEL under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Health risks are principally to workers and could include fatalities from waste management activities over the 20-year period of analysis. Collective worker health risk estimates are one fatality each for LLMW and LLW depending on whether INEL is selected as a disposal site, one fatality for HLW, and two fatalities for TRUW. Less than one latent cancer fatality is estimated among the offsite population for waste management activities under the preferred alternatives for all waste types at INEL.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air or groundwater quality standards. No major impacts to ecological resources, land use, or infrastructure are expected. The assessment of environmental justice impacts associated with treatment of TRUW at INEL identified a potential for disproportionately high and adverse health risks to low-income groups, which could require mitigation measures. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the maximum total number of LLMW, LLW, TRUW, and HLW shipments to and from INEL is estimated to be 23,670 truck or 9,770 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 1,913 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risks are primarily caused by waste management activities; however, the maximum cumulative increase in radiation dose to the offsite population is estimated to be well below the EPA standard of 10 millirems per year to the maximally exposed individual. Cumulative environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could substantially increase waste shipments entering or leaving the site.

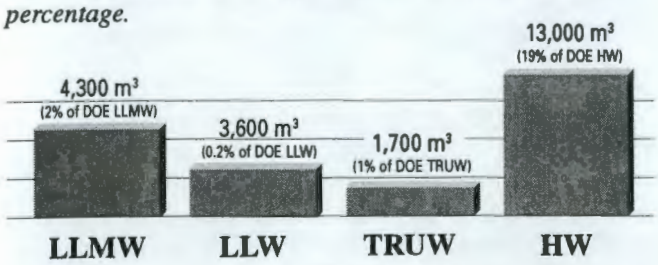
Site Summary

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory (LLNL), established in 1952 by the Atomic Energy Commission, has been a major Department of Energy (DOE) site for more than 40 years in nuclear weapons research. Today, its major programs include defense and related programs, laser fusion, laser isotope separation, human genome study, supercomputation, and environmental restoration and waste management. LLNL and its components occupy approximately 12.8 square miles east of San Francisco, California. The laboratory includes Site 300, located near Tracy, California, and Sandia National Laboratories-California.

LLNL is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), and hazardous waste (HW) and, in some alternatives, other sites' LLMW and LLW. LLNL currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future. The WM PEIS includes waste volumes for SNL-CA in its evaluation of LLNL as a candidate for waste management facilities.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the four waste types analyzed at LLNL, are shown in the following chart. Also, how LLNL relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at LLNL include the storage of LLMW with the treatment of wastewater only, preparation of LLW for shipment off site for disposal, storage of TRUW on site, and the transport of HW off site for treatment. A waste minimization and pollution prevention program has been developed and is being implemented at LLNL to reduce waste volumes.

Waste Management Alternatives at LLNL

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*1 subalternative:* **Treatment On Site** (including shipments from offsite facilities)	Treatment Off Site
		Disposal On Site (LLNL waste only)	**Disposal On Site**	
			Disposal Off Site (TRU-contaminated LLMW)	
	Storage On Site	Disposal Off Site (TRU-contaminated LLMW)	*3 subalternatives:* **Treatment Off Site**	Disposal Off Site
			Disposal Off Site	
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 subalternatives:* **Treatment On Site***	*2 subalternatives:* Minimum Treatment On Site
			Disposal On Site (including shipments from offsite facilities)	Disposal Off Site
			3 subalternatives: **Minimum Treatment On Site**	*3 subalternatives:* Treatment Off Site
	Disposal Off Site	Disposal On Site (including shipments from offsite facilities)	**Disposal Off Site**	
			2 subalternatives: **Treatment Off Site**	Disposal Off Site
			Disposal Off Site	
TRUW	Treatment On Site	Treatment On Site	Treatment Off Site	Treatment Off Site
	Storage On Site	Storage On Site	Storage Off Site	Storage Off Site
HW	Treatment Off Site (commercial facilities)	Treatment Off Site (commercial facilities)	Treatment Off Site (DOE and commercial facilities)	Not Analyzed

* Minimum treatment in one subalternative.

= DOE's preferred alternatives.

LLNL

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, LLNL's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which LLNL fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat LLNL's LLMW on site consistent with LLNL's site treatment plan. DOE prefers to ship LLNL's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat LLNL's LLW on site. DOE prefers to ship LLNL's LLW to one of 2 or 3 regional disposal sites.

Transuranic Waste: DOE prefers the Decentralized Alternative for onsite treatment and storage of LLNL's TRUW.

Hazardous Waste: DOE prefers the No Action Alternative where LLNL would continue to use commercial facilities for HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for LLNL under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for LLNL under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Less than one latent cancer fatality is estimated among the offsite population, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at LLNL.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. This assumes that any new water requirements at Site-300 would be provided through a municipal system rather than by groundwater. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW, LLW, and TRUW shipments from LLNL is estimated to be 1,010 truck or 430 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 387 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risks are primarily caused by waste management activities; however, the maximum cumulative increase in radiation dose to the offsite population is estimated to be below the EPA standard of 10 millirems per year to the maximally exposed individual. Cumulative environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could substantially increase waste shipments leaving the site.

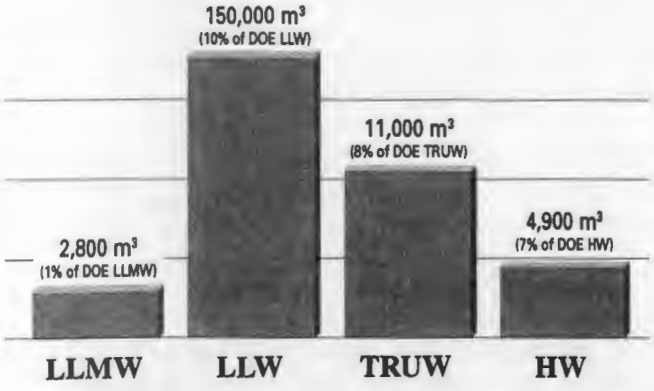
Site Summary

Los Alamos National Laboratory

Los Alamos National Laboratory (LANL) has been a major Department of Energy (DOE) site since 1943, providing nuclear weapons research and development and related projects. LANL is located on 43 square miles, 25 miles north of Santa Fe in north central New Mexico.

LANL is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own, and in some alternatives, other sites' low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), and hazardous waste (HW). LANL currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the four waste types at LANL, are shown in the following chart. Also, how LANL relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at LANL include the storage of LLMW with the treatment of wastewater only; treatment and disposal of LLW on site; storage of TRUW on site; and the transport of HW off site for treatment. A pollution prevention program has been developed and is being implemented at LANL to reduce waste volumes.

Waste Management Alternatives at LANL

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*2 subalternatives:* **Treatment On Site** (including offsite shipments); **Disposal On Site**	Treatment Off Site
	Storage On Site	Disposal On Site	*1 subalternative:* **Treatment On Site** (including offsite shipments); **Disposal Off Site**; *1 subalternative:* **Treatment Off Site**; **Disposal Off Site**	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*5 subalternatives:* **Treatment On Site** (minimum treatment in 2 subalternatives); **Disposal On Site** (including offsite shipments)	*2 subalternatives:* **Minimum Treatment On Site** (including offsite shipments); **Disposal Off Site**
	Disposal On Site	Disposal On Site	*2 subalternatives:* **Minimum Treatment On Site**; **Disposal Off Site**	*2 subalternatives:* **Treatment On Site** (including offsite shipments); *1 subalternative:* **Treatment Off Site**; **Disposal Off Site**
TRUW	Storage On Site	Treatment On Site	*2 subalternatives:* **Treatment On Site** (CH only, including offsite shipments); **Treatment Off Site** (RH only); **Storage On Site** (CH only)	Treatment Off Site
		Storage On Site	**Storage Off Site** (RH only); *1 subalternative:* **Treatment Off Site**; **Storage Off Site**	Storage Off Site
HW	Treatment Off Site (commercial facilities)	Treatment On Site (organic HW only)	*1 subalternative:* **Treatment On Site** (organic HW only, including offsite shipments); **Treatment Off Site** (non-organic HW to commercial facilities)	Not Analyzed
		Treatment Off Site (non-organic HW to commercial facilities)	*1 subalternative:* **Treatment Off Site** (DOE and commercial facilities)	

RH = Remote-handled TRUW. CH = Contact-handled TRUW.

= DOE's preferred alternatives. DOE does not yet have site preferences for LLMW and LLW disposal.

LANL

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, LANL's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which LANL fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat LANL's LLMW on site consistent with LANL's site treatment plan. LANL could be selected as one of the regional disposal sites for LLMW.

Low-Level Waste: DOE prefers to treat LANL's LLW on site. LANL could be selected as one of the regional disposal sites for LLW.

Transuranic Waste: DOE prefers the Decentralized Alternative for onsite treatment and storage of LANL's TRUW. This alternative could include treatment of TRUW received from SNL-NM.

Hazardous Waste: DOE prefers the No Action Alternative where LANL would continue to use commercial facilities for HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for LANL under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for LANL under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Health risks are principally to workers and could include physical hazard and latent cancer fatalities from waste management activities over the 20-year period of analysis. Collective worker health risk estimates are two fatalities for LLW depending on whether LANL is selected as a disposal site, one fatality for TRUW, and less than one fatality for LLMW. Less than one latent cancer fatality is estimated among the offsite population for waste management activities under the preferred alternatives for all waste types at LANL.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air or groundwater quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the maximum total number of LLMW, LLW and TRUW shipments to and from LANL is estimated to be 20,170 truck or 7,810 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 1,012 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could greatly increase waste shipments leaving the site.

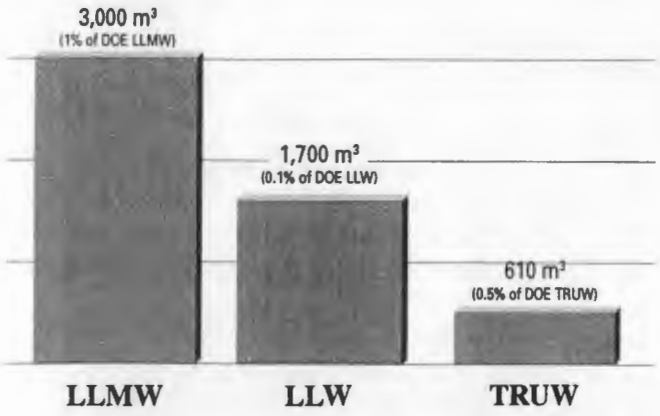
Site Summary

Nevada Test Site

The Nevada Test Site (NTS) has been the primary location for testing nuclear explosive devices since 1957. NTS is also a low-level waste disposal site. NTS occupies 1,350 square miles of desert valley and mountain terrain, 65 miles northwest of Las Vegas in southern Nevada.

NTS is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), and transuranic waste (TRUW) and, in some alternatives, other sites' LLMW and LLW. NTS does not have an inventory of high-level waste and is not considered a major generator of hazardous waste.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the three waste types at NTS, are shown in the following chart. Also, how NTS relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at NTS include the storage of LLMW with the treatment of wastewater only, treatment and disposal of LLW on site, and storage of TRUW on site. A waste minimization and pollution prevention plan has been developed and is being implemented at NTS to reduce waste volumes.

Waste Management Alternatives at NTS

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*3 suballernatives:* Treatment Off Site; Disposal Off Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site (including shipments from offsite facilities)	*1 suballernative:* Treatment Off Site; Disposal On Site (including shipments from all DOE facilities)	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 suballernatives:* Minimum Treatment On Site; Disposal On Site	*1 suballernative:* Minimum Treatment On Site; Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*3 suballernatives:* Minimum Treatment On Site (including offsite shipments); Disposal On Site	*1 suballernative:* Minimum Treatment On Site; Disposal On Site (including shipments from all DOE facilities)
LLW	Disposal On Site (including shipments from offsite facilities)	Disposal On Site	*1 suballernative:* Minimum Treatment On Site; Disposal Off Site	*2 suballernatives:* Treatment Off Site; Disposal Off Site
LLW	Disposal On Site (including shipments from offsite facilities)	Disposal On Site	*1 suballernative:* Minimum Treatment On Site; Disposal On Site (including shipments from all western DOE sites)	*1 suballernative:* Treatment Off Site; Disposal On Site
TRUW	Storage On Site	Treatment On Site; Storage On Site (including small quantities of offsite TRUW)	Treatment Off Site; Storage Off Site	Treatment Off Site; Storage Off Site

= DOE's preferred alternatives. DOE does not yet have site preferences for LLMW and LLW disposal.

NTS

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, NTS's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which NTS fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers regionalized treatment of NTS' LLMW. Under this alternative, NTS' LLMW would be shipped off site for treatment. NTS could be selected as one of the regional disposal sites for LLMW.

Low-Level Waste: DOE prefers to treat NTS' LLW on site. NTS could be selected as one of the regional disposal sites for LLW.

Transuranic Waste: DOE prefers the Decentralized Alternative for onsite treatment and storage of NTS' TRUW.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated NTS for potential impacts under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for NTS under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Health risks are principally to workers and could include physical hazard and latent cancer fatalities from waste management activities over the 20-year period of analysis. Collective worker health risk estimates are one fatality for LLMW and three fatalities for LLW, depending on whether NTS is selected as a disposal site, and less than one fatality for TRUW. Among the offsite population latent cancer fatalities are estimated to be essentially zero for waste management activities under the preferred alternatives for all waste types at NTS.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of groundwater quality standards. Equipment and vehicular emissions could require mitigative measures to meet air quality standards for nonattainment areas in the region. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the maximum total number of shipments of TRUW is estimated to be 90 truck or rail shipments. The total number of shipments of LLMW and LLW to and from NTS is dependent upon DOE's final selection of disposal sites for these wastes. Centralized disposal of LLW, which was analyzed in the WM PEIS, could result in approximately 242,000 to 257,000 truck shipments or 91,000 to 97,000 rail shipments to a single site; centralized disposal of LLMW could result in 7,500 to 9,600 truck shipments or 3,300 to 3,700 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 1,535 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

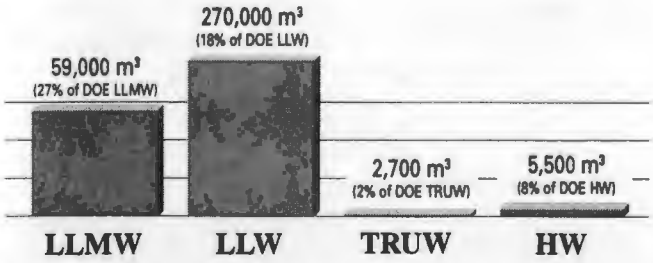
Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded, except for air quality criteria air pollutants (CO). Waste management activities could greatly increase waste shipments entering or leaving the site.

Oak Ridge Reservation

For the past 50 years, the U.S. Department of Energy's (DOE's) mission has involved weapons production, uranium enrichment, and energy research — all of which have contributed to the legacy of complex environmental cleanup challenges at the Oak Ridge Reservation (ORR). The Reservation consists of three separate sites, situated on 54.7 square miles in eastern Tennessee: a national laboratory, a manufacturing and developmental engineering plant, and a former gaseous diffusion plant. Presently, ORR's mission includes environmental restoration, waste management, energy and medical research, defense programs, and technology transfer.

ORR is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own and, in some alternatives, other sites' low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), and hazardous waste (HW). ORR currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the four waste types analyzed at ORR, are shown in the following chart. Also, how ORR relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at ORR include the treatment and storage of LLMW on site, treatment and disposal of LLW on site, storage of TRUW on site, treatment of organic HW on site, and the transport of remaining HW off site for treatment. A pollution prevention program has been developed and is being implemented at ORR to reduce waste volumes.

Waste Management Alternatives at ORR

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site	Treatment On Site	*1 subalternative:* Treatment On Site Disposal On Site *2 subalternatives:* Treatment On Site (including shipments from offsite facilities)	Treatment Off Site
LLMW	Storage On Site	Disposal On Site	Disposal On Site *1 subalternative:* Treatment On Site (including shipments from offsite facilities) Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 subalternatives:* Treatment On Site* Disposal On Site *3 subalternatives:* Treatment On Site* (including shipments from offsite facilities)	*2 subalternatives:* Minimum Treatment On Site Disposal Off Site *2 subalternatives:* Treatment On Site (including shipments from offsite facilities)
LLW	Disposal On Site	Disposal On Site	Disposal On Site (including shipments from offsite facilities) *2 subalternatives:* Minimum Treatment On Site Disposal Off Site	Disposal Off Site *1 subalternative:* Treatment Off Site Disposal Off Site
TRUW	Treatment On Site	Treatment On Site	Treatment On Site (RH only, including shipments from offsite facilities) Treatment Off Site (CH only)	Treatment On Site (RH only, including shipments from offsite facilities) Treatment Off Site (CH only)
TRUW	Storage On Site	Storage On Site (including shipments from offsite facilities)	Storage On Site (RH only) Storage Off Site (CH only)	Storage On Site (RH only) Storage Off Site (CH only)
HW	Treatment On Site (organic HW only)	Treatment On Site (organic HW only)	Treatment On Site (organic HW only, including shipments from offsite facilities)	Not Analyzed
HW	Treatment Off Site (commercial facilities)	Treatment Off Site (commercial facilities)	Treatment Off Site (commercial facilities)	

* Minimum treatment in one subalternative.
RH = Remote-handled TRUW. CH = Contact-handled TRUW.
= DOE's preferred alternatives. DOE does not yet have site preferences for LLMW and LLW disposal.

ORR

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, ORR's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which ORR fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers regional treatment of LLMW at ORR consistent with ORR's site treatment plan. This alternative could include treatment of LLMW generated at other sites. ORR could be selected as one of the regional disposal sites for LLMW.

Low-Level Waste: DOE prefers to treat ORR's LLW on site. ORR could be selected as one of the regional disposal sites for LLW.

Transuranic Waste: DOE prefers the Regionalized Alternative for onsite treatment and storage of ORR's remote-handled TRUW. This alternative could include treatment and storage of some remote-handled TRUW received from SRS. Also, under this alternative, DOE could ship ORR's contact-handled TRUW to SRS for treatment and storage.

Hazardous Waste: DOE prefers the No Action Alternative where organic HW at ORR would continue to be treated on site. ORR would continue to use commercial facilities for all other HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for ORR under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for ORR under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Health risks are principally to workers and could include physical hazard and latent cancer fatalities from waste management activities over the 20-year period of analysis. Collective worker health risk estimates are one fatality each for LLMW and LLW, depending on whether ORR is selected as a disposal site, and less than one fatality for TRUW. Among the offsite population latent cancer fatalities are estimated to be essentially zero for waste management activities under the preferred alternatives for all waste types at ORR.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. To meet drinking water standards, performance-based waste acceptance criteria may be needed for onsite disposal of LLMW. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the maximum total number of LLMW, LLW and TRUW shipments to and from ORR is estimated to be 69,130 truck or 26,490 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 1,658 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

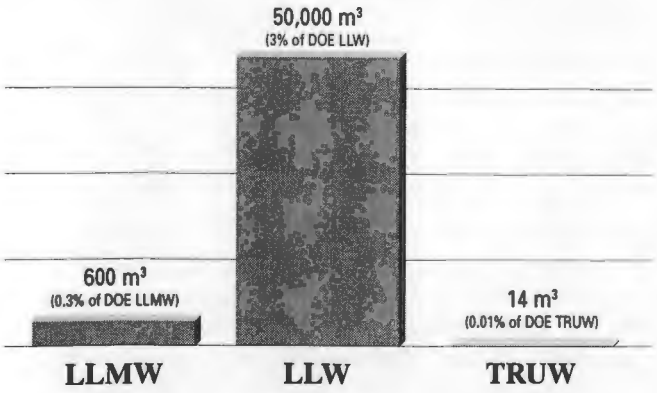
Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. However, to meet drinking water standards, performance-based waste acceptance criteria may be needed for onsite disposal of LLMW. Waste management activities could greatly increase waste shipments entering or leaving the site.

Paducah Gaseous Diffusion Plant

The Paducah Gaseous Diffusion Plant (PGDP) has been a major Department of Energy (DOE) site for more than 40 years, producing enriched uranium for commercial nuclear power reactors in the United States and overseas. PGDP is located on 5.4 square miles in western Kentucky.

PGDP is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), and transuranic waste (TRUW) and, in some alternatives, other sites' LLMW and LLW. PGDP currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future. In addition, PGDP is not considered a major generator of hazardous waste.

The estimated total waste inventories, including current inventory and 20 years of generation for the three waste types at PGDP, are shown in the following chart. Also, how PGDP relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at PGDP include the storage of LLMW with the treatment of wastewater only, preparation of LLW for shipment off site for disposal, and storage of TRUW on site. A waste minimization and pollution prevention program has been developed and is being implemented at PGDP to reduce waste volumes.

Waste Management Alternatives at PGDP

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*1 subalternative:* Treatment On Site (including shipments from offsite facilities) Disposal On Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site (including shipments from offsite facilities)	*3 subalternatives:* Treatment Off Site Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 subalternatives:* Treatment On Site* (including shipments from offsite facilities) Disposal On Site	*2 subalternatives:* Minimum Treatment On Site Disposal Off Site
LLW	Disposal Off Site	Disposal On Site (including shipments from offsite facilities)	*3 subalternatives:* Minimum Treatment On Site Disposal Off Site *2 subalternatives:* Treatment Off Site Disposal Off Site	*3 subalternatives:* Treatment Off Site Disposal Off Site
TRUW	Storage On Site	Treatment On Site	Treatment Off Site	Treatment Off Site
TRUW	Storage On Site	Storage** Off Site	Storage Off Site	Storage Off Site

*Minimum treatment in one subalternative.

** The WM PEIS analyses assumed offsite storage; however, DOE prefers onsite decentralized storage.

= DOE's preferred alternatives.

PGDP

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, PGDP's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which PGDP fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat most of PGDP's LLMW at an offsite regional treatment facility, although some LLMW would be treated on site, consistent with PGDP's site treatment plan. DOE prefers to ship PGDP's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat PGDP's LLW on site. DOE prefers to ship PGDP's LLW to one of 2 or 3 regional disposal sites.

Transuranic Waste: DOE prefers onsite treatment and storage of PGDP's TRUW.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for PGDP under all of the alternatives that identified a role for this site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for PGDP under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at PGDP.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW, LLW, and TRUW shipments from PGDP is estimated to be 6,330 truck or 2,410 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 157 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could substantially increase waste shipments leaving the site.

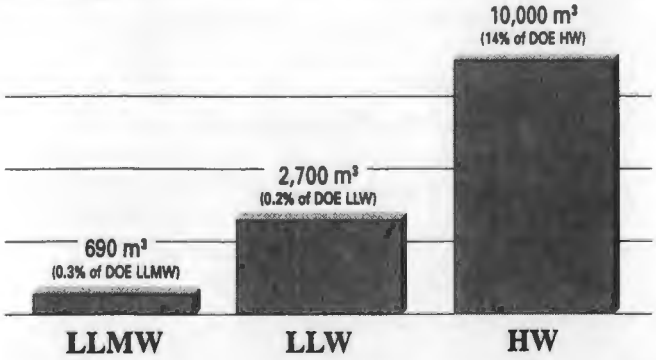
Site Summary

Pantex Plant

The Pantex Plant has been a major Department of Energy (DOE) site for more than 40 years, providing nuclear weapons assembly facilities. The mission of the Pantex Plant includes disassembly, assembly, quality evaluation, and maintenance of the U.S. nuclear weapons stockpile. The site is also a candidate for tritium supply and recycling. The Pantex Plant, consisting of 15.8 square miles of DOE-owned land and 9.2 square miles of land leased from Texas Tech University, is located about 17 miles northeast of Amarillo, Texas.

The Pantex Plant is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), and hazardous waste (HW). The Pantex Plant currently has a very small amount of transuranic waste (TRUW). The Pantex Plant currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the three waste types at the Pantex Plant, are shown in the following chart. Also, how Pantex relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at the Pantex Plant include the storage of LLMW with the treatment of wastewater only, preparation of LLW for shipment off site for disposal, and the transport of HW off site for treatment. A pollution prevention and waste minimization program has been developed and is being implemented at the Pantex Plant to reduce waste volumes.

Waste Management Alternatives at Pantex

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*1 suballernative:* Treatment On Site; Disposal On Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site	*3 suballernatives:* Treatment Off Site; Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 suballernatives:* Treatment On Site (minimum treatment in one suballernative); Disposal On Site; *3 suballernatives:* Minimum Treatment On Site; Disposal Off Site	Treatment Off Site (minimum treatment in 2 suballernatives)
LLW	Disposal Off Site	Disposal On Site	*2 suballernatives:* Treatment Off Site; Disposal Off Site	Disposal Off Site
HW	Treatment Off Site (commercial facilities)	Treatment Off Site (commercial facilities)	Treatment Off Site (DOE and commercial facilities)	Not Analyzed

= DOE's preferred alternatives.

Pantex

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, Pantex's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which Pantex fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat LLMW generated at Pantex on site consistent with Pantex's site treatment plan. DOE prefers to ship Pantex's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat LLW generated at Pantex on site. DOE prefers to ship Pantex's LLW to one of 2 or 3 regional disposal sites.

Transuranic Waste: DOE prefers offsite treatment and storage of Pantex's very small amount of TRUW.

Hazardous Waste: DOE prefers the No Action Alternative where Pantex would continue to use commercial facilities for HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for Pantex under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for Pantex under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at Pantex.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW and LLW shipments from the Pantex Plant is estimated at 460 truck or 190 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 102 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

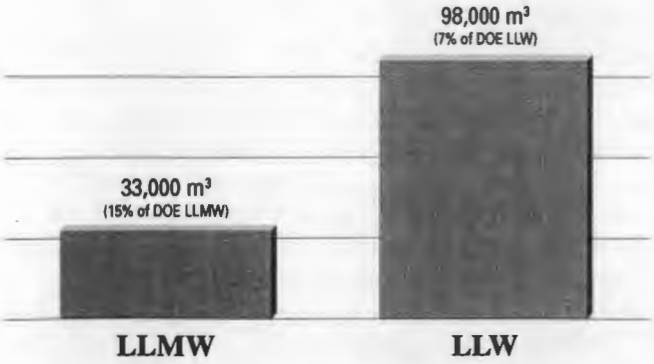
Cumulative health risks are primarily caused by waste management activities; however, the maximum cumulative increase in radiation dose to the offsite population is estimated to be well below the EPA standard of 10 millirems per year to the maximally exposed individual. Cumulative environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded.

Portsmouth Gaseous Diffusion Plant

The Portsmouth Gaseous Diffusion Plant (PORTS) has been a major Department of Energy (DOE) site for more than 40 years, producing enriched uranium. PORTS is located on 6.3 square miles, about 22 miles northeast of Portsmouth, Ohio.

PORTS is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW) and low-level waste (LLW) and, in some alternatives, other sites' LLMW and LLW. PORTS currently does not have an inventory of transuranic waste or high-level waste and is not expected to manage these waste types in the future. In addition, PORTS is not considered a major generator of hazardous waste.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the two waste types at PORTS, are shown in the following chart. Also, how PORTS relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at PORTS include the storage of LLMW with the treatment of wastewater only and preparation of LLW for shipment off site for disposal. A waste minimization and pollution prevention program has been developed and is being implemented at PORTS to reduce waste volumes.

Waste Management Alternatives at PORTS

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*1 subalternative:* Treatment On Site (including shipments from offsite facilities) Disposal On Site (including shipments from offsite facilities) *2 subalternatives:* Treatment On Site (including shipments from offsite facilities) Disposal Off Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site (including shipments from offsite facilities)	*1 subalternative:* Treatment Off Site Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 subalternatives:* Treatment On Site* (including shipments from offsite facilities) Disposal On Site (including shipments from offsite facilities) *3 subalternatives:* Minimum Treatment On Site	*2 subalternatives:* Minimum Treatment On Site Disposal Off Site *2 subalternatives:* Treatment On Site (including shipments from offsite facilities)
LLW	Disposal Off Site	Disposal On Site (including shipments from offsite facilities)	Disposal Off Site *1 subalternative:* Treatment On Site (including shipments from offsite facilities) Disposal Off Site *1 subalternative:* Treatment Off Site Disposal Off Site	Disposal Off Site *1 subalternative:* Treatment Off Site Disposal Off Site

*Minimum treatment in one subalternative.

= DOE's preferred alternatives.

PORTS

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, PORTS's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which PORTS fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat PORTS' LLMW on site consistent with Portsmouth's site treatment plan. DOE prefers to ship PORTS' LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat PORTS' LLW on site. DOE prefers to ship PORTS' LLW to one of 2 or 3 regional disposal sites.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for PORTS under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for PORTS under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at PORTS.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW and LLW shipments from PORTS is estimated to be 34,090 truck or 13,000 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 399 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

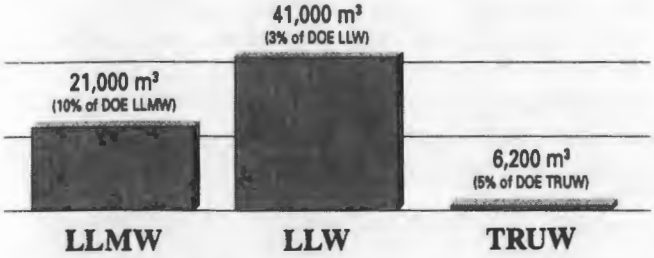
Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could greatly increase waste shipments leaving the site.

Rocky Flats Environmental Technology Site

The Rocky Flats Environmental Technology Site (RFETS) has been a major Department of Energy (DOE) site for more than 40 years, producing nuclear weapons components from plutonium and other metals. In 1992, its mission changed to environmental restoration and decontamination and decommissioning. RFETS occupies 11 square miles, approximately 16 miles northwest of Denver, Colorado.

RFETS is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), and transuranic waste (TRUW) and, in some alternatives, other sites' LLMW and LLW. RFETS currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future. In addition, RFETS is not considered a major generator of hazardous waste.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the three waste types at RFETS, are shown in the following chart. Also, how RFETS relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at RFETS include the storage of LLMW with the treatment of wastewater only, preparation of LLW for shipment off site for disposal, and storage of TRUW on site. A waste minimization program has been developed and is being implemented at RFETS to reduce waste volumes.

Waste Management Alternatives at RFETS

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	*1 suballernative:* Treatment On Site (including shipments from offsite facilities) Disposal On Site *2 suballernatives:* Treatment On Site (including shipments from offsite facilities) Disposal Off Site *1 suballernative:* Treatment Off Site Disposal Off Site	Treatment Off Site
LLMW	Storage On Site	Disposal On Site (including shipments from offsite facilities)		Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*2 suballernatives:* Treatment On Site* Disposal On Site *1 suballernative:* Treatment On Site (including shipments from offsite facilities) Disposal Off Site	*2 suballernatives:* Minimum Treatment On Site Disposal Off Site *2 suballernatives:* Treatment On Site (including shipments from offsite facilities)
LLW	Disposal Off Site	Disposal On Site	*1 suballernative:* Treatment Off Site Disposal Off Site *2 suballernatives:* Minimum Treatment On Site Disposal Off Site	Disposal Off Site *1 suballernative:* Treatment Off Site Disposal Off Site
TRUW	Treatment On Site	Treatment On Site	*2 suballernatives:* Treatment On Site Storage On Site	Treatment Off Site
TRUW	Storage On Site	Storage On Site	*1 suballernative:* Treatment Off Site Storage Off Site	Storage Off Site

*Minimum treatment in one suballernative.

= DOE's preferred alternatives.

RFETS

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, RFETS's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which RFETS fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat RFETS' LLMW on site consistent with RFETS' site treatment plan. DOE prefers to ship RFETS' LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat RFETS' LLW on site. DOE prefers to ship RFETS' LLW to one of 2 or 3 regional disposal sites.

Transuranic Waste: DOE prefers the Decentralized Alternative for onsite treatment and storage of some of RFETS' TRUW. Some of RFETS' TRUW could be treated at INEL.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for RFETS under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for RFETS under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

The largest estimated health risks are to workers and are related to the waste volumes being handled. Physical accidents typically result in a higher potential for fatalities than exposure to radiation. One worker fatality could occur for the preferred treatment alternative for LLMW. Among the offsite population, latent cancer fatalities are estimated to be essentially zero for waste management activities under the preferred alternatives for all waste types at RFETS.

Environmental Effects

Under the preferred alternatives, equipment and vehicular emissions could require mitigative measures to meet air quality standards for nonattainment areas in the region. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW, LLW and TRUW shipments from RFETS is estimated to be 6,920 truck or 2,690 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 774 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risks are primarily caused by waste management activities; however, the maximum cumulative increase in radiation dose to the offsite population is estimated to be below the EPA standard of 10 millirems per year to the maximally exposed individual. Cumulative environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded, except for air quality criteria air pollutants (CO and NO_2). Waste management activities could greatly increase waste shipments leaving the site.

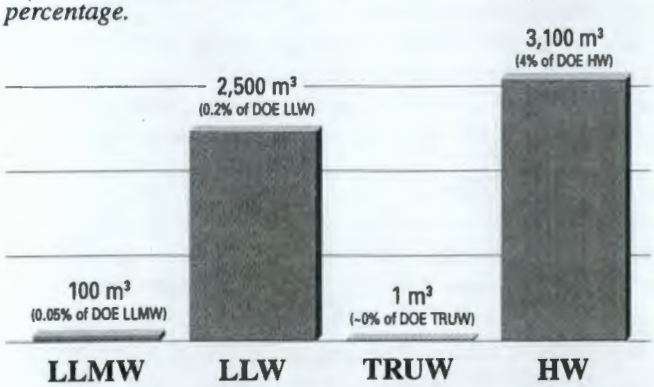
Site Summary

Sandia National Laboratories

Sandia National Laboratories-New Mexico (SNL-NM) is a major Department of Energy (DOE) research and development laboratory with a primary mission of developing, engineering, and testing non-nuclear components of nuclear weapons. SNL-NM is located on 4.4 square miles southeast of Albuquerque, New Mexico, on the Kirtland Air Force Base.

SNL-NM is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), and hazardous waste (HW). SNL-NM currently does not have an inventory of high-level waste and is not expected to manage this waste type in the future. The WM PEIS includes waste volumes for ITRI in its evaluation of SNL-NM as a candidate site for waste management facilities.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the four waste types at SNL-NM, are shown in the following chart. Also, how SNL-NM relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at SNL-NM include the storage of LLMW with the treatment of wastewater only, preparation of LLW for shipment off site for disposal, storage of TRUW on site, and the transport of HW off site for treatment. A waste minimization and pollution prevention plan has been developed and is being implemented at SNL-NM to reduce waste volumes.

Waste Management Alternatives at SNL-NM

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	Treatment Off Site	Treatment Off Site
	Storage On Site	Disposal On Site	Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*3 subalternatives:* Treatment Off Site; Disposal Off Site	*2 subalternatives:* Minimum Treatment On Site; Disposal Off Site
	Disposal Off Site	Disposal On Site	*4 subalternatives:* Minimum Treatment On Site; Disposal Off Site	*3 subalternatives:* Treatment Off Site; Disposal Off Site
TRUW	Storage On Site	Treatment On Site	Treatment Off Site	Treatment Off Site
		Storage Off Site	Storage Off Site	Storage Off Site
HW	Treatment Off Site (commercial facilities)	Treatment Off Site (commercial facilities)	Treatment Off Site (DOE and commercial facilities)	Not Analyzed

= DOE's preferred alternatives.

SNL-NM

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, SNL-NM's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which SNL-NM fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat SNL-NM's LLMW on site consistent with SNL-NM's site treatment plan. DOE prefers to ship SNL-NM's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat SNL-NM's LLW on site. DOE prefers to ship SNL-NM's LLW to one of 2 or 3 regional disposal sites.

Transuranic Waste: DOE prefers the offsite treatment and storage of SNL-NM's TRUW.

Hazardous Waste: DOE prefers the No Action Alternative where SNL-NM would continue to use commercial facilities for HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for SNL-NM under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for SNL-NM under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at SNL-NM.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW, LLW, and TRUW shipments from SNL-NM is estimated to be 370 truck or 180 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 46 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Waste management activities could greatly increase waste shipments leaving the site.

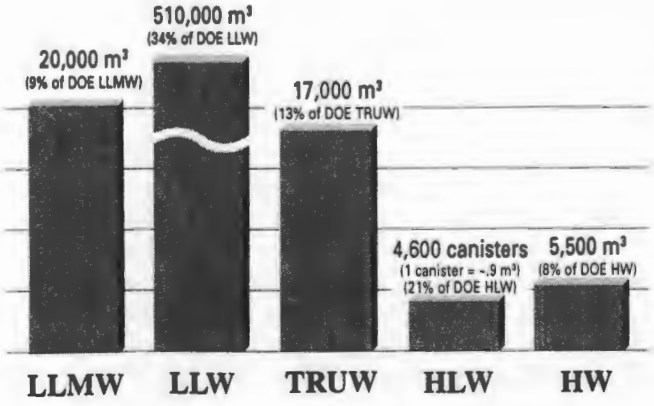
Site Summary

Savannah River Site

The Savannah River Site (SRS) has played a major role in national security for more than 40 years, producing nuclear materials (primarily plutonium and tritium) for weapons, managing the resulting radioactive and hazardous waste, and performing a variety of missions related to energy research and nuclear materials management. SRS is located on approximately 310 square miles, about 20 miles south of Aiken, South Carolina, and 25 miles southeast of Augusta, Georgia.

SRS is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), high-level waste (HLW), hazardous waste (HW), and, in some alternatives, other sites' LLMW, LLW, TRUW and HLW.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the five waste types at SRS, are shown in the following chart. Also, how SRS relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at SRS include the treatment and storage of LLMW, treatment and disposal of LLW on site, storage of TRUW on site, storage of HLW on site pending disposal in a geologic repository, and the transport of HW off site for treatment. A waste minimization and pollution prevention plan has been developed and is being implemented at SRS to reduce waste volumes.

Waste Management Alternatives at SRS

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site	Treatment On Site	*3 subalternatives:* Treatment On Site (including offsite shipments); Disposal On Site	Treatment On Site (RH only); Treatment Off Site
LLMW	Storage On Site	Disposal On Site (including offsite shipments)	*1 subalternative:* Treatment On Site (including offsite shipments); Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*5 subalternatives:* Treatment On Site*; Disposal On Site (including offsite shipments)	*4 subalternatives:* Treatment On Site* (including offsite shipments); Disposal Off Site
LLW	Disposal On Site (including offsite shipments)	Disposal On Site (including offsite shipments)	*2 subalternatives:* Minimum Treatment On Site; Disposal On Site (including shipments from all eastern sites)	*1 subalternative:* Treatment Off Site; Disposal Off Site
TRUW	Treatment On Site	Treatment On Site	Treatment On Site (including offsite CH)	Treatment Off Site
TRUW	Storage On Site	Storage On Site	Storage On Site	Storage Off Site
HLW	Storage On Site	Storage On Site; *Pending* Disposal Off Site (geologic repository)	Storage On Site (possibly including offsite shipments); *Pending* Disposal Off Site (geologic repository)	Storage Off Site
HW	Treatment Off Site (commercial facilities)	Treatment On Site (organic only); Treatment Off Site (commercial facilities)	*1 subalternative:* Treatment On Site (organic only); Treatment Off Site (commercial facilities); *1 subalternative:* Treatment Off Site (DOE and commercial facilities)	Not Analyzed

* Minimum treatment in 2 subalternatives.
RH = Remote-handled TRUW. CH = Contact-handled TRUW.
= DOE's preferred alternatives. DOE does not yet have site preferences for LLMW and LLW disposal.

SRS

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, SRS' future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which SRS fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers regionalized treatment of LLMW at SRS. This alternative includes onsite treatment of SRS's LLMW and could include treatment of LLMW generated at other sites. LLMW activities at SRS would be conducted in accordance with SRS's site treatment plan. SRS could be selected as one of the regional disposal sites for LLMW.

Low-Level Waste: DOE prefers to treat SRS' LLW on site. SRS could be selected as one of the regional disposal sites for LLW.

Transuranic Waste: DOE prefers the Regionalized Alternative for onsite treatment and storage of SRS' contact-handled TRUW. Under this alternative, some contact-handled TRUW could be received from ORR for treatment and storage. Also, DOE could ship SRS' remote-handled TRUW to ORR for treatment and storage.

High-Level Waste: DOE prefers onsite storage of SRS' immobilized HLW pending disposal in a geologic repository.

Hazardous Waste: DOE prefers the No Action Alternative where SRS would continue to use commercial facilities for HW treatment.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for SRS under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for SRS under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Health risks are primarily to workers and could include fatalities from waste management activities over the 20-year period of analysis. Collective worker health risk estimates are one fatality for LLMW and five fatalities for LLW, depending on whether SRS is selected as a disposal site, one fatality for HLW, and less than one fatality for TRUW. Less than one latent cancer fatality is estimated among the offsite population for waste management activities under the preferred alternatives for all waste types at SRS.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. To meet drinking water standards, performance-based waste acceptance criteria may be needed for onsite disposal of LLMW. Expenditures for WM activities could cause socioeconomic effects that include the benefits of increased regional employment and income as well as regional population growth that could alter community structure and stress available housing and community services. No major impacts to ecological resources, land use, infrastructure, or environmental justice are expected. The programmatic analyses did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the maximum total number of LLMW, LLW, TRUW, and HLW shipments to and from SRS is estimated to be 74,862 truck or 27,275 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 2,406 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. However, to meet drinking water standards, performance-based waste acceptance criteria may be needed for onsite disposal of LLMW and LLW. Waste management activities could greatly increase waste shipments entering or leaving the site.

Site Summary

Waste Isolation Pilot Plant Site

The Waste Isolation Pilot Plant (WIPP) is a Department of Energy (DOE) research and development facility for the safe and permanent disposal of defense-generated transuranic waste (TRUW). WIPP will become a permanent disposal site for TRUW if it meets all regulatory requirements and DOE decides to open it. The WIPP site is located on 16 square miles in southeastern New Mexico, approximately 25 miles from Carlsbad.

WIPP is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential geologic disposal site for TRUW from other DOE sites. The WIPP site does not currently manage or contain waste.

In 1981, DOE issued a Record of Decision for the phased development of WIPP. In 1990, a subsequent Record of Decision was issued that called for the continuation of the phased development of WIPP. To support a decision on whether to proceed to disposal, DOE prepared a second Supplemental EIS (SEIS II) to evaluate impacts associated with disposal at the site. Also, a number of regulatory and legislative requirements must be met before shipments of TRUW for disposal at WIPP could begin.

DOE's current strategy is to have all TRUW meet the WIPP waste acceptance criteria established by DOE in consultation with the Environmental Protection Agency (EPA) and the State of New Mexico. These criteria are not yet final and may be modified to require more extensive treatment of TRUW before disposal. The WM PEIS only analyzes the role of the WIPP site with respect to the treatment of TRUW. The environmental impacts of TRUW disposal at WIPP are evaluated in the WIPP SEIS II mentioned above. If certified as a TRUW disposal site by EPA, WIPP will operate as a repository, accepting TRUW for approximately 35 years (under the Proposed Action in the WIPP SEIS II). At the end of that time, DOE will backfill and permanently seal the facility.

Waste Management Alternatives at WIPP

TRUW	No Action	Decentralized	Regionalized	Centralized
	Storage Off Site	Treatment Off Site	Treatment Off Site	Treatment On Site (including shipments of contact-handled TRUW only)
				Treatment Off Site (remote-handled)
		Storage Off Site	Storage Off Site	Storage On Site (contact-handled only)
				Storage Off Site (remote-handled)

= DOE's preferred alternatives.

WIPP

DOE's Preferred Alternative

In the development of a national strategy for each waste type, WIPP's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS, the WIPP SEIS II, and regulatory requirements. Although the site's role will not be determined until the Records of Decision are issued and other requirements are met, the way in which WIPP fits within the preferred waste management alternative for TRUW is as follows.

Transuranic Waste: DOE prefers the Decentralized Alternative in which all DOE-generated TRUW would be treated and stored at the sites where it is generated and then shipped to WIPP for disposal. Although the FFC Act's requirement for a Site Treatment Plan would not apply to WIPP, DOE did include management plans for mixed TRUW in the proposed site treatment plans of the sites where mixed TRUW is currently being managed.

Potential Impacts of Preferred Alternative

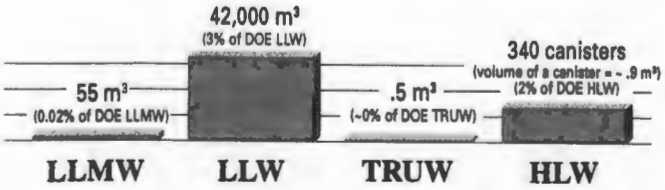
The WM PEIS evaluated WIPP only under the Centralized Alternative, in which treatment of TRUW would occur at WIPP. These impacts are discussed in Chapter 8. However, in the preferred Decentralized Alternative, treatment of TRUW would occur elsewhere. The potential impacts of TRUW disposal have been assessed in previous EISs and the WIPP SEIS II.

West Valley Demonstration Project

The West Valley Demonstration Project (WVDP) is located on the site of the only U.S. commercial nuclear fuel reprocessing plant, which recycled fuel from commercial and federally owned reactors until 1972. Under the WVDP Act, a Public Law enacted by Congress in 1980, the Department of Energy (DOE) is required to develop and demonstrate a technology for solidifying high-level waste in preparation for disposal. Other WVDP activities include programs for waste management and decontamination and decommissioning. The WVDP is located on 0.3 square mile in West Valley, approximately 31 miles south of Buffalo, New York.

WVDP is considered in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) as a potential waste management site for its own low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), and high-level waste (HLW). WVDP currently does not have a large inventory of hazardous waste and is not expected to manage large quantities of this waste type in the future.

The estimated total waste inventories, consisting of current inventory and 20 years of generation for the four waste types at WVDP, are shown in the following chart. Also, how WVDP relates to DOE's entire 20-year projected inventory for each waste type is provided below as a percentage.



Current waste management activities at WVDP include the storage of LLMW with the treatment of wastewater only, preparation of LLW for shipment off site for disposal, storage of TRUW on site, and the storage of HLW on site pending disposal in a geologic repository. A waste minimization/pollution prevention program has been developed and is being implemented at WVDP to reduce waste volumes.

Waste Management Alternatives at WVDP

	No Action	Decentralized	Regionalized	Centralized
LLMW	Treatment On Site (wastewater only)	Treatment On Site	Treatment Off Site	Treatment Off Site
	Storage On Site	Disposal On Site	Disposal Off Site	Disposal Off Site
LLW	Minimum Treatment On Site	Minimum Treatment On Site	*3 subalternatives:* Treatment Off Site	*2 subalternatives:* Minimum Treatment On Site
			Disposal Off Site	Disposal Off Site
	Disposal Off Site	Disposal On Site	*4 subalternatives:* Minimum Treatment On Site	*3 subalternatives:* Treatment Off Site
			Disposal Off Site	Disposal Off Site
TRUW	Storage On Site	Treatment On Site	Treatment Off Site	Treatment Off Site
		Storage* Off Site	Storage Off Site	Storage Off Site
HLW	Storage On Site	Storage On Site	Storage Off Site	Storage Off Site
		Pending Disposal Off Site (geologic repository)		

* Although the WM PEIS analyses assumed offsite storage, DOE prefers onsite decentralized storage of WVDP transuranic waste.

= DOE's preferred alternatives.

WVDP

DOE's Preferred Alternatives

In the development of a national strategy for each waste type, WVDP's future role will be shaped in part by DOE's preferred alternatives, along with decision criteria discussed in Section 1.7.3 of the WM PEIS. Although the site's role will not be determined until the Records of Decision for each waste type are issued, the ways in which WVDP fits within each preferred waste management alternative are as follows.

Low-Level Mixed Waste: DOE prefers to treat WVDP's LLMW according to the Regionalized Alternative and consistent with WVDP's site treatment plan. Under this alternative, WVDP's LLMW would be shipped off site for treatment. DOE prefers to ship WVDP's LLMW to one of 2 or 3 regional disposal sites.

Low-Level Waste: DOE prefers to treat WVDP's LLW on site. DOE prefers to ship WVDP's LLW to one of 2 or 3 regional disposal sites.

Transuranic Waste: DOE prefers the onsite treatment and storage of WVDP's TRUW.

High-Level Waste: DOE prefers onsite storage of WVDP's immobilized HLW pending disposal in a geologic repository.

Potential Impacts of Preferred Alternatives

The WM PEIS evaluated potential impacts for WVDP under all of the alternatives that identified a role for the site. These impacts are discussed in Chapters 6 through 11. Results of the analyses for WVDP under DOE's preferred alternatives are highlighted for the following impacts.

Health Effects

Latent cancer fatalities among the offsite population are estimated to be essentially zero, and collective physical hazard and latent cancer risks to workers are less than one fatality, for waste management activities under the preferred alternatives for all waste types at WVDP.

Environmental Effects

The preferred alternatives are not expected to cause exceedances of air quality standards. No major impacts to ecological resources, land use, or environmental justice are expected; moderate increases to requirements for wastewater treatment and power for activities under the preferred alternatives could lead to requirements for additional capacity and corresponding costs for these systems. The programmatic analysis did not select exact locations for facilities within site boundaries; some location-specific impacts, such as to cultural and sensitive ecological resources, could require impacts assessment when exact locations are determined.

Transportation

Under the preferred alternatives, the total number of LLMW, LLW, TRUW, and HLW shipments from WVDP is estimated to be 6,990 truck or 2,578 rail shipments.

Site Employment

Under the preferred alternatives, the annual workforce required for waste management operations is estimated to average 142 workers. This could include workers currently employed for existing waste management operations.

Cumulative Effects

Cumulative health risk and environmental impacts are primarily caused by existing conditions and other actions at the site. Although waste management activities may add to cumulative impacts, these additions are not expected to cause standards or guidelines to be exceeded. Wastewater and power requirements could cause current capacities to be exceeded. Waste management activities could substantially increase waste shipments leaving the site.

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U.S. Department of Energy
Office of Environmental Management

Final Waste Management Programmatic Environmental Impact Statement

For Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

Volume I of V

DOE/EIS-0200-F

May 1997

DOE/EIS-0200-F

FINAL
WASTE MANAGEMENT
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT
for
Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste

Volume I of V

Chapters 1-15

May 1997

U.S. Department of Energy
Office of Environmental Management
1000 Independence Ave.
Washington, DC 20585

COVER SHEET

Responsible Federal Agency: U.S. Department of Energy

Title:

Final Waste Management Programmatic Environmental Impact Statement.

Contact:

For further information about this Environmental Impact Statement call or contact:

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For general information on the U.S. Department of Energy National Environmental Policy Act process call 1-800-472-2756 to leave a message or contact:

Carol Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
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Washington, DC 20585
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Abstract:

The Final Waste Management Programmatic Environmental Impact Statement (WM PEIS) examines the potential environmental and cost impacts of strategic management alternatives for managing five types of radioactive and hazardous wastes that have resulted and will continue to result from nuclear defense and research activities at a variety of sites around the United States. The five waste types are low-level mixed waste, low-level waste, transuranic waste, high-level waste, and hazardous waste. The WM PEIS provides information on the impacts of various siting alternatives which the Department of Energy (DOE) will use to decide at which sites to locate additional treatment, storage, and disposal capacity for each waste type. This information includes the cumulative impacts of combining future siting configurations for the five waste types and the collective impacts of other past, present, and reasonably foreseeable future activities.

The selected waste management facilities being considered for these different waste types are treatment and disposal facilities for low-level mixed waste; treatment and disposal facilities for low-level waste; treatment and storage facilities for transuranic waste in the event that treatment is required before disposal; storage facilities for treated (vitrified) high-level waste canisters; and treatment of nonwastewater hazardous waste by DOE and commercial vendors. In addition to the no action alternative, which includes only existing or approved waste management facilities, the alternatives for each of the waste type configurations include decentralized, regionalized, and centralized alternatives for using existing and operating new waste management facilities. However, the siting, construction and operations of any new facility at a selected site will not be decided until completion of a sitewide or project-specific environmental impact review.

Reader's Guide

What is the purpose of this environmental impact statement?

The purpose of all environmental impact statements is to inform the public and decision makers of the potential impacts of proposed Federal actions and to identify which of these impacts might be significant to human health or the environment. In brief, the **Waste Management Programmatic Environmental Impact Statement (WM PEIS)** evaluates the possible impacts of several strategic waste management alternatives being considered by the U.S. Department of Energy (DOE).

How is it organized?

Chapter 1 of Volume I describes how the WM PEIS is organized. Recognizing that the public has varying levels of interest, the WM PEIS is separated into distinct levels that increase in complexity from the Summary to the technical reports. These levels are shown in the box at right.

VOLUME V contains an indexed compilation of the public's comments on the draft WM PEIS and DOE's responses to them. All comments received during the public comment period were carefully considered.

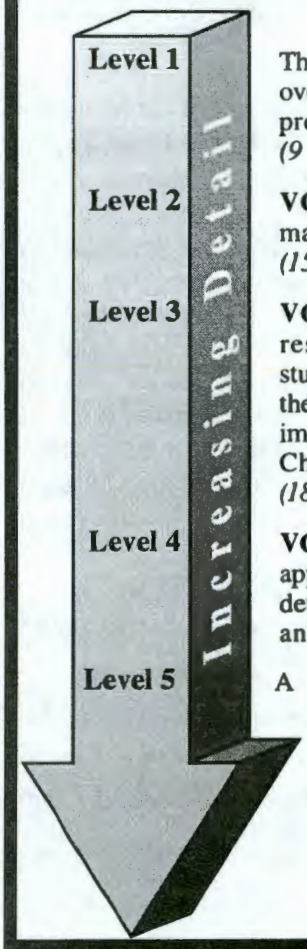
How can I tell where the final document has been changed?

All text changes that have occurred since publication of the Draft WM PEIS are indicated with shading for tables and marginal rules for text. One exception is Appendix I, which is completely new.

What if I don't understand a term or an abbreviation?

The glossary in Chapter 14 of Volume I contains definitions of technical and less commonly used words. Some definitions can also be found in the main text of the document. Acronym lists spelling out the abbreviations used in the WM PEIS and its appendices are provided in the front of the document (the Summary and Volume I) and before each appendix.

Levels of Detail in the WM PEIS



The **SUMMARY** contains an overview of all of the material presented in the WM PEIS. *(9 sections)*

VOLUME I contains the main text of the document. *(15 chapters)*

VOLUME II presents the results of the analytical studies, by site, that constitute the basis of the environmental impact discussions provided in Chapters 6–10 of Volume I. *(18 chapters)*

VOLUMES III AND IV are appendices that provide more detail concerning the analyses and results. *(9 appendices)*

A series of **TECHNICAL REPORTS** (available in the DOE reading rooms listed in Chapter 1 of Volume I) contains detailed information of interest to technical experts. *(32 reports)*

Where can I find out what proposed Federal actions are evaluated in the WM PEIS?

DOE evaluates several possible alternatives for treatment, storage, or disposal of five types of waste generated from nuclear weapons production and related activities. The alternatives considered for each waste type are introduced in Chapter 1 of Volume I, and summarized in Section 1 of the Summary. Chapter 2 of Volume I discusses why DOE needs to make waste management decisions.

Where does DOE define the five waste types?

Definitions for the waste types are found in Section 1.5 of Volume I and Section 1.3 of the Summary.

Where are the waste management alternatives described?

Chapter 3 of Volume I and Section 2 of the Summary describe the alternatives for each type of waste and the methods used to develop the alternatives.

How did DOE decide which of its sites to include in the various alternatives?

Chapter 1 of Volume I introduces the basic rationale for identifying 17 DOE sites as the "major" sites in the waste management complex. Chapters 6–10 of Volume I present the rationale for determining which of these sites are included in each alternative for each waste type. Sections 2 and 4–8 of the Summary also contain this information.

Does DOE have preferred alternatives? Where can I find them discussed?

Yes, DOE has preferred alternatives for each of the five waste types. These alternatives are described in Chapter 3 of Volume I and in Section 2 of the Summary. The criteria used to select the preferred alternatives are presented in Chapter 1 of Volume I and Section 2 of the Summary.

How can I find out quickly and easily which alternatives were considered for each waste type?

An "At a Glance" page for each waste type summarizes the waste management alternatives (including DOE's preferred alternative) considered for that waste type. The data and assumptions used to compare the alternatives and the highlights of what was learned are also provided. The "At a Glance" pages can be found at the beginning of each waste type section in the Summary (Sections 4–8).

Where can I find more details about the possible impacts at a site?

More detailed information about possible impacts is provided in Volume II, where site-specific modeling results for health risks, air quality, water resources, socioeconomic impacts, and costs are presented. Also note that the maps in Appendix C (Volume III) depict minority and low-income population distributions for the major waste management sites. The table at the end of this guide shows where to find all of this information for each of the major sites.

What can DOE do about the possible impacts at a site?

Chapter 12 of Volume I describes the "mitigation measures" that DOE can use to reduce or eliminate potential impacts wherever appropriate. These measures are described on both a programmatic and a site level.

Where can I find information about a site near me?

The WM PEIS is a *programmatic* (i.e., Department-wide) study to evaluate strategies for managing waste. It is not a site-specific review. However, two chapters of Volume I are organized by site: Chapter 4, *Affected Environment*, and Chapter 11, *Cumulative Impacts*. Refer to the table at the end of this guide to find the sections of these chapters that discuss the site you are interested in.

Chapters 6–10 provide information in tables organized by site. A foldout table is included at the end of each of these chapters to use as a handy reference while you are reading the chapter. The foldout tables provide the waste management activities analyzed for each site under each alternative.

At the end of the Summary, a profile of each "major" site summarizes the amount of each type of waste at the site and the waste management alternatives considered for the site. The possible human health and environmental impacts of the preferred alternatives at the site are also briefly identified.

Guide to Finding Site Information in the WM PEIS

	Topic and WM PEIS Volume Number				
	Affected Environment	Cumulative Impacts	Site Data Tables	Distribution of Minority Populations (and Tribal Lands)	Distribution of Low-Income Populations
DOE Site	**Volume I**	**Volume I**	**Volume II**	**Volume III**	**Volume III**
ANL-E	Section 4.4.1	Section 11.3	Chapter II.2	Figure C.4-7	Figure C.4-24
BNL	Section 4.4.2	Section 11.4	Chapter II.3	Figure C.4-8	Figure C.4-25
FEMP	Section 4.4.3	Section 11.5	Chapter II.4	Figure C.4-9	Figure C.4-26
Hanford	Section 4.4.4	Section 11.6	Chapter II.5	Figure C.4-10a,b	Figure C.4-27
INEL	Section 4.4.5	Section 11.7	Chapter II.6	Figure C.4-11a,b	Figure C.4-28
LANL	Section 4.4.7	Section 11.9	Chapter II.7	Figure C.4-13a,b	Figure C.4-30
LLNL	Section 4.4.6	Section 11.8	Chapter II.8	Figure C.4-12	Figure C.4-29
NTS	Section 4.4.8	Section 11.10	Chapter II.9	Figure C.4-14	Figure C.4-31
ORR	Section 4.4.9	Section 11.11	Chapter II.10	Figure C.4-15	Figure C.4-32
Pantex	Section 4.4.11	Section 11.13	Chapter II.12	Figure C.4-17	Figure C.4-34
PGDP	Section 4.4.10	Section 11.12	Chapter II.11	Figure C.4-16	Figure C.4-33
PORTS	Section 4.4.12	Section 11.14	Chapter II.13	Figure C.4-18	Figure C.4-35
RFETS	Section 4.4.13	Section 11.15	Chapter II.14	Figure C.4-19	Figure C.4-36
SNL-NM	Section 4.4.14	Section 11.16	Chapter II.15	Figure C.4-20a,b	Figure C.4-37
SRS	Section 4.4.15	Section 11.17	Chapter II.16	Figure C.4-21	Figure C.4-38
WIPP	Section 4.4.16	Section 11.18	Chapter II.17	Figure C.4-22	Figure C.4-39
WVDP	Section 4.4.17	Section 11.19	Chapter II.18	Figure C.4-23a,b	Figure C.4-40

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Acronyms and Abbreviations

AI	Atomics International
Ames	Ames Laboratory
AMRC	Albany Metallurgical Research Center
ANL-E	Argonne National Laboratory-East
ANL-W	Argonne National Laboratory-West
ARAM	Automated Remedial Action Methodology
ARARs	Applicable or Relevant and Appropriate Requirements
AEA	Atomic Energy Act
BEA	Bureau of Economic Analysis
BCL	Battelle Columbus Laboratory
BEMR	Baseline Environmental Management Report
Bettis	Bettis Atomic Power Laboratory
BGV	below-ground vault
BNL	Brookhaven National Laboratory
BRC	Below Regulatory Concern
CAA	Clean Air Act
CEER	Center for Energy and Environmental Research
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH	Contact-handled
Charleston	Charleston Naval Shipyard
CISS	Colonie Interim Storage Site
CWA	Clean Water Act
CY	Calendar Year
D&D	Decontamination and Decommissioning
DNFSB	Defense Nuclear Facilities Safety Board
DOC	U.S. Department of Commerce
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DP	Defense Programs
DUST	Disposal Unit Source Term
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
EDE	Effective Dose Equivalent
EH	DOE Office of Environment, Safety, and Health
EIS	Environmental Impact Statement
EM	Office of Environmental Management
EMAB	Environmental Management Advisory Board
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration

ETEC	Energy Technology Engineering Center
et seq.	and that which follows
FEMA	U.S. Federal Emergency Management Agency
FEMP	Fernald Environmental Management Project
Fermi	Fermi National Accelerator Laboratory
FFCAct	Federal Facility Compliance Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FTE	Full-time Equivalent
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	Fiscal Year
GA	General Atomics
GCR	General Conformity Rule
GE	General Electric Vallecitos Nuclear Center
GJPO	Grand Junction Projects Office
GTCC	Greater-Than-Class C
Hallam	Hallam Nuclear Power Facility
Hanford	Hanford Site
HAPs	Hazardous Air Pollutants
HEPA	High Efficiency Particulate Air
HHS	U.S. Department of Health and Human Services
HLW	High-Level Waste
HW	Hazardous Waste
ICF	Inertial Confinement Fusion
ICPP	Idaho Chemical Processing Plant
IDHL	Immediately Dangerous to Life and Health
INEL	Idaho National Engineering Laboratory
IP	Implementation Plan
ITRI	Inhalation Toxicology Research Institute
K-25	Oak Ridge K-25 Site
KAFB	Kirtland Air Force Base
KAPL	Knolls Atomic Power Laboratory
KAPL-K	Knolls Atomic Power Laboratory-Kesselring
KAPL-N	Knolls Atomic Power Laboratory-Niskayuna
KAPL-W	Knolls Atomic Power Laboratory-Windsor
KCP	Kansas City Plant
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley Laboratory
LDRs	Land Disposal Restrictions
LEHR	Laboratory for Energy-Related Health Research
LLMW	Low-Level Mixed Waste

LLNL	Lawrence Livermore National Laboratory
LLW	Low-Level Waste
m^3	cubic meter (1 cubic meter is equal to 35.314 cubic feet, or 264,173 gallons)
Mare Is	Mare Island Naval Shipyard
MISS	Maywood Interim Storage Site
MCL	Maximum Contaminant Level
MEI	Maximally Exposed Individual
MEPAS	Multimedia Environmental Pollutant Assessment System
Middlesex	Middlesex Sampling Plant
Mound	Mound Plant
MWIR	Mixed Waste Inventory Report
NAAQS	National Ambient Air Quality Standards
nCi/g	nanocuries per gram
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NOI	Notice of Intent
Norfolk	Norfolk Naval Shipyard
NRC	U.S. Nuclear Regulatory Commission
NRF	Naval Reactor Facility
NRHP	National Register of Historic Places
NHL	National Historic Landmark
NTS	Nevada Test Site
NWPA	Nuclear Waste Policy Act
ODS	Ozone-Depleting Substance
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Act
Paducah	Paducah Gaseous Diffusion Plant
PA/SI	Preliminary Assessment and Site Investigation
Palos	Palos Forest
Pantex	Pantex Plant
PCBs	Polychlorinated Biphenyls
PEIS	Programmatic Environmental Impact Statement
Pearl H	Pearl Harbor Naval Shipyard
PGDP	Paducah Gaseous Diffusion Plant
Pinellas	Pinellas Plant
PM_{10}	Particulate matter of aerodynamic diameter equal to or less than 10 micrometers
PNNL	Batelle Pacific Northwest National Laboratory
PORTS	Portsmouth Gaseous Diffusion Plant
Ports Nav	Portsmouth Naval Shipyard
PPPL	Princeton Plasma Physics Laboratory

PSD	Prevention of Significant Deterioration
Puget So	Puget Sound Naval Shipyard
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
RH	Remote-handled
RI/FS	Remedial Investigation/Feasibility Study
RIMS	Regional Input-Output Modeling System
RMI	RMI Titanium Company
ROD	Record of Decision
ROI	Region of Influence
Salton Sea	Salton Sea Test Base
SARA	Superfund Amendment Reauthorization Act
SARs	Safety Analysis Reports
SDWA	Safe Drinking Water Act
SIW	Sanitary and Industrial Waste
SLAC	Stanford Linear Accelerator Center
SMAC	Shipment/Mobility Accountability Collection
SNF	Spent Nuclear Fuel
SNM	Special Nuclear Material
SNL-CA	Sandia National Laboratories (California)
SNL-NM	Sandia National Laboratories (New Mexico)
SRS	Savannah River Site
STPs	Site Treatment Plans
TAPs	Toxic Air Pollutants
TBE	Teledyne Brown Engineering
TCLP	Toxicity Characteristic Leaching Procedure
TEDE	Total Effective Dose Equivalent
TRUW	Transuranic Waste
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
U of MO	University of Missouri
UMTRA	Uranium Mill Tailings Remedial Action Project
USAMC	U.S. Army Material Command
USC	U.S. Code
VOCs	Volatile Organic Compounds
WAC	Waste Acceptance Criteria
WIPP	Waste Isolation Pilot Plant
WIPP LWA	Waste Isolation Pilot Plant Land Withdrawal Act
WIPP-WAC	Waste Isolation Pilot Plant Waste Acceptance Criteria
WM PEIS	Waste Management Programmatic Environmental Impact Statement

WNYNSC	Western New York Nuclear Service Center
WSSR	Weldon Spring Remedial Action Project
WVDP	West Valley Demonstration Project
Y-12	Oak Ridge Y-12 Plant

CHAPTER 1
Introduction and Background

This chapter describes the U.S. Department of Energy's (DOE's) past and ongoing activities that generate and have resulted in the accumulation of wastes, and provides information about the statutory and regulatory framework under which DOE must operate to manage five types of waste. These waste types are defined, the involved DOE sites are identified, and the decisions that DOE must make with respect to managing those wastes are described. This chapter also includes a discussion of the relationship of this decision-making process to other DOE National Environmental Policy Act (NEPA) documents and programs.

1.1 Purpose of the Waste Management Programmatic Environmental Impact Statement

This Waste Management Programmatic Environmental Impact Statement (WM PEIS) is a nationwide study examining the environmental impacts of managing more than 2 million cubic meters of radioactive and hazardous wastes from past and future DOE activities. The WM PEIS will assist the U.S. Department of Energy (DOE) in improving the efficiency and reliability of managing its current and anticipated volumes of radioactive and hazardous wastes, will help DOE continue to comply with applicable laws and regulations, and will promote the protection of workers, public health and safety, and the environment (DOE, 1994b). The WM PEIS allows the public and DOE decision makers to make comparisons of the impacts from various potential configurations for the management of DOE wastes. The goal is a nationwide strategy to treat wastes in a safe, responsible, and efficient manner that minimizes impacts. Nevertheless, there will always be legitimate questions regarding waste management activities at certain sites. DOE understands and appreciates these concerns and will carefully consider them in making these strategic decisions.

Wastes analyzed in the WM PEIS result primarily from nuclear weapons production and related activities.[1] Wastes produced from nuclear weapons production and related activities are categorized into five waste types. These are: low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), high-level waste (HLW), and hazardous waste (HW). More information on the scope of this document and its relationship to other actions and programs can be found in Sections 1.7 and 1.8.

[1] Environmental restoration (ER), another activity resulting in waste generation, is reviewed but not analyzed in the WM PEIS.

Definitions of Wastes Analyzed in the WM PEIS:

- **Low-level mixed waste.** Waste that contains both hazardous waste under the Resource Conservation and Recovery Act (RCRA) and source, special nuclear, or by-product material subject to the Atomic Energy Act (AEA) of 1954 (42 USC 2011, *et seq.*).
- **Low-level waste.** Waste that contains radioactivity and is not classified as HLW, TRUW, or spent nuclear fuel, or byproduct tailings containing uranium or thorium from processed ore (as defined in Section 11(e)(2) of the Atomic Energy Act). Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, provided that the concentration of transuranic is less than 100 nCi/g.

Terms of Radioactivity

The spontaneous decay of unstable nuclei in the atom causes the release of particles or electromagnetic waves. These releases are measured in terms of the number of nuclear disintegrations per unit of time. The common unit for this is the "curie," which is 37 billion disintegrations per second. A ***nanocurie****, or one-billionth of a curie, designated as "nCi," is 37 disintegrations per second. The activity level of radiation, measured in curies, declines over time. The time it takes for the activity to drop to one-half of its starting value is known as the* ***half-life*** *of the material. DOE waste has half-lives as short as minutes in the case of some fission products (smaller atoms left over by the splitting of uranium and plutonium) to billions of years in the case of uranium-238 (one of two main isotopes of uranium).*

The dosage of radiation a person receives is measured in ***REMs*** *(roentgen equivalent man) and is typically stated in terms of thousandths of REMs (1/1,000 REM or millirem [mrem]).*

- **Transuranic wastes**. Waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, with half-lives greater than 20 years, per gram of waste, and an atomic number greater than 92 except for (a) HLW, (b) waste that DOE has determined, with the concurrence of the Administrator of the U.S. Environmental Protection Agency (EPA), does not need the degree of isolation required by 40 CFR 191, or (c) waste that the U.S. Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.
- **High-level waste**. The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly from reprocessing and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation. High-level waste may include other highly radioactive material that the NRC, consistent with existing law, determines by rule requires permanent isolation.
- **Hazardous waste**. Under RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause or significantly

contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Source, special nuclear material, and by-product material, as defined by the AEA, are specifically excluded from the definition of solid waste.

Waste management is broadly defined as the treatment, storage, or disposal of waste. The activities associated with the management of the waste include:

- Pollution prevention
- Identifying and contracting with private vendors to manage waste
- Modifying existing waste management facilities or constructing new facilities at particular sites
- Operating modified or new waste management facilities at those sites
- Transporting wastes among sites as necessary
- Handling, surveillance, and maintenance

The WM PEIS will help DOE select a configuration for the following activities:

- Treatment and disposal of LLMW
- Treatment and disposal of LLW
- Treatment and storage of TRUW
- Storage of treated (vitrified) HLW in canisters
- Treatment of nonwastewater HW

The decision-making process will follow a "tiered" approach. First, DOE will make broad Departmentwide decisions, supported by this programmatic NEPA review, about which sites will manage which wastes. DOE will follow these broad decisions with an analysis of narrower proposals for the implementation of programmatic decisions in related NEPA reviews. Although DOE intends to identify a configuration (i.e., select sites for waste management activities as a result of this *programmatic* EIS), DOE will take a closer look (including site-specific design, location on the site, operating parameters for new facilities, and site-specific impacts) in *sitewide* or *project-level* NEPA reviews.

To assist DOE in making decisions regarding the sites at which it should locate waste management facilities, this PEIS considers four broad categories of alternatives for each waste type: the No Action Alternative, Decentralized Alternatives that would minimize the transportation of waste between sites, Regionalized Alternatives that would locate waste management facilities at several sites throughout the nation, and

Centralized Alternatives that would locate large waste management facilities at only one or two sites. For certain waste types, DOE considers more than one Regionalized or Centralized alternative in order to vary the number of sites analyzed for waste management facilities and the sites at which the facilities could be located. This variation among alternatives bounds potential impacts and allows the decision maker maximum flexibility to compare impacts of potential waste management configurations when considering alternatives.

1.2 The Legacy of Nuclear Weapons Production

Over the past 50 years, DOE and its predecessor agencies have been responsible for atomic energy and nuclear weapons research and production in the United States. In 1946, the AEA established the Atomic Energy Commission to administer and regulate the production and uses of atomic power. Soon after its inception, the Commission expanded its work from building a stockpile of nuclear weapons to peaceful uses of atomic energy and studies of the health and safety hazards of radioactive materials. In 1974, the Atomic Energy Commission was replaced by two new agencies: the NRC, which was charged with regulating the civilian uses of nuclear power, and the Energy Research and Development Administration, whose duties included the production of the nation's nuclear weapons and control of the nuclear weapons complex—a vast network of research, development, and manufacturing facilities, as well as testing sites. In 1977, the duties of the Energy Research and Development Administration were transferred to the newly created DOE.

At its peak, the nuclear weapons complex consisted of 16 major facilities, including large sites in Nevada, Idaho, Washington, and South Carolina. National laboratories in New Mexico and California designed weapons that were produced from components fabricated in plants located in Colorado, Florida, Missouri, Ohio, Tennessee, and Washington. Like most industrial and manufacturing operations, the production of nuclear weapons generated waste, pollution, and contamination. However, many of the problems posed by DOE's nuclear operations are unlike those associated with any other industry. Among these problems are unique radiation hazards; contaminated structures, such as nuclear reactors; and chemical plants that processed nuclear materials. By far, the largest contributor to the contamination problem which exists at these facilities resulted from producing the nuclear materials required for the weapons. This activity generated large quantities of wastes in plants designed and constructed in the 1940s and 1950s.

Nuclear weapons have played an important role in national security, and the nation continues to maintain an arsenal of nuclear weapons and some production capability. With the end of the Cold War and the

nuclear arms race, national priorities have shifted, and waste management and environmental restoration have become central to DOE's mission.

Thus, DOE is faced with an environmental legacy of the Cold War and must provide for the proper management of its wastes and for the environmental restoration of contaminated facilities and sites.[2] DOE faces the challenge of treating, storing, and disposing of its waste inventories, both hazardous (treatment only) and radioactive, that have resulted from its past nuclear energy and weapons research and production, as well as waste that may be generated in the future.

The DOE Office of the Assistant Secretary for Environmental Management was established in 1989, with responsibilities for a variety of waste management and environmental restoration activities. These activities include:

- Stabilizing and maintaining a large number of nuclear materials and facilities
- Managing a large amount and variety of wastes
- Providing safe storage for wastes while building and operating a variety of treatment facilities to prepare wastes for disposal
- Cleaning up areas of existing contamination and pollution—the environmental restoration portion of the environmental management program
- Managing a national program of technology development for environmental cleanup, waste management, and related activities
- Reducing waste through waste minimization and pollution prevention practices at each site
- Providing support for international nonproliferation policies

The DOE Environmental Management Program is continually working to accelerate cleanup schedules, increase efficiency, and foster cooperative relationships with its regulators and stakeholders. However, there is concern whether support can be sustained for a program that may last more than 70 years and cost more than $200 billion (DOE, 1996l). DOE has been challenged to accelerate reduction of this "cleanup mortgage" from the Cold War to reduce long-term economic and environmental liabilities. DOE is working on a 2006 Plan (previously the Ten Year Plan) to meet this challenge (see Section 1.8.2). The goal of this

[2] For an overview of DOE's approach to existing environmental, safety, and health issues throughout the nuclear weapons complex, see *Closing the Circle on the Splitting of the Atom—The Environmental Legacy of Nuclear Weapons Production in the United States and What the Department of Energy is Doing About It* (DOE, 1995a). In addition, DOE's *Baseline Environmental Management Report*, issued in June 1996, examines the costs associated with waste management and environmental restoration activities (DOE, 1996l).

plan is that, within the next decade, most DOE facilities will be able to treat and dispose of the backlog of wastes safely and to clean up their land and buildings. These steps would dramatically reduce long-term costs and open a large portion of the land and other resources controlled by DOE for other purposes.

1.3 How the WM PEIS Is Organized

Volume I of the WM PEIS contains the main text of the document. The remainder of this chapter describes the statutory and regulatory constraints under which DOE must operate in managing its waste, defines the five waste types that are analyzed in the WM PEIS, and discusses the waste management sites that are the focus of the document. The chapter also outlines the decisions that DOE expects to make on the basis of the WM PEIS and the relationship of the WM PEIS to other ongoing and planned DOE actions and programs.

Following this introductory chapter, the purpose and need for DOE action (Chapter 2), the alternatives (Chapter 3), the affected environment (Chapter 4), and the impact analysis methodologies (Chapter 5) are described and discussed. Chapters 6 through 10 analyze the health risk, environmental and socioeconomic impacts, and costs associated with each of the alternatives for each waste type. Chapter 11 examines the cumulative effects of the alternatives and other ongoing and proposed DOE activities. Chapter 12 discusses mitigation as well as unavoidable and irreversible impacts of the alternatives. A glossary is also provided in Volume I, Chapter 14.

Volume II consists of tables, organized by major site, that contain information regarding the potential impacts associated with all of the alternatives for the five waste types at those sites.

DOE has also prepared extensive appendices (Volumes III and IV) and technical reports that provide supporting data as well as in-depth descriptions and explanations of a variety of issues. A list of these background documents is provided in Chapter 15 at the end of this volume. Responses to public comments on the Draft WM PEIS are in Volume V.

1.4 Consultations, Laws, and Requirements

This section identifies and summarizes the major laws, regulations, executive orders, and DOE orders that may apply to the programmatic alternatives for WM.

Section 1.4.1 discusses the major Federal statutes that impose environmental requirements upon DOE. In addition, there may be other Federal, State, and local measures applicable to the Waste Management Program because Federal law delegates enforcement authority to State or local agencies. Section 1.4.2 addresses environmentally related presidential executive orders that clarify issues of national policy and set guidelines under which Federal agencies, including DOE, must act. DOE implements its responsibilities for protection of public health, safety, and the environment through a series of departmental orders that impose requirements on the operating contractors of DOE facilities. Section 1.4.3 discusses those DOE orders related to the environment, health, and safety. Hazardous and radioactive materials transportation regulations are summarized in Section 1.4.4. Section 1.4.5 describes DOE's relationship to agencies and organizations, including American Indian Tribes.

1.4.1 Federal Environmental Statutes and Regulations

Some laws require DOE to obtain permits from the EPA or States before constructing and operating waste management facilities that discharge effluent, emit air pollutants, or treat or dispose of toxic substances. Wherever new facilities are located as a result of the decisions made on the basis of the WM PEIS, existing permits will need to be amended or new permits obtained.

National Environmental Policy Act of 1969, as Amended (42 USC §§4321 *et seq.*). NEPA establishes a national policy that promotes awareness of the environmental consequences of the activity of humans on the environment and consideration of the environmental impacts during the planning and decision-making stages of a project. NEPA requires all agencies of the Federal government to prepare a detailed statement on the environmental effects of proposed major Federal actions that may significantly affect the quality of the human environment.

Key Statutes

National Environmental Policy Act (NEPA). *In addition to establishing a broad national policy on the environment, NEPA requires DOE and all other Federal agencies to consider the potential environmental consequences related to proposed actions and requires them to prepare detailed statements on the environmental effects of major actions, alternatives to the action, and measures to avoid or minimize adverse effects.*

Resource Conservation and Recovery Act (RCRA). *The statute outlines the framework for national programs to achieve environmentally sound management of HW from "cradle to grave" and requires agencies, including DOE, to follow specific regulations, procedures, and standards for managing HW, including the hazardous components of radioactive waste (mixed waste).*

Federal Facility Compliance Act (FFCAct). *An amendment to RCRA, the FFCAct waives immunity for DOE and other Federal agencies, allowing States and the EPA to impose fines and penalties for RCRA violations. DOE may avoid these penalties and fines if they are otherwise in compliance with approved site treatment plans.*

Atomic Energy Act (AEA). *The AEA provides the authority for DOE to develop procedures and standards to ensure proper and safe management of radioactive materials.*

Nuclear Waste Policy Act (NWPA). *This Act authorizes Federal agencies to develop a geologic repository for the permanent disposal of spent nuclear fuel and high-level radioactive waste. The Act specifies the process for selecting a repository site and constructing, operating, closing, and decommissioning the repository. The Act also establishes programmatic guidance for these activities.*

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). *Also known as "Superfund," CERCLA outlines the framework for liability, compensation, remediation, and emergency response for hazardous substances released into the environment and for the remediation of inactive hazardous waste disposal sites. CERCLA also provides the basis for requirements affecting DOE's environmental restoration activities.*

This PEIS has been prepared in accordance with the Council on Environmental Quality's (CEQ's) NEPA Implementing Regulations (40 CFR Parts 1500–1508) and DOE's Implementing Procedures (10 CFR Part 1021).

Both the CEQ and DOE regulations encourage the preparation of a programmatic EIS for broad Federal actions (40 CFR 1502.4 and 10 CFR 1021.330). An agency preparing an EIS may then "tier" from the broad, programmatic EIS to one of narrower scope in order to eliminate repetitive discussions and to focus on the issues ready for decision (40 CFR 1502.20; 10 CFR 1021.210). "Tiering" means that when a PEIS has been prepared, a subsequent NEPA document need only summarize or incorporate by reference the issues discussed in the broader statement.

This PEIS has been prepared to assist DOE in determining the sites at which it should either continue to operate certain waste management facilities or locate new facilities. Project-level environmental impact statements (EISs) or environmental assessments (EAs) will assess the environmental impacts of applying alternative treatment, storage, and disposal technologies, and the impacts of constructing and operating these facilities at specific locations on the selected sites.

The CEQ and DOE regulations require the preparation of EISs in two stages, draft and final (40 CFR 1502.9; 10 CFR 1021.313). The draft and final EISs must contain discussions of the purpose and need for the proposed action; reasonable alternatives to the proposed action, including the "No Action" Alternative; the environment potentially affected by the proposed action and the alternatives; and the environmental consequences of the proposed action and alternatives (40 CFR 1502.10 and 10 CFR 1021.310), including cumulative effects and recommended mitigation and monitoring. At the time the agency reaches a decision, but no sooner than 30 days after completing the Final EIS, the agency preparing the EIS must prepare one or more Records of Decision that state what the decisions are and identify the alternatives considered (40 CFR 1505.2; 10 CFR 1021.315).

Resource Conservation and Recovery Act (RCRA). DOE's management of wastes with hazardous constituents (LLMW, some TRUW, HLW, and HW) must comply with the RCRA (42 USC 6901 *et seq.*). RCRA was enacted to ensure the safe and environmentally responsible management of hazardous and nonhazardous solid waste, and to promote resource recovery techniques to minimize waste volumes. Regulations issued by EPA under RCRA set forth a comprehensive program to provide "cradle to grave" control of HW by requiring generators and transporters of HW, and owners and operators of treatment, storage, and disposal facilities, to meet specific standards and procedures. Hazardous waste is defined under RCRA as a waste that poses a potential hazard to human health or the environment when improperly treated, stored, or disposed.

The RCRA regulations include requirements for locating and operating treatment, storage, and disposal facilities. RCRA also required EPA to issue regulations containing land disposal restrictions (LDRs) that require the use of the best demonstrated available technologies to treat certain HW and waste containing certain hazardous constituents. The land disposal restrictions also prohibit storing waste that requires treatment except to facilitate proper recovery, treatment, or disposal. Much of DOE's waste that is currently stored, as well as some waste that it will generate in the future, is HW or contains hazardous constituents that are subject to RCRA and LDRs. DOE facilities that store, treat, or dispose of HW or waste containing

hazardous constituents subject to RCRA requirements must obtain a permit from EPA, or from States that are delegated permitting authority by EPA, before such facilities can be constructed and operated. States granted permitting authority by EPA can adopt more stringent requirements.

Federal Facility Compliance Act (FFCAct). The 1992 FFCAct (42 USC §6961) waives DOE's sovereign immunity by allowing States to impose fines and penalties for RCRA violations. The FFCAct also requires DOE to prepare plans for developing treatment capacity for its mixed wastes (waste containing both radioactive and hazardous components subject to RCRA requirements). The FFCAct subjects DOE to fines and penalties after October 6, 1995, for DOE's violations at sites of RCRA's LDRs for waste storage unless the site is otherwise in compliance with an approved STP and compliance order issued by the appropriate regulator. DOE expects and intends that the environmental impact analysis contained in the WM PEIS will also be used by regulators and other stakeholders involved in the FFCAct implementation process. Sixteen of the 17 major sites analyzed in the WM PEIS are required to prepare site treatment plans (STPs). Each of these sites has submitted an STP, and all but three (ANL-E, BNL, and LLNL) have been approved by the appropriate agency. Compliance orders or agreements have incorporated the approved STPs.

Atomic Energy Act (AEA). DOE must also comply with the AEA (42 USC §§2011 *et seq.*) in managing its radioactive wastes. One purpose of the Act is to ensure proper management—production, possession, and use—of radioactive materials. The AEA and other related legislation (including the Energy Reorganization Act of 1974 and the Department of Energy Organization Act of 1977) authorize DOE to develop generally applicable standards for protecting the environment from radioactive materials. Pursuant to the AEA, DOE has established a system of standards and requirements, issued as DOE Orders.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as Amended (42 USC §§9601 *et seq.*). The Comprehensive Environmental Response, Compensation, and Liability Act provides a statutory framework for the cleanup of waste sites containing hazardous substances and — as amended by the Superfund Amendments and Reauthorization Act (SARA) — provides an emergency response program in the event of a release (or threat of a release) of a hazardous substance to the environment. Using the Hazard Ranking System, Federal and private sites are ranked and may be included on the National Priorities List. The Act requires such Federal facilities having such sites to undertake investigations and remediation as necessary. The Act also includes requirements for reporting releases of certain hazardous substances in excess of specified amounts to State and Federal agencies.

Nuclear Waste Policy Act of 1982, as Amended (42 USC §§10101–10270). The Nuclear Waste Policy Act established a national policy for disposal of HLW and spent nuclear fuel (SNF) in a geologic repository and directed DOE to characterize the Yucca Mountain site in Nevada for suitability as the site of a first United States repository. The Act authorizes disposal of HLW and SNL in the first repository, subject to a limit on repository capacity and the payment of appropriate fees. The Act specifically instructs the NRC to limit the first geologic repository to 70,000 metric tons of heavy metal or a quantity of solidified HLW resulting from the reprocessing of such a quantity of SNF until such time as a second geologic repository is in operation. For planning purposes, DOE assumes that some or all of the Hanford Site HLW that satisfies the repository's acceptance criteria could be placed in the potential geologic repositories developed under the Nuclear Waste Policy Act.

Sufficient information is not available to determine at this time whether the Yucca Mountain site is a suitable candidate for geologic disposal of SNF and HLW. DOE, however, is in the early planning stages for a repository EIS. DOE has issued a formal notice of its intent to prepare this analysis. The repository EIS will evaluate potential environmental impacts using the best available information and data and would support the Secretary of Energy's final recommendation to the President, as required by the Nuclear Waste Policy Act. The repository EIS would examine the site-specific environmental impacts from construction, operation, and eventual closure of the repository, including potential post-closure radiological effects to the environment, and would assess the impacts of transporting SNF and HLW to a repository.

The Nuclear Waste Policy Act provides that any repository for the disposal of HLW resulting only from atomic energy defense activities shall be subject to licensing under Section 202 of the Energy Reorganization Act of 1974 (42 USC §5842). Further, Section 202 of the Energy Reorganization Act authorizes NRC licensing of facilities authorized for the express purpose of long-term storage of HLW that are not used for, or are not a part of, research and development activities. Therefore, to the extent that any decision requires defense HLW to be placed in a repository constructed under the Nuclear Waste Policy Act or a facility subject to licensing under Section 202 of the Energy Reorganization Act, such a repository or facility would be subject to licensing by the NRC. NRC's regulations governing the licensing of a geologic repository are contained in 10 CFR Part 60.

The Nuclear Waste Policy Act also directed EPA to promulgate waste standards pursuant to the Atomic Energy Act. EPA responded by issuing the "Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Wastes" (final rule) in 40 CFR Part 191. The final

rule announcement (58 FR 66398) notes that 40 CFR 191 does not apply to the candidate Yucca Mountain site.

The final version of 40 CFR 191 consists of three subparts. Subpart A establishes dose limits for members of the public, including doses resulting from management and storage of SNF and HLW or TRUW at any disposal facility operated by DOE that is not regulated by NRC or by agreement States. Subpart B establishes containment requirements, assurance requirements, and individual protection requirements for disposal systems for SNF, HLW, and TRUW. This part specifies a 10,000-year design objective and discusses requirements for institutional controls; monitoring performance of a disposal system; designation by records, markers, and passive controls; and retrievability of wastes. Subpart C establishes groundwater protection standards for underground sources of drinking water for disposal systems for SNF, HLW, and TRUW.

The rule was developed primarily for mined geologic repositories. However, EPA states that "Although developed primarily through consideration of mined geologic repositories, 40 CFR 191... applies to disposal of the subject wastes by any method with three exceptions." The standards do not apply to ocean disposal or disposal that occurred before the 1985 standards. The groundwater protection requirements of Subpart C may not apply to disposal systems located within a quarter mile of an underground source of drinking water.

Occupational Safety and Health Act of 1970, as Amended (29 USC §§651 *et seq.*). The Occupational Safety and Health Act establishes standards to enhance safe and healthful working conditions in places of employment throughout the United States. The Act is administered and enforced by the Occupational Safety and Health Administration (OSHA), a U.S. Department of Labor agency. While OSHA and EPA both have a mandate to reduce exposures to toxic substances, OSHA's jurisdiction is limited to safety and health conditions that exist in the workplace environment. In general, under the Act, it is the duty of each employer to furnish all employees a place of employment free of recognized hazards likely to cause death or serious physical harm. Employees have a duty to comply with the occupational safety and health standards and all rules, regulations, and orders issued under the Act. OSHA regulations (published in Title 29 of the *Code of Federal Regulations*) establish specific standards telling employers what must be done to achieve a safe and healthful working environment. DOE emphasizes compliance with these regulations at its facilities and prescribes through DOE orders the standards that contractors shall meet, during their work at Government-owned, contractor-operated facilities (DOE Orders 5480.1B, 5483.1A).

DOE keeps and makes available the various records of illnesses, injuries, and work-related deaths as required by OSHA regulations.

Clean Air Act, as Amended (42 USC §§7401 *et seq.*). The Clean Air Act is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Section 118 of the Clean Air Act requires that each Federal agency, such as DOE, with jurisdiction over any property or facility that might result in the discharge of air pollutants, comply with "all Federal, state, interstate, and local requirements" with regard to the control and abatement of air pollution.

The Act requires EPA to establish National Ambient Air Quality Standards as necessary to protect public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 USC §7409). The Act also requires establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 USC §7411) and requires specific emission increases to be evaluated so as to prevent a significant deterioration in air quality (42 USC §7470). Hazardous air pollutants, including radionuclides, are regulated separately (42 USC §7412). Air emissions are regulated by EPA in 40 CFR Parts 50 through 99. In particular, radionuclide emissions and hazardous air pollutants are regulated under the National Emission Standard for Hazardous Air Pollutants Program (see 40 CFR Part 61 and 40 CFR Part 63).

Safe Drinking Water Act, as Amended (42 USC §§300[F] *et seq.*). The primary objective of the Safe Drinking Water Act is to protect the quality of the public water supplies and all sources of drinking water. The implementing regulations, administered by EPA unless delegated to the States, establish standards applicable to public water systems. They promulgate maximum contaminant levels, including those for radioactivity, in public water systems. Safe Drinking Water Act requirements have been promulgated by EPA in 40 CFR Parts 100 through 149. Other programs established by the Safe Drinking Water Act include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program.

Clean Water Act, as Amended (33 USC §§1251 *et seq.*). The Clean Water Act, which amended the Federal Water Pollution Control Act, was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The Clean Water Act prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the Clean Water Act requires

all branches of the Federal government engaged in any activity that might result in a discharge or runoff of pollutants to surface waters to comply with Federal, State, interstate, and local requirements. In addition to setting water quality standards for the Nation's waterways, the Clean Water Act supplies guidelines and limitations for effluent discharges from point-source discharges and provides authority for EPA to implement the National Pollutant Discharge Elimination System permitting program. The National Pollutant Discharge Elimination System program is administered by the Water Management Division of EPA pursuant to regulations in 40 CFR Part 122 *et seq*.

Sections 401 and 405 of the Water Quality Act of 1987 added Section 402(p) to the Clean Water Act. Section 402(p) requires that the Environmental Protection Act establish regulations for issuing permits for stormwater discharges associated with industrial activity. Stormwater discharges associated with industrial activity are permitted through the National Pollutant Discharge Elimination System. General Permit requirements are published in 40 CFR Part 122.

Emergency Planning and Community Right-to-Know Act of 1986 (42 USC §§11001 *et seq*.) (also known as "SARA Title III"). Under Subtitle A of this Act, Federal facilities, including those owned by DOE, provide various information (such as inventories of specific chemicals used or stored and releases that occur from these sites) to the State Emergency Response Commission and to the Local Emergency Planning Committee to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. Implementation of the provisions of this Act began voluntarily in 1987, and inventory and annual emissions reporting began in 1988 based on 1987 activities and information. In 1993, Executive Order 12856 (see Section 1.4.2, below) directed compliance by Federal agencies. The requirements for this Act were promulgated by EPA in 40 CFR Parts 350–372.

Toxic Substances Control Act (15 USC §§2601 *et seq*.). The Toxic Substances Control Act provides EPA with the authority to require testing of chemical substances, both new and old, entering the environment, and regulates them where necessary. The law complements existing toxic substance laws such as §112 of the Clean Air Act and §307 of the Clean Water Act. The Act came about because there were no general Federal regulations for the potential environmental or health effects of the thousands of new chemicals developed each year before they were introduced into the public or commerce. The Act also regulates the treatment, storage, and disposal of certain toxic substances, specifically polychlorinated biphenyls, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium. The asbestos regulations under the Act were ultimately overturned. However, regulations pertaining to asbestos

removal, storage, and disposal are promulgated through the National Emission Standard for Hazardous Air Pollutants Program (40 CFR Part 61, Subpart M). For chlorofluorocarbons, Title VI of the Clean Air Act Amendments of 1990 requires a reduction of chlorofluorocarbons beginning in 1991 and prohibits production beginning in 2000.

Pollution Prevention Act of 1990 (42 USC §§13101 *et seq.*). The Pollution Prevention Act of 1990 establishes a national policy for waste management and pollution control that focuses first on source reduction, followed sequentially by environmentally safe recycling, treatment, and lastly, disposal. Disposal or releases to the environment should only occur as a last resort. In response, DOE has committed to participation in the Superfund Amendments and Reauthorization Act Section 313, U.S. Environmental Protection Agency 33/50 Pollution Prevention Program. The goal, for facilities already involved in Section 313 compliance, is to achieve a 33% reduction in the release of 17 priority chemicals by 1997, from a 1993 baseline. On August 3, 1993, Executive Order 12856 was issued, expanding the 33/50 program such that DOE must reduce its total releases of all toxic chemicals by 50% by December 31, 1999. The DOE is also requiring each DOE site to establish site-specific goals to reduce generation of all waste types.

National Historic Preservation Act, as Amended (16 USC §§470 *et seq.*). The National Historic Preservation Act provides that sites with significant national historic value be placed on the *National Register of Historic Places*. No permits or certifications are required under the Act. However, if a particular Federal activity may impact a historic property resource, consultation with the Advisory Council on Historic Preservation will generally result in a Memorandum of Agreement, including stipulations that must be followed to minimize adverse impacts. Coordination with the State Historic Preservation officer is also undertaken to ensure that potentially significant sites are properly identified and appropriate mitigative actions are implemented.

Archaeological Resource Protection Act, as Amended (16 USC §§470aa *et seq.*). This Act protects archaeological resources and sites on public and Indian lands. It requires a permit for any excavation or removal of archaeological resources from public or Indian lands. Excavations must be undertaken for the purpose of furthering archaeological knowledge in the public interest, and resources removed are to remain the property of the United States. Indian tribes must be notified of possible harm or destruction of sites having religious or cultural importance. For resources on Indian tribes, consent must be obtained from the Indian tribe owning the lands on which a resource is located before issuance of a permit, and the permit must contain terms or conditions requested by the tribe.

Native American Grave Protection and Repatriation Act of 1990 (25 USC §§3001 *et seq.*). This Act requires Federal agencies and federally funded museums to repatriate human remains, sacred objects, and objects of cultural patrimony to the culturally affiliated Native American groups. This includes repatriation of cultural items in collections, proof of consultation with appropriate Native American groups for excavation on Federal or tribal lands, and notification of the Federal land manager and appropriate Native American group when an inadvertent discovery is made on Federal or tribal land. Any cultural items excavated after November 16, 1990, pertaining to this Act are owned by lineal descendants.

American Indian Religious Freedom Act of 1978 (42 USC §1996). This Act reaffirms Native American religious freedom under the First Amendment and sets United States policy to protect and preserve the inherent and constitutional right of American Indians to believe, express, and exercise their traditional religions. This Act requires that Federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religions.

Religious Freedom Restoration Act of 1993 (42 USC §§2000bb *et seq.*). This Act prohibits the Government, including Federal departments, from substantially burdening the exercise of religion unless the Government demonstrates a compelling governmental interest and the action furthers that interest and is the least restrictive means of furthering that interest.

Endangered Species Act, as Amended (16 USC §§1531 *et seq.*). The Endangered Species Act is intended to prevent the further decline of endangered and threatened species and to restore these species and their habitats. The Act is jointly administered by the U.S. Departments of Commerce and the Interior. Section 7 of the Act requires consultation with the U.S. Fish and Wildlife Service to determine whether endangered and threatened species or their critical habitats are known to be in the vicinity of the proposed action.

Migratory Bird Treaty Act, as Amended (16 USC §§703 *et seq.*). The Migratory Bird Treaty Act is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying mode of harvest, hunting seasons, and bag limits. The Act stipulates that it is unlawful at any time, by any means, or in any manner to "kill . . . any migratory bird." Although no permit for this project is required under the Act, DOE is required to consult with the U.S. Fish and Wildlife Service regarding impacts to migratory birds and to evaluate ways to avoid or minimize these effects in accordance with the U.S. Fish and Wildlife Service Mitigation Policy.

Bald and Golden Eagle Protection Act, as Amended (16 USC §§668–668d). The Bald and Golden Eagle Protection Act makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States (Section 668, 688c). A permit must be obtained from the U.S. Department of the Interior to relocate a nest that interferes with resource development or recovery operations.

Wild and Scenic Rivers Act, as Amended (16 USC §§1271 *et seq.* 71:8301 *et seq.*). The Wild and Scenic Rivers Act protects certain selected rivers of the Nation, which possess outstanding scenic, recreational, geological, fish and wildlife, historical, cultural, or other similar values. These rivers are to be preserved in a free-flowing condition to protect water quality and other vital national conservation purposes. The purpose of the Act is to institute a national wild and scenic rivers system, to designate the initial rivers that are a part of that system, and to develop standards for the addition of new rivers in the future.

Noise Control Act of 1972, as Amended (42 USC §§4901 *et seq.*). Section 4 of the Noise Control Act of 1972, as amended, directs all Federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare.

In addition to these laws, the Nuclear Waste Policy Act (42 USC §§10101–10270) authorizes the development of a geologic repository for the permanent disposal of spent nuclear fuel and HLW. The West Valley Demonstration Project Act was enacted in 1980 and authorizes DOE (1) to develop a solidification process that can be used to prepare HLW for disposal and (2) to conduct a nuclear waste management project on the site of the Western New York Nuclear Service Center near West Valley, New York.

1.4.2 Executive Orders

Executive Order 12088, Federal Compliance With Pollution Control Standards (10/13/78). As amended by Executive Order 12580 (January 23, 1987), Federal Compliance with Pollution Control Standards, Executive Order 12088 directs Federal agencies, including DOE, to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, the Noise Control Act, the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act (15 USC §§2601 *et seq.*), and the Resource Conservation and Recovery Act.

Executive Order 11593, National Historic Preservation (5/13/71). Executive Order 11593 directs Federal agencies, including DOE, to locate, inventory, and nominate properties under their jurisdiction or control to the *National Register of Historic Places* if those properties qualify. This process requires DOE to provide the Advisory Council on Historic Preservation the opportunity to comment on the possible impacts of the proposed activity on any potential eligible or listed resources.

Executive Order 11514, Protection and Enhancement of Environmental Quality. Executive Order 11514 directs Federal agencies to continually monitor and control their activities to protect and enhance the quality of the environment and to develop procedures to ensure that fullest practicable provision of timely public information and understanding of the Federal plans and programs with environmental impact to obtain the views of interested parties. The DOE has issued regulations (10 CFR Part 1021) and DOE Order 451.1 for compliance with this executive order.

Executive Order 11988, Floodplain Management. Executive Order 11988 directs Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable.

Executive Order 11990, Protection of Wetlands. Executive Order 11990 directs governmental agencies to avoid, to the extent practicable, any short- and long-term adverse impacts on wetlands wherever there is a practicable alternative.

Executive Order 12580, Superfund Implementation. Executive Order 12580 delegates to the heads of executive departments and agencies the responsibility for undertaking remedial actions for releases or threatened releases that are not on the National Priority List and removal actions at any facility under the jurisdiction or control of executive departments and agencies.

Executive Order 12856, Right to Know Laws and Pollution Prevention Requirements. This order directs all Federal agencies to reduce and report toxic chemicals entering any waste stream; improve emergency planning, response, and accident notification; and encourage clean technologies and testing of innovative prevention technologies. The Executive Order also provides that Federal agencies are persons for purposes of the Emergency Planning and Community Right-to-Know Act (SARA Title III), which obliges agencies to meet the requirements of the Act.

Executive Order 12898, Environmental Justice. This order directs Federal agencies to promote environmental justice by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. The order creates an Interagency Working Group on Environmental Justice and directs each Federal agency to develop strategies within prescribed time limits to identify and address environmental justice concerns. The order further directs each Federal agency to collect, maintain, and analyze information on the race, national origin, income level, and other readily accessible and appropriate information for areas surrounding facilities or sites expected to have a substantial environmental, human health, or economic effect on the surrounding populations, when such facilities or sites become the subject of a substantial Federal environmental administrative or judicial action and to make such information publicly available.

Executive Order 12114, Environmental Effects Abroad of Major Federal Actions. This order declares that Federal agencies are required to prepare environmental analyses for "major Federal actions significantly affecting the environment of the global commons outside the jurisdiction of any nation (e.g., the ocean or Antarctica)." According to the Executive Order, major Federal actions significantly affecting the environment of foreign countries may also require environmental analyses under certain circumstances. The procedural requirements imposed by the Executive Order are analogous to those under the National Environmental Policy Act.

Executive Order 13007, Sacred Sites. Executive Order 13007 directs Executive agencies, to the extent permitted by law and not inconsistent with agency missions, to avoid adversely affecting sacred sites and to provide access to Native American religious practitioners for religious practices.

1.4.3 Department of Energy Regulations and Orders

Through the authority of the Atomic Energy Act, DOE is responsible for establishing a comprehensive health, safety, and environmental program for its facilities. The regulatory mechanisms through which DOE manages its facilities are the promulgation of regulations and the issuance of DOE orders.

The DOE regulations are generally found in Title 10 of the Code of Federal Regulations. These regulations address such areas as energy conservation, administrative requirements and procedures, nuclear safety, and

classified information. For purposes of this PEIS, relevant regulations include 10 CFR Part 820, Procedures for DOE Nuclear Activities; 10 CFR Part 830.120, Quality Assurance; 10 CFR Part 834, Radiation Protection of the Public and the Environment (proposed); 10 CFR Part 835, Occupational Radiation Protection; 10 CFR Part 1021, Compliance with the National Environmental Policy Act; and 10 CFR Part 1022, Compliance with Floodplains/Wetlands Environmental Review Requirements.

DOE orders generally set forth policy and the programs and internal procedures for implementing those policies. The following sections provide a brief discussion of selected orders.

DOE Order 151.1, Comprehensive Emergency Management System (9/25/95). This order describes the roles and responsibilities for the DOE Emergency Management System. One purpose of the order is to ensure that the DOE Emergency Management System is ready to respond promptly, efficiently, and effectively to any emergency involving DOE facilities, activities, or operations. The order requires emergency planning for DOE sites/facilities, including DOE transportation activities, in order to ensure personnel and resources are prepared to respond effectively to emergencies.

DOE Order 451.1, National Environmental Policy Act Compliance Program (9/11/95). This order sets forth DOE internal requirements and responsibilities for implementing the NEPA and associated regulations, including preparation of environmental impact assessments. It also directs Agency personnel to "incorporate NEPA values . . . to the extent practicable, in DOE documents prepared under [CERCLA]."

DOE Order 5820.2A, Radioactive Waste Management (9/26/88). DOE Order 5820.2A establishes policies and guidelines for management of radioactive waste and contaminated facilities. The generation, treatment, storage, transportation, and/or disposal of such wastes is to be accomplished in a manner that complies with all applicable Federal, state, and local environmental, safety, and health laws and regulations, as well as DOE requirements. The order contains materials pertaining to management of high-level waste, transuranic waste, low-level waste, and other types of radioactive waste, plus guidelines on decommissioning of radioactively contaminated facilities. DOE is currently in the process of updating this order.

10 CFR Part 835, Occupational Radiation Protection. This rule establishes radiation protection standards, limits, and program requirements for occupational exposure at DOE facilities and operations. Each activity must have a Radiation Protection Program. The order sets the goal of minimizing workplace

exposure and establishes maximum allowable exposures on the basis of national and international recommended standards. The rule also establishes policies on worker training, workplace monitoring and dosimetry, entry control, and other aspects of workplace radiation safety.

DOE Order 5400.5, Radiation Protection of the Public and the Environment (2/8/90). The purposes of DOE's program on radiation protection of the public and the environment are to: (1) establish dose limits for exposure of members of the public to radiation and implementation of the Department's "as low as reasonably achievable" (ALARA) policy; (2) manage radioactive materials in liquid waste discharges, in soil columns, and in selected solid waste containing radioactive materials, including a groundwater protection program for each DOE site; (3) establish requirements for decontamination, survey, and release of buildings, land, equipment, and personal property containing residual radioactive material and for the management, storage, and disposal of wastes generated by these activities; and (4) establish an "Environmental Radiation Protection Program and plan (including an effluent monitoring and environmental surveillance program) to set forth the programs, plans, and other processes to protect the public from exposures to radiation. DOE is in the process of codifying this policy; Proposed Rule 10 CFR 834 was issued for comment on March 25, 1993.

1.4.4 Hazardous and Radioactive Materials Transportation Regulations

Transportation of hazardous and radioactive materials, substances, and wastes is governed by the U.S. Department of Transportation, NRC, EPA regulations, and the Hazardous Materials Transportation Act. These regulations may be found in 49 CFR Parts 171–178, 49 CFR Parts 383–397, 10 CFR Part 71, and 40 CFR Part 262 and 265, respectively.

U.S. Department of Transportation regulations contain requirements for identifying a material as hazardous or radioactive. These regulations interface with those of the NRC or EPA for identifying material, but the U.S. Department of Transportation hazardous material regulations govern the hazard communication (such as marking, hazard labeling, vehicle placarding, and emergency response telephone number) and shipping requirements (such as required entries on shipping papers or EPA waste manifests).

NRC regulations applicable to radioactive materials transportation are found in 10 CFR Part 71, which includes detailed packaging design requirements and package certification testing requirements. Complete

documentation of design and safety analysis and results of the required testing are submitted to the NRC to certify the package for use. This certification testing involves the following components: heat, physical drop onto an unyielding surface, water submersion, puncture by dropping package onto a rigid spike, and gas tightness. Some of the required tests simulate maximum reasonably foreseeable accident conditions.

EPA regulations pertaining to hazardous waste transportation are found in 40 CFR Part 262. These regulations deal with the use of the EPA waste manifest, which is the shipping paper for transporting RCRA hazardous waste.

1.4.5 Consultations With Other Agencies, Organizations, and American Indian Tribes

Section 102(2)(c)(v) of NEPA and 40 CFR 1503.1 require that Federal agencies (defined to include American Indian tribes) with jurisdiction or special expertise regarding any environmental impacts be consulted and involved in the National Environmental Policy process. 10 CFR 1502.25 requires consultation with agencies that have the authority to issue applicable permits, licenses, and other regulatory approvals, as well as those responsible for protecting significant resources (for example, endangered species, critical habitats, or cultural resources).

In addition to these provisions, DOE's NEPA regulation 10 CFR 1021.341(b) requires consultation with other agencies when necessary or appropriate. The PEIS Implementation Plan (DOE, 1994b) described the scoping process of the WM PEIS and the extent of EPA involvement in that process. Chapter 5 of the plan summarizes the roles and responsibilities of EPA and DOE with regard to technical coordination on issues of mutual concern. EPA participated by reviewing the Preliminary Draft and Final WM PEIS before they were issued to the public, helping DOE to define issues and concerns to address in the PEIS, and providing information in areas in which EPA has regulatory authority or technical expertise. EPA also participated in meetings involving review of the human health risk methodology. Moreover, during the course of developing the draft and final WM PEIS, DOE invited comment from and held discussions with certain groups with special interests, such as the Environmental Management Advisory Board (EMAB), the Site Specific Advisory Board (SSAB) representatives, and others.

As stated in a Presidential Memorandum (April 29, 1994), "The United States government has a unique legal relationship with Native American tribal governments as set forth in the constitution of the United

States, treaties, statutes, and court decisions." This memorandum directs each executive department to operate within a government-to-government relationship with Federally recognized tribal governments, consult with tribal governments, and assess the impact of Federal government plans, projects, programs, and activities on tribal trust resources. The importance of these relationships and consultations is echoed in the DOE American Indian policy, as implemented by DOE Order 1230.2, which emphasizes the importance of establishing a proactive approach to solicit input from tribal governments on Departmental policies and issues. It also encourages tribal governments and their members to participate fully in national and regional dialogues concerning Departmental programs. Consultation with Federally recognized tribes is also an integral part of compliance with a number of cultural resource statutes and their implementing regulations discussed in Section 1.4.1. DOE has initiated consultation with some of the tribal governments that have trust, treaty, and traditional lands near DOE facilities. In recent years, DOE has worked to build government-to-government relationships with tribes near Departmental sites.

DOE has received comments regarding tribal values and the requirement for government-to-government consultations, which have been considered in this Final WM PEIS. Many issues between DOE and the tribes are dealt with at the site level, such as local cultural resources, and ongoing and planned DOE activities. To facilitate discussion between DOE and the tribes, each local DOE office has a point of contact for tribal issues, including cultural resource and historic preservation issues.

The WM PEIS analysis focuses mainly on alternatives addressing national-level strategic issues. Follow-on project and site-specific NEPA reviews will be conducted that will more fully explore specific concerns related to the respective sites. During these reviews, local DOE offices will work with other agency and tribal representatives as well as members of the interested public to identify the locations of any necessary facilities and related activities such as transportation. It is during this next level of planning and project-level implementation that specific values and environmental impact analyses will be considered.

1.5 Waste Types

DOE is responsible for managing large inventories of LLMW, LLW, TRUW, HLW, and HW. DOE manages each of these waste types separately because they have different components, have different levels of radioactivity, and must meet different regulatory requirements. The definitions of these waste types have different bases: some are defined by source, some by physical or chemical characteristics, and some by

exception. Moreover, a given radionuclide can appear in more than one waste type but usually in different concentration.

LLMW and LLW are categorized either as alpha or nonalpha waste, depending on whether the waste contains concentrations of alpha particles at or above 10 nanocuries per gram. All TRUW is alpha waste. There are typically two categories of LLMW, LLW, and TRUW—"contact-handled" (CH) and "remote-handled" (RH). The categories differ because of the concentration of radioactive materials. Remote-handled waste typically requires additional shielding and containment to protect workers and the public.

Types of Radioactivity

The four principal types of radiation are: alpha particles, beta particles, gamma rays, and neutrons. ***Alpha radiation*** *can be stopped by a sheet of paper and will not penetrate skin, but it is harmful if ingested or inhaled.* ***Beta radiation*** *can pass through an inch of water or skin, but not through a thin sheet of aluminum, plywood, or steel.* ***Gamma rays*** *and* ***neutrons*** *are the most penetrating radiation and can pass through many materials, including the human body. Dense materials like lead are effective for stopping gamma rays, whereas hydrogenous materials like water are effective in slowing down and stopping neutrons.*

The following sections define and discuss each of the waste types considered in this PEIS. The environmental impacts associated with managing those wastes types under the four broad categories of alternatives are contained in the waste-type Chapters 6 through 10. Privatized management is also considered in this PEIS. Privatization means that the private sector would own (or control) the means for treatment, storage, or disposal of nuclear waste. Privatization is detailed in Section 1.7.4.

1.5.1 Low-Level Mixed Waste

LLMW contains both hazardous and low-level radioactive components. The hazardous component in LLMW is subject to RCRA, whereas the radioactive components are subject to the AEA (42 USC 2011 *et seq.*). LLMW is characterized as either CH or RH and as alpha or nonalpha. LLMW results from a variety of activities, including the processing of nuclear materials used in nuclear weapons production, and energy research and development activities. The WM PEIS evaluates approximately 82,000 cubic meters of LLMW currently stored and an estimated 137,000 cubic meters

Metric Units

Volumes in this document are given in the metric unit of cubic meters. One cubic meter is equal to approximately 35 cubic feet, or 264 gallons.

expected to be generated over the next 20 years (excluding LLMW that could be generated as a result of environmental restoration activities) for a total of approximately 219,000 cubic meters. Presently, commercial and DOE facilities are insufficient to treat DOE's inventory of LLMW. However, it is possible that some portion of the inventory could be treated at commercial facilities and that the capacity of such facilities could increase rapidly if specific DOE sites were to decide to use commercial facilities. This PEIS addresses the treatment and disposal of LLMW; storage of LLMW is not addressed because RCRA prohibits storage of untreated waste except to facilitate proper recovery, treatment, or disposal. Table 1.5–1 summarizes the range of decisions that DOE could make with respect to LLMW.

Contact- and Remote-Handled Wastes

*Radioactive waste is classified as "contact-handled" or "remote-handled." **Contact-handled** wastes are those wastes whose external surface dose rate does not exceed 200 millirem per hour.*

***Remote-handled** wastes are those wastes whose external surface dose rate exceeds 200 millirem per hour.*

LLMW, LLW, and TRUW are categorized as either contact-handled or remote-handled.

1.5.2 Low-Level Waste

LLW includes all radioactive waste that is not classified as HLW, spent nuclear fuel (fuel discharged from nuclear reactors), TRUW, uranium and thorium mill tailings, or waste from processed ore. LLW does not contain hazardous constituents regulated under RCRA. Most LLW consists of relatively large amounts of waste materials contaminated with small amounts of radionuclides, such as contaminated equipment (e.g., gloveboxes, ventilation ducts, shielding, and laboratory equipment), protective clothing, paper, rags, packing material, and solidified sludges. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranics is less than 100 nanocuries per gram of waste. Low-level waste is subject to the provisions of the Atomic Energy Act and is categorized as CH or RH and as alpha or nonalpha on the basis of the types and levels of radioactivity present. However, most LLW contains short-lived radionuclides and generally can be handled without additional shielding or remote handling equipment. DOE has an inventory of approximately 67,500 cubic meters of LLW in storage, and approximately 1,440,000 cubic meters are expected to be generated during the next 20 years (excluding LLW that may be generated as a result of environmental restoration activities), for a total of 1,500,000 cubic meters. This PEIS addresses the treatment and disposal of LLW. Table 1.5–1 summarizes the decisions that DOE must make with respect to LLW.

Table 1.5–1. Decisions DOE Will Make Based on Evaluations in the WM PEIS

Decisions	Type of Waste and Whether DOE Will Decide on Basis of WM PEIS (Yes or No)				
	Low-Level Mixed Waste	Low-Level Waste	Transuranic Waste	High-Level Waste	Hazardous Waste
Where to treat?	YES LLMW could be treated at 1 to 37 DOE sites.	YES LLW volume reduction and treatment could be conducted at 1 to 11 DOE sites. Minimum treatment could occur at all sites.	YES TRUW could be treated at 3 to 16 DOE sites.	NO HLW will be treated at 4 DOE sites where it was generated.	YES HW could be treated at DOE sites, or DOE could rely on commercial treatment.
Where to store?	NO LLMW will be stored at sites where generated until treatment and disposal.	NO LLW will be stored at sites where generated until treatment and disposal.	YES TRUW could be stored at 3 to 16 sites, pending final disposition.	YES HLW canisters containing treated HLW could be placed into storage at 1 to 4 DOE sites.	NO HW sent to commercial facilities will be stored for less than 90 days unless there is a permitted storage facility.
Where to dispose of?	YES LLMW could be disposed of at 1 to 16 DOE sites.	YES LLW could be disposed of at 1 to 16 DOE sites.	NO Separate evaluation of Waste Isolation Pilot Plant (WIPP) Disposal Phase is being prepared.	NO Separate evaluations to be prepared pursuant to the Nuclear Waste Policy Act as amended.	NO Commercial HW disposal facilities will continue to be used.

1.5.3 TRANSURANIC WASTE

TRUW is waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years and an atomic number greater than 92, except for (a) high-level radioactive waste, (b) waste that the Secretary has determined, with the concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations, or (c) waste that the NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR 61.[3] TRUW is produced during reactor fuel assembly, nuclear weapons production, research and development, and spent nuclear fuel reprocessing.

TRUW, some of which also contains hazardous constituents, has radioactive components such as plutonium, with lesser amounts of neptunium, americium, curium, and californium. TRUW components have half-lives greater than 20 years. These radionuclides generally decay by emitting alpha particles. Like LLMW and LLW, TRUW also contains radionuclides that emit gamma rays, requiring TRUW to be managed as either CH or RH. Approximately 60% is mixed waste, containing both radioactive components and hazardous components regulated under RCRA.

[3] LLW and LLMW may also contain these transuranic isotopes, but with concentrations less than 100 nanocuries per gram of waste.

DOE has approximately 68,000 cubic meters of TRUW retrievably stored since 1970, and about 64,000 cubic meters expected to be generated over the next 20 years (excluding TRUW that could be generated as a result of environmental restoration activities), for a total of about 132,000 cubic meters. The waste volumes do not include TRUW generated before 1970. Pre-1970 TRUW is known as "buried TRUW." This waste is considered environmental restoration waste.

DOE is currently proposing to dispose of retrievably stored and newly generated TRUW in a geologic repository called the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The environmental impacts of developing WIPP were assessed in previous environmental impact statements (DOE, 1980; DOE, 1990). DOE is examining whether to dispose of TRUW at WIPP in a second supplemental EIS (SEIS-II; DOE, 1996n). Therefore, this PEIS evaluates alternative configurations for the treatment and storage of TRUW. Table 1.5–1 summarizes the decisions that DOE must make with respect to TRUW.

Quantities of Waste*

Low-Level Mixed Waste. *The WM PEIS addresses approximately 82,000 cubic meters of LLMW currently stored and an estimated 137,000 cubic meters expected to be generated over the next 20 years.*

Low-Level Waste. *Approximately 67,500 cubic meters of LLW are stored, and an estimated 1,440,000 cubic meters are expected to be generated over the next 20 years.*

Transuranic Waste. *Approximately 68,000 cubic meters are retrievably stored, and an estimated 64,000 cubic meters are expected to be generated over the next 20 years.*

High-Level Waste. *Approximately 378,000 cubic meters of HLW are stored, and limited additional quantities will be generated. Approximately 21,600 HLW canisters are expected to be produced as a result of treating HLW.*

Hazardous Waste. *Approximately 69,000 cubic meters of nonwastewater HW are expected to be generated in the next 20 years.*

** Volumes do not include environmental restoration wastes.*

1.5.4 HIGH-LEVEL WASTE

HLW is the highly radioactive waste resulting from reprocessing spent nuclear fuel and irradiated targets from reactors and is liquid before it is treated and solidified. Some of its constituents will remain radioactive for thousands of years. HLW is also a mixed waste because it contains hazardous constituents that are regulated under RCRA. DOE has about 378,000 cubic meters of HLW stored in large tanks at far sites.

DOE is proceeding with plans to treat HLW by processing it into a solid form (e.g., borosilicate glass) that would not be readily dispersible into air or leachable into ground or surface water. This treatment process is called vitrification. The environmental impacts of vitrifying HLW have been analyzed in previous DOE environmental impact statements (DOE, 1982a,b; 1987; 1994a; 1995e). Vitrification will result in the generation of approximately 21,600 canisters from the current inventory of HLW. Canisters are assumed to vary in volume between 0.85 cubic meters and 1.26 cubic meters. DOE plans to dispose of the HLW canisters in a geologic repository. This PEIS addresses only the storage of vitrified HLW prior to its ultimate disposal in a geologic repository. Table 1.5–1 summarizes the decisions that DOE must make with respect to HLW.

Spent Nuclear Fuel

"Spent nuclear fuel" is fuel that has been withdrawn from nuclear reactors following irradiation, the constituent elements of which have not been separated. A "target" is material that is placed in a nuclear reactor to be bombarded with neutrons to produce new, manmade radioactive materials, such as plutonium and tritium. Uranium/neptunium target material is managed as spent nuclear fuel.

Initially, DOE intended to evaluate the management of spent nuclear fuel in this PEIS. However, DOE analyzed its management in a separate PEIS—"Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement" published in April 1995. The impacts of managing spent nuclear fuel presented in that PEIS are included in the cumulative impacts of the WM PEIS.

1.5.5 Hazardous Waste

HW is defined as a solid waste that because of its quantity, concentration, or physical, chemical, or infectious characteristics may significantly contribute to an increase in mortality, or may pose a potential hazard to human health or the environment when improperly treated, stored, or disposed. RCRA defines a "solid" waste to include solid, liquid, semisolid, or contained gaseous material (42 USC 6901 *et seq.*). By definition, HW contains no radioactive components. For purposes of this PEIS, HW includes State-designated HW and TSCA wastes in addition to RCRA wastes.

The quantities and types of HW generated as a result of DOE activities vary considerably and include acids, metals, industrial solvents, paints, oils, rags contaminated with hazardous cleaning compounds, and other

hazardous materials that are byproducts of routine maintenance and operations. Almost 99% of DOE's HW is wastewater and is treated at DOE sites. Treatment residues and the remaining 1%, predominantly solvents and cleaning agents, are treated at commercial facilities. The WM PEIS evaluates the treatment of nonwastewater HW. Over the next 20 years, approximately 69,000 cubic meters of nonwastewater HW are expected to be generated. Treated HW will continue to be disposed of at commercial facilities. Table 1.5–1 summarizes the decisions that DOE must make with respect to HW.

1.5.6 Waste Types Not Considered

Nonhazardous and nonradioactive sanitary waste, nonhazardous solid waste, hazardous and low-level process wastewater, and commercial "Greater-Than-Class-C" (GTCC) LLW are not considered in the WM PEIS. Additionally, some wastes within the radioactive waste type categories, such as LLW, TRUW, and HLW, have characteristics that require special considerations and different management than most of the other waste within that category. These wastes are "special case wastes" and are managed on a case-by-case basis; they not specifically evaluated in the WM PEIS, although the waste volumes reported in the PEIS largely account for them.

Nonhazardous and nonradioactive sanitary and industrial waste requires limited handling and can be treated or disposed in properly designed facilities or used in energy production. DOE currently manages sanitary and industrial waste on a site-by-site basis. Some DOE sites dispose of this waste in onsite landfills that have permits issued by appropriate State agencies, while other sites use commercial landfills. The types and quantities of sanitary and industrial waste vary considerably from site to site. Sanitary and industrial waste was not included in the scope of wastes to be addressed in the WM PEIS because of the site-specific nature of these wastes and because DOE is not proposing a program for managing it. Sanitary and industrial wastes may be appropriate for consideration in sitewide and project-level NEPA reviews.

Wastewater is treated at the site where it is generated because it is not practical to ship relatively large volumes of wastewater between sites for treatment. Because impacts from hazardous wastewater are independent of programmatic decisions to be made in the WM PEIS and are generally minor, they are not analyzed. For the same reasons, the impacts of managing wastewater contaminated with LLW are not analyzed. Secondary sludges resulting from LLW wastewater treatment are, however, captured in the WM PEIS analysis.

Some wastes at some sites are managed on a case-by-case basis independent of the program applicable to that class of waste. Although not a formal waste category, these wastes are frequently designated "special case wastes" by the generating site.[4] Primarily, these are waste streams within existing waste types that have limited or no disposal alternatives at this time, such as LLW that, because of its high radioactivity levels, does not meet site-specific acceptance criteria, or TRUW that may not meet disposal criteria at WIPP. Classified waste, which requires protection against unauthorized information or material disclosure for reasons of national security, is special case waste when there is no management plan for it. Although it may be categorized as LLW or TRUW, such waste would be managed separately. DOE did not undertake a detailed waste-stream and site-specific analysis in the WM PEIS to develop programmatic alternatives for each of these exceptions. As detailed analyses are conducted, management plans for each waste stream will be established. For example, a more detailed analysis could determine that some LLW currently managed as a special case meets the acceptance criteria for disposal; or, some TRUW could be determined acceptable for disposal at WIPP. These waste streams would no longer be considered special case, and the fact that the waste was once classified as special case waste would no longer be relevant. Such determinations would not be expected to affect the overall conclusions reached in the WM PEIS for a waste type, which are based upon evaluation of the majority of that waste. Additionally, a determination would be made regarding the need for supplemental NEPA reviews on an individual special case waste stream basis.

The PEIS, in general, does not address the management of wastes produced from commercial applications of radiation and atomic energy. For example, the Low-Level Radioactive Waste Policy Amendments Act of 1985 (42 USC 2021 *et seq.*) makes the States responsible for the disposal of commercially generated low-level radioactive waste, and consequently disposal of such LLW is not addressed. However, under this Act (42 USC 2021), DOE is responsible for commercially generated GTCC LLW. Commercial GTCC LLW includes activated metals, process wastes, other contaminated solids generated from the operation of commercial nuclear power plants, and radioactive materials that are used in minerals exploration and as part of medical treatments.

Some waste managed as a special case and GTCC LLW must be isolated from human exposure for periods in excess of hundreds or thousands of years. These wastes are not currently authorized for disposal in a geologic repository under the Nuclear Waste Policy Act (42 USC 10101–10270). On March 13, 1995, DOE published a notice in the *Federal Register* inviting interested parties to provide input into the development

[4] Such wastes account for less than 4% of LLW, LLMW, and TRUW inventories.

of proposed strategies for such wastes. Two workshops were held in April 1995 to discuss preliminary strategies. The Department is currently developing strategies for these wastes.

Not all radioactive materials that are contained in waste are discrete waste types. Special nuclear material, for example, is defined by the Atomic Energy Act to be plutonium, uranium enriched in isotope uranium-235 or -233, and any other material that the U.S. Nuclear Regulatory Commission determines to be special nuclear material pursuant to Section 51 of the Atomic Energy Act of 1954. Special nuclear material is not inherently a waste, and although small quantities of SNM may be present in LLW, LLMW, TRUW, and HLW, SNM of sufficient purity can be used for production of energy or for national defense.

1.6 Waste Management Sites

There are 54 sites for which DOE has some waste management responsibility and that are within the scope of this PEIS. Figure 1.6–1 is a map showing the location of these 54 sites. Table 1.6–1 lists the 54 sites and indicates the type of waste that has been generated, is expected to be generated, or is stored at each site.

Of the 54 sites, 40 are DOE sites. DOE is also responsible for 11 sites participating in the joint DOE/Navy Nuclear Propulsion Program, two sites managed under the Formerly Utilized Sites Remedial Action Program, and the WIPP in New Mexico, which may be used in the future for TRUW disposal. Two sites, the Charleston Naval Shipyard and Mare Island Naval Shipyard, which may generate small quantities of LLW in addition to LLMW, have been closed and their properties released for unrestricted use subsequent to their inclusion in the WM PEIS as waste management sites.

54 Waste Management Sites

40	*DOE sites*
11	*Joint DOE/Navy Nuclear Propulsion Program sites*
2	*Formerly Utilized Sites Remedial Action Program sites*
1	*Waste Isolation Pilot Plant*

To evaluate where to manage each of the five waste types, several of the sites and their wastes have been grouped together, as indicated in Table 1.6–1. These groupings are generally based on geographic proximity (for example, Argonne National Laboratory-West [ANL-W] is located within the site boundary

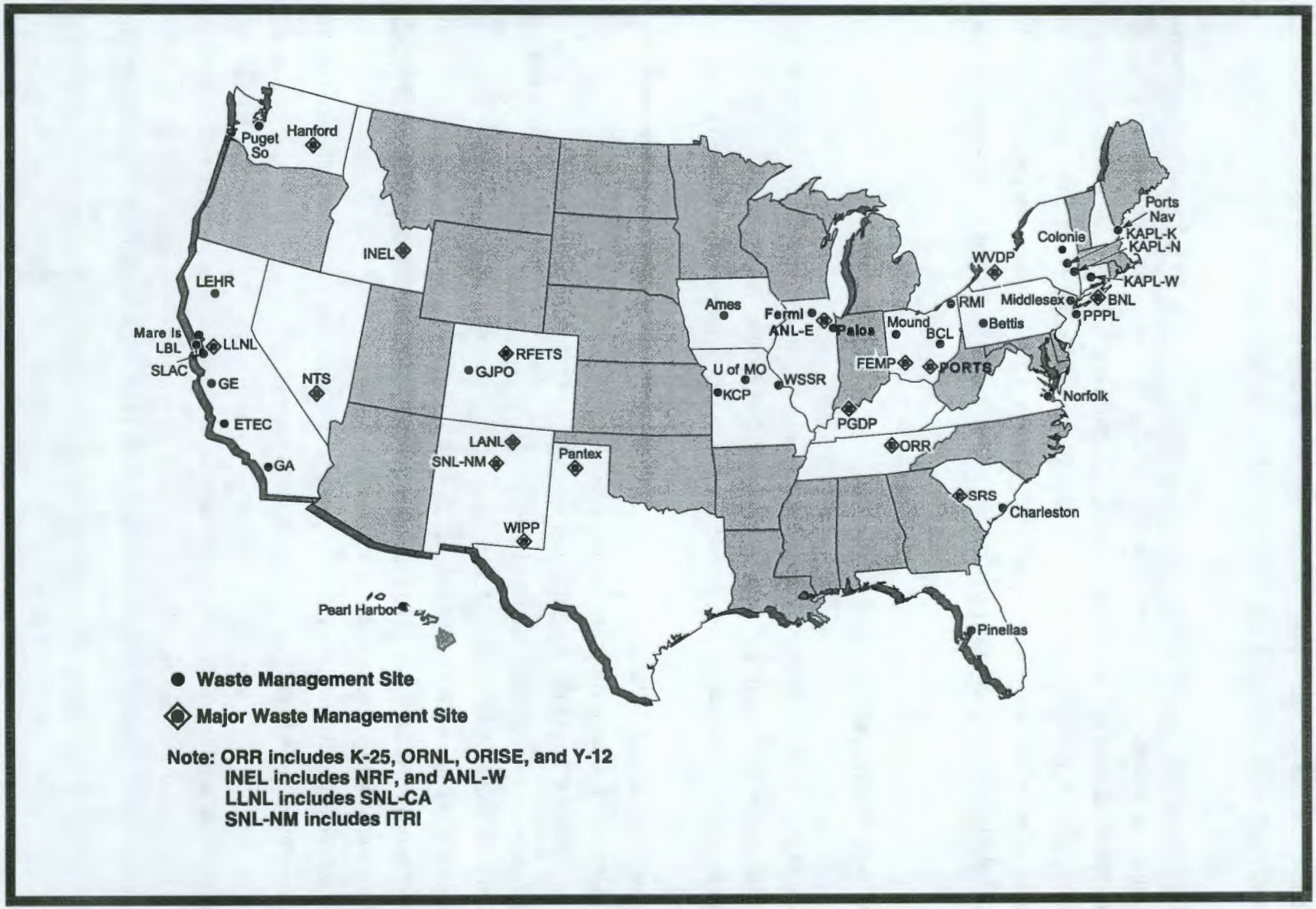

Figure 1.6–1. Waste Management Sites.

Table 1.6–1. Waste Management Sites

Sites	State	Symbol	Major Site[a]	Waste Type Managed				
				LLMW	LLW	TRUW	HLW	HW[b]
1 Ames Laboratory	IA	Ames		✓	✓			
2 Argonne National Laboratory-East	IL	ANL-E	✓	✓	✓	✓		✓
3 Battelle Columbus Laboratories	OH	BCL		✓				
4 Bettis Atomic Power Laboratory	PA	Bettis		✓	✓			
5 Brookhaven National Laboratory	NY	BNL	✓ c	✓	✓			
6 Charleston Naval Shipyard	SC	Charleston		✓	g			
7 Colonie	NY	Colonie		d				
8 Energy Technology Engineering Center	CA	ETEC		✓		✓		
9 Fermi National Accelerator Laboratory	IL	Fermi			✓			✓
10 Fernald Environmental Management Project	OH	FEMP	✓	✓	✓			
11 General Atomics	CA	GA		✓				
12 General Electric Vallecitos Nuclear Center	CA	GE		d	d			
13 Grand Junction Projects Office	CO	GJPO		✓				
14 Hanford Site	WA	Hanford	✓	✓	✓	✓	✓	✓
Idaho National Engineering Laboratory	ID	INEL	✓	✓	✓	✓	✓	✓
15 Idaho National Engineering Laboratory	ID	INEL		e	e	e	e	e
16 Argonne National Laboratory-West	ID	ANL-W		e	e	e		
17 Naval Reactor Facility	ID	NRF			e			
18 Kansas City Plant	MO	KCP		✓	✓			✓
Knolls Atomic Power Laboratory	NY	KAPL		✓	✓			
19 Knolls Atomic Power Laboratory (Kesselring)	NY	KAPL-K		e	e			
20 Knolls Atomic Power Laboratory (Niskayuna)	NY	KAPL-N		e	e			
21 Knolls Atomic Power Laboratory (Windsor)	CT	KAPL-W		e	e			
22 Laboratory for Energy-Related Health Research	CA	LEHR		✓				
23 Lawrence Berkeley Laboratory	CA	LBL		✓	✓	✓		
Lawrence Livermore National Laboratory	CA	LLNL	✓	✓	✓	✓		✓
24 Lawrence Livermore National Laboratory	CA	LLNL		e	e	e		c
25 Sandia National Laboratories (California)	CA	SNL-CA		e	e			
26 Los Alamos National Laboratory	NM	LANL	✓	✓	✓	✓		✓
27 Mare Island Naval Shipyard	CA	Mare Is		✓	g			
28 Middlesex Sampling Plant	NJ	Middlesex		d				
29 Mound Plant	OH	Mound		✓	✓	✓		
30 Nevada Test Site	NV	NTS	✓	✓	✓	✓		
31 Norfolk Naval Shipyard	VA	Norfolk		✓	g			

Table 1.6-1. Waste Management Sites—Continued

Sites	State	Symbol	Major Site[a]	Waste Type Managed				
				LLMW	LLW	TRUW	HLW	HW[b]
Oak Ridge Reservation	TN	ORR	✓	✓	✓	✓		✓
32 K-25 Site	TN	K-25		e	e			e
33 Oak Ridge Institute for Science and Education	TN	ORISE			e			
34 Oak Ridge National Laboratory	TN	ORNL		e	e	e		e
35 Y-12 Plant	TN	Y-12		e	e			e
36 Paducah Gaseous Diffusion Plant	KY	PGDP	✓	✓	✓	✓		
37 Palos Forest (Site A/Plot M)	IL	Palos		d	d			
38 Pantex Plant	TX	Pantex	✓c	✓	✓			✓
39 Pearl Harbor Naval Shipyard	HI	Pearl H		✓	g			
40 Pinellas Plant	FL	Pinellas		✓	✓			
41 Portsmouth Gaseous Diffusion Plant	OH	PORTS	✓	✓	✓			
42 Portsmouth Naval Shipyard	ME	Ports Nav		✓	g			
43 Princeton Plasma Physics Laboratory	NJ	PPPL		✓	✓			
44 Puget Sound Naval Shipyard	WA	Puget So		✓	g			
45 RMI Titanium Company	OH	RMI		✓	✓			
46 Rocky Flats Environmental Technology Site	CO	RFETS	✓	✓	✓	✓		
Sandia National Laboratories	NM	SNL-NM	✓c	✓	✓	✓		✓
47 Sandia National Laboratories (New Mex)	NM	SNL-NM		e	e	e		e
48 Inhalation Toxicology Research Institute	NM	ITRI		e	e			
49 Savannah River Site	SC	SRS	✓	✓	✓	✓	✓	✓
50 Stanford Linear Accelerator Center	CA	SLAC			✓			
51 University of Missouri	MO	UofMO		✓		✓		
52 Waste Isolation Pilot Plant	NM	WIPP	✓			f		
53 Weldon Spring Site Remedial Action Project	MO	WSSR		d	d			
54 West Valley Demonstration Project	NY	WVDP	✓c	✓	✓	✓	✓	
Total sites			17	37	27	16	4	11

Notes: ✓ = the facility is included in the indicated group. A site is listed under a waste type if it currently manages or is expected to manage that type of waste in the future. Joint DOE/Navy Nuclear Propulsion Program sites are: Bettis, Charleston, KAPL-K, KAPL-N, KAPL-W, Mare Is, Norfolk, NRF, Pearl H, Ports Nav, and Puget So. Former FUSRAP (Formerly Utilized Sites Remedial Action Program) sites are Colonie and Middlesex.

[a] "Major" sites are those that are the focus of the WM PEIS because they meet one or more of the following criteria: (1) they are candidates to receive wastes generated offsite; (2) they are candidates to host disposal facilities; (3) they manage HLW; or (4) they were included to be consistent with the Federal Facility Compliance Act process.

[b] Sites analyzed in the WM PEIS are those 11 sites that generated more than 90% of DOE's HW for the year 1992. Other DOE sites also manage HW but were not evaluated. Naval Nuclear Propulsion Program sites were not considered in the WM PEIS analysis for HW.

[c] Although this site is designated as a major site, none of the alternatives would result in wastes from other sites being shipped to this site for treatment or disposal.

[d] The site is included in the table because it is listed in data sources for LLMW; however, no programmatic waste management decision would be applicable to the site. Since it is managed as an environmental restoration site, it is excluded from the WM PEIS alternatives and waste totals.

[e] For evaluating candidate sites for waste management facilities in this WM PEIS: ANL-W and NRF have been combined with INEL; ITRI has been combined with SNL-NM; K-25, ORISE, ORNL, and Y-12 have been combined under ORR; SNL-CA has been combined with LLNL; and KAPL-K, KAPL-N, and KAPL-W have been combined under KAPL.

[f] TRUW is not currently stored or managed at WIPP. WIPP is a planned disposal site and is included because of its potential to treat TRUW.

[g] Naval shipyards may generate small quantities of LLW; however, they are not reported in the WM PEIS.

of the Idaho National Engineering Laboratory [INEL]; and the location of Sandia National Laboratories-California [SNL-CA], is adjacent to Lawrence Livermore National Laboratory).[5]

Table 1.6-2 lists estimated quantities of LLMW, LLW, TRUW, HLW, and HW to be managed at each of the 54 sites. The values are based on current inventories and projections of generation for a 20-year period. DOE made broad, programmatic assumptions applicable to all sites for the purpose of analysis. These include the assumption that LLMW, LLW, HW, and TRUW would be stored where generated until treatment and disposal. This assumption was not meant to restrict site-specific operations and exceptions where they would not prejudice analysis or decisions.

1.6.1 Major Sites Analyzed in the WM PEIS

Of the 54 sites, 17 were designated major sites in the PEIS because they meet one or more of the following criteria: (1) they are candidates to receive wastes generated offsite, (2) they are candidates to host disposal facilities, (3) they manage HLW, or (4) they were included to be consistent with the Federal Facility Compliance Act process. The major sites store or will generate the bulk of the five waste types, have the capability for disposal of LLW or LLMW, or have existing or planned major waste management facilities. The designation of these sites as major has no relevance outside the context of this PEIS analysis. Major and candidate sites were not "preselected" for waste management activities; rather, analysis of potential activities at these sites provides a range of reasonably foreseeable environmental impacts that could arise from treating, storing, and disposing of DOE's wastes. As a result, broad comparisons of potential impacts across sites can be made.

1.6.2 Waste Volumes at Major Sites

Table 1.6–3 lists the major sites and indicates the current and projected volume of each waste type at each of the sites (WIPP does not currently contain any waste and thus is not included). In addition, the table shows the overall percentage of each type of waste at each site.

[5] The one exception to these groupings based on geographic proximity is the Knolls Atomic Power Laboratories—two in New York and one in Connecticut. Data for these sites were compiled on a collective rather than an individual site basis; therefore, these sites are considered as one site.

Table 1.6–2. Quantities of Waste Material at Waste Management Sites (values in cubic meters except HLW in numbers of canisters)

Site	Major Sites[c]	LLMW[a]		LLW[a]		TRUW[a,b]		HLW		HW
		Inventory	20-Year Projected Generation	Inventory	20-Year Projected Generation	Inventory	20-Year Projected Generation	Inventory (Liquid)	Total Canisters Projection	20-Year Projected Generation
Ames		0.3	0.1	26	80					d
ANL-E	✓	34[i]	130[i]	880	5,800	15	1,300			4,100
BCL		0	0.1							d
Bettis		32	16	0	12,000					d
BNL	✓e	85	110	560[i]	5,080[i]					d
Charleston		0.3	3							d
ETEC		3.7	13			0.02	0			d
Fermi				45	1,400					980
FEMP	✓	2,600	48	g	g					d
GA		43	0.4							d
GJPO		0.6	0.9							d
Hanford	✓	3,100	33,000	0	89,000	12,200	39,400	210,000	15,000	6,100
INEL	✓	25,000	9,600	3,500	101,000	38,000	780	10,000	1,700	3,900
INEL[h]		(25,000)	(9,600)	(3,500)	(101,000)	(38,000)	(780)	(10,000)	(1,700)	(3,900)
ANL-W[h]		(16)	(24)							d
NRF[h]				h						
KCP		0.8	0	4	20					12,000
KAPL		3.1	220	0	19,000					d
KAPL-K		(2)	(100)							d
KAPL-N		(1)	(80)							d
KAPL-W			(40)							d
LEHR		4	3							d
LBL		6	270	53	1,200	0.8	0.2			d
LLNL	✓	230	4,100	780	2,800	200	1,500			13,000
LLNL[h]		(220)	(4,000)	(730)	(2,500)	(200)	(1,500)			(13,000)
SNL-CA[h]		(11)	(100)	(50)	(280)					d
LANL	✓	670	2,100	0	150,000	8,300	2,500			4,900
Mare Is		10	42							d
Mound		76	4	1,600	37,000	270	1,200			d
NTS	✓	300[i]	2,700[i]	270[i]	1,400[i]	610	0			d
Norfolk		0	6							d
ORR	✓	26,000	33,000	20,000	250,000	2,000	720			5,500
K-25[h]		(11,000)	(16,000)	(15,000)	(162,000)					d
ORISE[h]					(500)					d
ORNL[h]		(3,000)	(9,500)	(3,500)	(26,000)	(2,000)	(720)			d
Y-12[h]		(12,000)	(7,300)	(1,000)	(62,000)					d

Table 1.6–2. Quantities of Waste Material at Waste Management Sites (values in cubic meters except HLW in numbers of canisters)—Continued

Site	Major Sites[c]	LLMW[a]		LLW[a]		TRUW[a,b]		HLW		HW
		Inventory	20-Year Projected Generation	Inventory	20-Year Projected Generation	Inventory	20-Year Projected Generation	Inventory (Liquid)	Total Canisters Projection	20-Year Projected Generation
Pantex	✓[c]	130	560	210[i]	2,440[i]					10,000
Pearl H		2	4							d
PGDP	✓	600	0	5,300	45,000	14	0			d
Pinellas		0.02	0.02	16	1,300					d
PORTS	✓	7,500	25,000	1,500	96,000					d
Ports Nav		0.4	0.8							d
PPPL		0	0.01	2	220					d
Puget So		62	170							d
RMI		22	7	2,500	48,000					d
RFETS	✓	8,300	13,000	2,400	39,000	1,500	4,800			d
SNL-NM	✓[c]	69	33	680	1,800	1	0			3,100
SNL-NM[h]		(66)		(410)	(820)					(3,100)
ITRI[h]		(4)	(33)	(270)	(1,000)					d
SRS	✓	6,600	13,000	11,000	500,000	5,100	12,000	150,000	4,600	5,500
SLAC				2,200	280					d
UofMO		0.4	1.7			0	2			d
WIPP	✓					f	f			d
WVDP	✓[c]	23	32	14,000[i]	28,000[i]	0.5	0	2,200	340	d
TOTAL	**17**	**82,000**	**137,000**	**67,500**	**1,440,000**	**67,700**	**64,000**	**378,000**	**21,600**	**69,000**

[a] Updated inventories and waste generation rates are summarized in Appendix I - "Update of Site-Specific Waste Volumes for LLW, LLMW, and TRUW." Most site data reported here have been rounded to two significant figures; therefore, totals may not precisely represent the waste totals as reflected in the following chapters and Appendix I.
[b] TRUW volumes presented in this table include both contact-handled and remote-handled TRUW. In addition, Table 8.1–1 shows in parentheses waste volumes for TRUW inventory as reported in BIR-2 (DOE, 1995i) and the WIPP SEIS-II (DOE, 1996n). Comparison of these values is not necessarily appropriate because the BIR-2 values reflect some level of treatment.
[c] Major sites are those that are the focus of the WM PEIS because they meet one or more of the following criteria: (1) they are candidates to receive wastes generated offsite, (2) they are candidates to host disposal facilities, (3) they manage HLW, or (4) they were included to be consistent with the Federal Facility Compliance Act process.
[d] These sites manage HW but were not evaluated. Sites analyzed in the WM PEIS are those sites that generated in total more than 90% of DOE's HW for the year 1992. Volumes include only nonwastewater RCRA-defined waste, which is the focus of this PEIS analysis.
[e] While designated as a major site, none of the alternatives would result in wastes being received from other sites for treatment or disposal.
[f] No waste reported in data sources used in the WM PEIS.
[g] Wastes at these sites are managed as ER wastes.
[h] For evaluating candidate sites for waste management facilities in this WM PEIS, ANL-W and NRF have been combined with INEL; ITRI has been combined with SNL-NM; K-25, ORISE, ORNL, and Y-12 have been combined under ORR; SNL-CA has been combined with LLNL; and KAPL-K, KAPL-N, and KAPL-W have been combined under KAPL.
[i] For purposes of analysis, data for this site were taken from the IDB Report-1994 (DOE, 1995h). See Appendix I, Section I.3, for a comparison of waste volumes between the 1992 IDB and IDB Report-1994.

Table 1.6–3. Volumes and Percent of Waste Management Waste at Major Sites[a]
(total inventory and projected waste loads in cubic meters, except HLW in number of canisters)

Waste Type		ANL-E	BNL	FEMP	Hanford	INEL	LLNL	LANL	NTS	ORR	PGDP	Pantex	PORTS	RFETS	SNL-NM	SRS	WVDP	Others
LLMW 99% at 16 sites	219,000	160	190	2,600	36,000	35,000	4,300	2,800	3,000	59,000	600	690	33,000	21,000	100	20,000	55	1,100
	100%	*	*	1%	16%	16%	2%	1%	1%	27%	*	*	15%	10%	*	9%	*	1%
LLW 91% at 15 sites	1,500,000	6,700	5,600		89,000	105,000	3,600	150,000	1,700	270,000	50,000	2,700	98,000	41,000	2,500	510,000	42,000	130,000
	100%	*	*		6%	7%	*	10%	*	18%	3%	*	7%	3%	*	34%	3%	9%
TRUW 99% at 12 sites	132,000	1,300			52,000	39,000	1,700	11,000	610	2,700	14			6,200	1	17,000	0.5	1,500
	100%	1%			38%	30%	1%	8%	0.5%	2%	*			5%	*	13%	*	1%
HLW 100% at 4 sites	21,600 canisters				15,000 canisters	1,700 canisters										4,600 canisters	340 canisters	
	100%				69%	8%										21%	2%	
HW[b] 81% at 9 sites	69,000	4,100			6,100	3,900	13,000	4,900		5,500		10,000			3,100	5,500		13,000
	100%	6%			9%	6%	19%	7%		8%		14%			4%	8%		19%

Notes: * indicates that waste percentage at this site is less than 0.5%. Blank cells indicate no volume for this waste type based on data sources analyzed in the WM PEIS.

[a] Waste volume projections contained in this and other WM PEIS tables may vary from the latest site estimates at the time of publication. Significant variances reported (e.g., ANL-E) have typically been in the conservative direction—the WM PEIS analyses were based on larger waste volumes than are currently projected. Updated inventories and waste generation volumes are summarized in Appendix I, "Update of Site-Specific Waste Volumes for LLW, LLMW, and TRUW." Table shows 16 of the 17 sites analyzed in detail by WM PEIS. WIPP, the 17th site, does not currently manage waste and is omitted. Site data have been rounded to two significant figures; therefore, totals may not sum to 100% and may not precisely represent the waste totals as reflected in the following chapters.

[b] HW volumes are shown for the 9 major sites managing nonwastewater regulated by RCRA. Other sites also manage HW but were not evaluated. HW volumes are calculated by adding onsite thermal treatment and fuel burning totals with offsite commercial treatment and multiplying the sum by 20 to obtain a 20-year projected inventory. For this PEIS, the conversion factor used is one metric ton of hazardous waste equals one cubic meter in volume.

Sources of data on inventory and projected waste volumes for each of the waste types are listed below and described in detail in the waste type chapters (Chapters 6–10) and Appendix I.

- LLMW—The *Mixed Waste Inventory Report* (DOE, 1994i) was used for all LLMW inventories and generation rates, except for Colonie, ETEC, and RFETS, whose generation rates and inventories come from late 1994 site estimates, and ANL-E and NTS, whose generation rates and inventories come from the updated *Mixed Waste Inventory Report* (DOE, 1995k).
- LLW—The *Integrated Data Base for 1992* (DOE, 1992b) was used for generation rates and inventories of stored waste except for BNL, NTS, ORR, Pantex, and WVDP, whose generation rates and inventories come from the updated *Integrated Data Base Report-1994* (DOE, 1995h). The Waste Management Information System (ORNL, 1992) was consulted for data not available in the Integrated Data Base.
- TRUW—The *Integrated Data Base for 1992* (DOE, 1992b) and the *Interim Mixed Waste Inventory Report* (DOE, 1993) were used for TRUW inventories and generation rates except for Hanford and SRS. SRS generation rates and inventories come from the updated *Mixed Waste Inventory Report* (DOE, 1995k), while Hanford's come from the *WIPP TRUW Baseline Inventory Report (BIR-2) for 1995* (DOE, 1995i).
- HLW—Site-specific plans and NEPA documents for Hanford, INEL, SRS, and WVDP were used for HLW volume and canister production rates.
- HW—The EPA Information System biennial and annual reports (EPA, 1991) were used for HW generation rates. Offsite shipments to commercial treatment were derived from DOE fiscal year 1992 HW shipping manifests.

Waste loads reported in Tables 1.6–2 and 1.6-3, as well as Chapters 6 through 10, represent a "snapshot in time"—accurate to the extent existing inventories and future operations were understood when the databases were developed. Accordingly, inventories and projections reported in Table 1.6–3 and Chapters 6 through 10 may not exactly match projections at the time of publication of the Final WM PEIS.

Factors responsible for the degree of uncertainty in estimating waste loads are discussed in Appendix I, which provides a more recent snapshot of DOE's waste inventory and projections. At selected sites, substantial differences are apparent, reflecting these uncertainties. As described in Appendix I, DOE determined that it was necessary to revise some of the waste load information and associated analyses presented in the WM PEIS on the basis of this more recent information. Additionally, as Appendix I shows,

consolidation of waste loads and operations across sites in Regionalized and Centralized Alternatives serves to dampen uncertainty associated with site-specific waste inventories and projections.

Considering these uncertainties, dampening effects, and the selected updates, the waste loads used for the WM PEIS analysis are sufficiently accurate for programmatic decision making.

17 Major Sites Analyzed

Argonne National Laboratory-East
Brookhaven National Laboratory
Fernald Environmental Management Project
Hanford Site
Idaho National Engineering Laboratory
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
Nevada Test Site
Oak Ridge Reservation
Paducah Gaseous Diffusion Plant
Pantex Plant
Portsmouth Gaseous Diffusion Plant
Rocky Flats Environmental Technology Site
Sandia National Laboratories-New Mexico
Savannah River Site
Waste Isolation Pilot Plant
West Valley Demonstration Project

1.7 Scope of the Waste Management Programmatic Environmental Impact Statement

1.7.1 Defining the Scope of the WM PEIS

Initially, the scope of the WM PEIS included both the Department's waste management and environmental restoration programs (DOE, 1994b). Although these programs both address the radioactive and chemical contaminants that are the legacy of the Cold War, they do so in different contexts. Environmental restoration contains or removes contaminants in environmental media such as soil and groundwater; whereas waste management activities include treatment, storage or disposal of wastes that are not part of the environment, such as sludge and liquids stored in tanks. Environmental restoration seeks to clean up past releases of contaminants. Waste management seeks to prevent further releases in the future by treating and disposing of wastes safely. Despite these differences, there is significant overlap between the two programs. They both address many of the same types of contaminants, and to the extent that environmental restoration removes contaminants from the environment, it may create wastes that, in some instances, will be transferred to the waste management program. Because of this overlap, DOE initially attempted to integrate evaluations of alternatives for both programs in the WM PEIS.

As DOE proceeded with preparation of the WM PEIS, however, it concluded that it should not develop or evaluate programmatic alternatives for environmental restoration. The initial decisions DOE must make about environmental restoration are not programmatic or strategic, but specific to its individual sites. These

decisions concern the uses to which each site will be put in the future. For the most part, a decision on how one site can or will be used in the future does not depend on how other sites in the complex will be used, but depends instead on such things as the degree of contamination, the applicable cleanup standards, the views of local residents and regulators, DOE's need for the site in the future, and the alternative uses that are feasible for the site. It would not be sensible to evaluate programmatic alternatives for future uses within the DOE complex, because the process of developing alternative uses and selecting among them will, for the most part, proceed at each site as part of cleanups undertaken pursuant to CERCLA and RCRA. For this reason, DOE announced on January 24, 1995, in the *Federal Register* that the scope of the PEIS would be limited to programmatic alternatives concerning where DOE should manage its different types of wastes (DOE, 1995b). Appendix A of this PEIS contains a summary of the comments received in response to DOE's proposal to change the scope and DOE's responses to those comments.

In contrast, it is appropriate to evaluate programmatic alternatives for waste management. There are economies of scale as to environmental impacts and costs that vary according to the degree to which waste management is centralized or dispersed among the sites in the complex. For example, centralized alternatives tend to increase transportation impacts, concentrate potential impacts from effluent and emissions at a few sites, and reduce costs and impacts from construction. Decentralized Alternatives tend to reduce transportation impacts, disperse potential impacts from effluent and emissions among many sites (but may increase the total amount of these impacts for the entire complex), and increase costs and construction impacts. The WM PEIS allows DOE to evaluate these often countervailing economies of scale so that it can decide how much—if at all—it should centralize the management of each of its five types of wastes.

There was one aspect of environmental restoration, however, that appeared suitable for programmatic analysis at the time DOE redefined the scope of the WM PEIS. This analysis would focus on those wastes generated during environmental restoration that would be transferred to the waste management program. The two general approaches to controlling contaminants in environmental media include containment and removal. Removing contaminated media from the environment creates waste. Although DOE plans to manage the majority of these wastes at commercial facilities or at facilities dedicated to the environmental restoration program, it also plans to transfer some of the waste generated during environmental restoration to the waste management program. These wastes, referred to as "environmental restoration (ER) transferred wastes," would be treated, stored, and disposed of in facilities DOE would also use to manage its inventory wastes and wastes generated from ongoing operations, which are collectively referred to as "waste management (WM) wastes."

If DOE had sufficient information about the ER transferred wastes, it would evaluate their impacts in the same manner as the impacts of WM wastes are evaluated in the WM PEIS. Unfortunately, DOE still does not have enough information on the volume or contaminant composition of these wastes to perform a meaningful impact evaluation at this time. The overall volume of ER transferred wastes depends on the extent of environmental restoration at a site, which in turn depends on decisions regarding the future use of the site and the amount of cleanup necessary to permit that use. It also depends on how sites and regulators strike the balance between containment and removal strategies at a site. For example, the more extensive the use of removal actions, the larger the volume of waste generated during environmental restoration. The volume of ER transferred waste also depends on the availability of commercial or environmental restoration facilities. For example, a site with a large volume of ER waste may transfer relatively little of it to the waste management program if commercial or dedicated environmental restoration facilities are available to manage these wastes.

At present, very little information is available to DOE about factors that will determine the volumes of environmental restoration wastes overall and the portion of the wastes that DOE will transfer to the waste management program. DOE lacks this information primarily because the Department and its regulators do not yet know how much environmental restoration is needed at sites or how it will be accomplished. Without this information, it is difficult to predict when and where environmental restoration wastes will be generated during the coming decades. Based on the limited information it does have, DOE has made some preliminary estimates of the volumes of environmental restoration wastes it may generate and the amounts it may transfer to the waste management program. These estimates are discussed in Appendix B.

Additionally, very little information is available to DOE about the composition of environmental restoration wastes. This prevents the Department from evaluating the impacts of managing these wastes at this time. Environmental restoration can produce low-level wastes, low-level mixed wastes, and transuranic wastes. Although DOE has made preliminary estimates about how much of each of these wastes environmental restoration may generate at a particular site, it has almost no information on how chemical or radiological contaminants vary within each of these broad types of environmental restoration wastes. Without this basic information on the nature and composition of these wastes, DOE cannot determine the facilities needed to manage them or the impacts those facilities would have on the environment. Appendix B of the WM PEIS discusses recent estimates of the expected volumes of ER transferred waste and how these wastes may affect waste management facilities.

Faced with these uncertainties about ER transferred wastes, DOE chose to proceed to evaluate programmatic alternatives for managing the WM wastes rather than delay the WM PEIS until detailed information about ER transferred wastes became available. For the following reasons, DOE concluded it would be better to proceed with the WM PEIS despite the uncertainties surrounding environmental restoration transferred wastes.

First, information about ER transferred wastes, particularly about its radiological and chemical composition, may be unavailable until most of DOE's environmental restoration activities are underway. Waiting for this information could delay DOE's decisions on how to treat and dispose of its WM wastes for years or decades. Second, decisions DOE's sites and regulators make about environmental restoration and the use of commercial and dedicated facilities to manage the wastes that cleanup activities generate could greatly reduce the amounts of wastes transferred to the waste management program. This would result in DOE having to postpone improving the management of its existing wastes in order to evaluate a set of wastes that by then might have become insignificant at many sites. Third, the impacts of sending ER transferred wastes to the waste management program are expected to be no more than adding equivalent amounts of waste management wastes, and could be much less because wastes generated during environmental restoration tend to have lower concentrations of chemical and radiological contaminants than WM wastes of the same type. Finally, DOE will have the opportunity to evaluate the impacts of ER wastes on waste management facilities during sitewide or project-level NEPA reviews or during the CERCLA process, which requires an evaluation of alternatives similar to NEPA's.

On the basis of the WM PEIS, DOE will decide which sites will manage its existing wastes and those wastes that DOE will generate in its ongoing operations. Regardless of the amount of ER transferred wastes that DOE may generate in the future, DOE needs to select the sites at which it will manage the WM wastes and, to the extent necessary, begin planning and building additional facilities it needs for these wastes. These new facilities will require additional NEPA analyses before DOE can decide where they would be located at a site, what technologies they would use, how they would be operated, how their adverse impacts would be mitigated, and what would be reasonable alternatives to the proposed facility. If at the time DOE conducts these analyses it proposes to use the facility for both ER transferred wastes and WM wastes, the Department can develop reasonable alternatives that incorporate more recent information about the specific ER transferred wastes it proposes to send to that facility. On the other hand, if DOE decides not to send ER transferred wastes to a waste management facility (either because such a facility is not available or because there is still insufficient information about the wastes), DOE would have to evaluate at some time — under either NEPA or CERCLA — the reasonable alternatives for managing these wastes, which could include

building a new facility dedicated to handling these wastes, modifying an existing facility, or sending them to a commercial facility.

While DOE determined that environmental restoration decisions, including the level of site remediation should be made on a site-specific basis, some national perspective and public participation is needed. Public input can guide consistency in site-specific decisions, weigh equity trade-offs between sites, and ensure an adequate level of protection and financial controls.

DOE has begun a "National Dialogue" initiative to provide a means for comprehensive discussion with governmental officials, regulatory authorities, and other interested organizations and publics regarding the major materials, waste, and cleanup decisions DOE needs to make. This dialogue will include public participation and input on national environmental restoration issues.

1.7.2 Public Involvement Related to the Draft WM PEIS

Before release of the Draft WM PEIS, DOE expanded its outreach efforts to focus on public awareness of its revised scope. These efforts included briefings to groups such as the Environmental Management Advisory Board and the Site Specific Advisory Board chairpersons, participation in quarterly public meetings at several sites, wide distribution of a WM PEIS Update newsletter, and the release of a video describing the WM PEIS. On September 22, 1995, DOE published a *Federal Register* notice announcing the release of the Draft WM PEIS and invited the public to comment on the document during the 90-day public comment period (September 22 through December 21, 1995). Opportunities to comment were provided in a series of 13 video conference hearings held from October 17, 1995, through January 24, 1996. Several of these video conferences linked multiple DOE sites together with DOE Headquarters; altogether, 18 locations were involved in the hearings.

The video conference hearing format was used to provide a wider opportunity for Headquarters' participation, allow an interactive meetings approach, and reduce costs. The public hearings were advertised through local newspapers, morning and evening drive-time radio announcements, and other mechanisms such as direct mailings to interested members of the public, meeting announcements to active groups or advisory boards, and additional advertising as deemed necessary by the DOE site representatives. Public comments collected at the hearings were summarized in the *Draft WM PEIS Hearing Summary Report: A Compilation of Public Hearing Summaries* and placed in DOE public reading rooms in early

February 1996. Comments were also received from the public and other interested parties directly through the mail.

During the public comment period for the Draft WM PEIS, more than 1,200 individuals, states, tribal nations, agencies, and organizations provided DOE with comments. Comments were received from virtually all of the communities near DOE sites identified as "major" in the PEIS, and from many other interested publics. Many citizens and organizations posed questions, comments, or objections regarding proposed waste management activities at particular DOE sites. Some suggested other alternatives for waste management activities; others expressed their preferences for the alternatives described in the PEIS. A few commenters thought that DOE should prepare one comprehensive environmental impact statement on all of its activities; some expressed their support for DOE's current efforts.

One recurring and controversial issue raised during the public comment period was potential human health impacts of treatment, storage, and disposal of the five waste types. The concerns raised included the risk assessment methodologies (e.g., models and assumptions) used in the analysis, risks to densely populated areas or minority and low-income populations, risks associated with subsistence fishing in some communities, transportation risks, impacts on future generations, and additional exposure to populations affected by other DOE nuclear activities.

Commenters challenged DOE's designation of particular sites as "major" sites in the PEIS and requested that these sites be removed from consideration. Related to this issue were comments regarding the accuracy of current waste loads at particular sites.

DOE also received comments and questions on the relationship of the WM PEIS to other DOE programs or projects; the perceived inconsistency of the PEIS with other DOE documents; other waste types or radioactive materials not analyzed in the PEIS; waste management technologies, particularly for waste treatment; the decision criteria DOE will use in making its waste management decisions; the future availability of geologic repositories at Yucca Mountain, Nevada, and the Waste Isolation Pilot Plant in New Mexico; and DOE credibility. Many commenters questioned DOE's February 1995 decision to separate environmental restoration decisions from the scope of the PEIS.

Several commenters offered comments on policies or Federal programs not specifically related to this PEIS, including suggestions to eliminate the production of radioactive and hazardous waste by eliminating certain DOE defense- and energy-related programs.

All comments were carefully considered by DOE. DOE made substantial changes to the Draft WM PEIS as a result of the comments and prepared the Comment Response Document, Volume V of this Final PEIS, to respond specifically to the comments received. In general, public comments, coupled with consultations with commenting agencies and state and tribal governments, resulted in additional analyses, clarification or correction of facts, or expanded discussion in several technical areas. The Comment Response Document provides an explanation of why certain comments did not warrant further change to the PEIS.

In response to the comments received, DOE made the following major changes to the PEIS.

- DOE modified the Decentralized Alternative for HW to replace LANL with INEL as a candidate site for onsite treatment of hazardous waste. This change recognizes the HW treatment capacity that exists at INEL but does not currently exist at LANL. The HW Decentralized Alternative remains the same for purposes of this programmatic analysis (treatment of HW at three sites). Thus, replacement of LANL with INEL does not constitute a substantial change in the proposed action or alternative.
- With respect to information on waste loads, DOE prepared a new appendix, Appendix I, which presents updated waste volume inventories and projections for all waste types. Further, Appendix I provides site-specific comparisons with earlier inventories and projections upon which the analysis in the Draft WM PEIS was based to determine if any of the more recent data would substantially change any of the impacts described in the Draft WM PEIS. Subsequently, DOE performed new analyses using the more recent data at selected sites for LLMW, LLW, TRUW, and HLW. The results of these additional analyses are contained in the relevant chapters.
- DOE modified its analysis of environmental justice concerns to provide a more precise analysis of whether high and adverse human health impacts could disproportionately affect a minority or low-income population. The maps illustrating the proximity of these populations around the major DOE sites have been improved and moved from the former Appendix I (in the Draft WM PEIS) to Appendix C of the Final WM PEIS. DOE performed additional analyses of the potential for offsite general population risk as a result of the disposal of LLMW and LLW. With respect to transportation impacts, DOE clarified the comparison of radiological risks in truck and rail transportation and included the potential number of shipments that would enter and exit each site. DOE also reiterated that the intersite routes used in the analysis are representative of possible routes, not descriptive of actual routes to be used, as the WM PEIS Records of Decision will not select transportation routes.
- DOE revised Chapter 11, "Cumulative Impacts," to provide a more comprehensive evaluation of other DOE actions (e.g., tritium supply and recycling, weapons material stockpile stewardship and management, and storage and disposition of excess fissile materials) that may affect the sites. In this

chapter, DOE also included estimates of fatalities that result from implementation of the alternatives in the absence of mitigation measures and clarified the analytical assumption concerning commingling of groundwater contaminated by releases from different disposal units.

Other substantive changes to the Draft WM PEIS include: an enhanced description of the decisions to be made by DOE (Section 1.7.3, which also consolidates decision criteria information from former Section 1.8); a statement clarifying DOE's compliance with state and local laws and a narrative on relevant DOE orders (Section 1.4); a more comprehensive discussion of site treatment plans, pollution prevention, and other DOE actions and programs (Section 1.8.2); a discussion of privatization (Section 1.7.4); a discussion of safeguards and security (Section 4.3.12); an enhanced discussion of interpreting risk values (Section 5.4.1); and an explanation as to why the No Action Alternatives for some wastes have smaller potential impacts than other alternatives (Sections 6.3.1, 7.3.1, and 8.3.1). DOE has also made other suggested changes to improve readability, including a short Readers' Guide at the beginning of Volume I, commonplace examples to demonstrate waste volumes, and a table for converting waste volumes to both cubic meters and cubic yards. The Final WM PEIS includes an updated list of preparers in Chapter 13.

1.7.3 DOE Waste Management Decisions

In accordance with its NEPA regulations, DOE can prepare three tiers of NEPA reviews: programmatic, sitewide, and project-level. These tiers represent a hierarchy in which broad and general programs and policies can be addressed in an initial programmatic NEPA review. Subsequent NEPA reviews could then analyze narrower proposals related to the program or policy. First-tier programmatic reviews, such as the WM PEIS, provide environmental evaluations for consideration in making decisions on broad agency actions, such as the adoption of new strategies, programs and policies to guide future actions. Sitewide NEPA reviews provide the opportunity for considering changes in the overall operations of a DOE site, including mission changes, and provide a current environmental baseline at the site, both to support and simplify project-level NEPA reviews. Project-level NEPA reviews evaluate the impacts of a specific project at specific locations at a site and are intended in part to provide environmental information on the impact of siting, constructing, and operating a facility. Sitewide NEPA reviews, which evaluate projects that could be implemented in the near-term at a site, may also serve as project-level NEPA reviews if projects can be evaluated sufficiently in the sitewide review. Project-level or sitewide NEPA reviews are generally more focused than programmatic NEPA reviews with regard to detailed site parameters.

In addition, compliance agreements and permitting requirements may require more detailed assessments of technologies prior to their implementation at a site. Project-level and sitewide NEPA reviews that address specific impacts at a site may, therefore, also evaluate the impacts of alternative technologies based on site-specific performance standards that differ from the representative technologies considered in this PEIS. Sitewide and project-level NEPA reviews may also consider more detailed waste characteristics and volumes, including waste from environmental restoration activities. These NEPA reviews may also consider the role that pollution prevention will play in minimizing the wastes under consideration.

In addition to preparing sitewide or project-level NEPA reviews tiered from the WM PEIS, DOE may also rely upon reviews that have already been completed. Existing sitewide and project-level NEPA analyses will be reviewed to determine whether modifications are needed to implement the decisions based on evaluations in the WM PEIS.

With the end of the Cold War, DOE's mission has shifted from an emphasis on nuclear weapons production to cleanup of contamination and disposal of the war's legacy of radioactive and hazardous wastes. Before the Department expends resources to establish new treatment, storage, and disposal facilities at every site where these wastes exist, it is prudent to determine whether to consolidate such functions at fewer sites to reduce costs and potential environmental impacts.

DOE will use the analyses presented in the PEIS to decide on a programmatic or strategic approach to managing its waste. DOE intends to select a configuration of DOE sites for waste management activities on the basis of the WM PEIS and other factors. The level of analysis in the WM PEIS is appropriate for making broad programmatic decisions on what DOE sites should be used for waste management. At the programmatic level, however, it is not possible to take into account special requirements for particular waste streams, different technologies that are or may be available to manage particular wastes, or site-specific environmental considerations such as the presence of culturally important resources or endangered species at a specific location on a site. DOE will rely upon other NEPA reviews, primarily ones that evaluate particular locations on sites or projects (sitewide or project-level reviews), for these analyses. Thus, decisions regarding specific locations for waste management facilities at DOE sites or the waste management technologies to be used will be made on the basis of sitewide or project-level NEPA reviews.

The WM PEIS analyzes four broad categories of alternatives that represent the range of reasonable alternatives concerning where DOE can manage its wastes. Within these broad categories of alternatives (No Action or "status quo," Decentralized, Regionalized, and Centralized), DOE developed different

configurations or sets of DOE sites that could be used for waste management activities. The sites identified in each alternative configuration were selected for evaluation based on the volume of waste they currently had in inventory, the amount of waste they were expected to generate in the future, the waste's origin and characteristics, and the waste treatment facilities at each site. DOE then analyzed the potential environmental impacts associated with the waste management activities under each alternative configuration for each waste type, which allowed DOE to assess and compare the alternatives. The WM PEIS describes the results of those analyses for use by the public and DOE's decision makers.

Because the locations of potential facilities cannot be determined at this time, some impacts that are inherently location-specific could not be assessed in this programmatic analysis. For example, the effects of construction of a waste treatment facility on a particular aspect of the environment may be significant if the facility were built at a certain location, and may be easily mitigated or eliminated if the facility were elsewhere. Such effects may include impacts on geology and soils, noise and aesthetic impacts, impacts on species and habitats, and impacts to land use and cultural resources. Although a number of these site-specific impacts are discussed in this PEIS in Chapters 6 through 10, they can be analyzed thoroughly only in sitewide or project-level NEPA reviews. DOE anticipates that, in the majority of cases, any such impacts found to be significant can be mitigated or eliminated by alteration of a proposed facility's location or by other changes.

This PEIS is intended to provide environmental information to assist DOE in determining where it should modify existing waste management facilities or construct new facilities. The types of facilities evaluated in this PEIS are:

- Treatment and disposal facilities for LLMW
- Treatment and disposal facilities for LLW
- Treatment and storage facilities for TRUW
- Storage facilities for treated (vitrified) HLW canisters until a geologic repository is available
- Treatment facilities for nonwastewater HW

LLMW. The evaluation of alternatives for managing LLMW in this PEIS was coordinated with the development of STPs that were prepared pursuant to the FFCAct. Information on possible alternatives, preliminary risk analyses, and cost studies was shared with the States to provide information for use in developing STPs. Although the Draft PEIS analyzed potential environmental risks and costs associated with a range of management alternatives for LLMW in the context of NEPA, decisions on LLMW treatment are made by the States and EPA under the FFCAct. This Final WM PEIS is being released after EPA or

authorized State agencies issued orders implementing most of the STPs. DOE will issue Records of Decision on the treatment and disposal of LLMW, explaining what decisions were made by the States and EPA and what alternatives were considered.

LLW. There is no regulatory requirement or timetable for LLW decisions. However, managing LLW is closely tied to the management of LLMW. Accordingly, DOE expects to issue a Record of Decision with respect to LLW in conjunction with its Record of Decision on LLMW management. As a result of a recommendation by the Defense Nuclear Facilities Safety Board (DNFSB)—identified as recommendation DNFSB 94-2—DOE has undertaken a review of the LLW management program across the nuclear weapons complex. This includes review of the regulatory structure for the program as well as an assessment of current operating facilities. Activities conducted in this effort were coordinated with analyses in the WM PEIS.

TRUW. DOE will decide where to treat and store TRUW based on evaluations in the WM PEIS and the requirements of the FFCAct because much of DOE's TRUW is also mixed waste. DOE needs to decide where to treat TRUW if treatment is deemed necessary before disposal at WIPP or some other form of disposition. The final acceptance criteria for TRUW disposal at WIPP are expected to be determined in 1997; at that time, DOE will need to be able to define necessary treatment requirements and select sites for treatment facilities. DOE will also decide where to store treated TRUW on the basis of the PEIS, a decision it must make regardless of whether or when WIPP opens.

HLW. In 1996, DOE began treating HLW at SRS and WVDP. DOE has also entered into an agreement with the State of Washington and EPA to begin treatment of HLW at the Hanford Site in 2009. DOE agreed with the State of Idaho to begin treating the HLW stored in tanks at INEL in 2014. DOE needs to decide where to store treated HLW until it can be permanently disposed of in a geologic repository.

HW. DOE's program for treatment of HW is well established and has been operating for some time. There is existing capacity in the commercial market for HW treatment, storage, and disposal. Accordingly, DOE will decide whether to continue its reliance on commercial vendors or to treat HW at selected DOE sites.

Preferred Alternatives. DOE has identified its preferred alternative for each waste type in Section 3.7. These alternatives were selected on the basis of factors and criteria developed after considering public

comments and other available information. The factors and criteria DOE used to select preferred alternatives are described below, in alphabetical order:

Factor:	**Criteria:**
Consistency	Favors alternatives that are consistent with other complexwide studies using methodologies that allow valid comparisons across sites.
Cost	Favors alternatives that have the potential to minimize overall cost for implementation of selected waste management strategies.
Cumulative Impacts	Favors selection of alternatives and sites that minimize cumulative adverse environmental impacts resulting from other activities at the site.
DOE Mission	Favors alternatives that further the Department's mission to safely and efficiently treat, store, and ultimately dispose of wastes.
Economic Dislocation	Favors alternatives that tend to minimize economic dislocation such as job losses.
Environmental Impact	Favors selection of alternatives and sites that minimize adverse environmental impacts.
Equity	Favors alternatives that distribute waste management facilities in ways that are considered equitable.
Human Health Risk	Favors alternatives that reduce human health risk to both workers and the public. Human health risks depend not only upon the magnitude of releases of radionuclides and hazardous chemicals, but also upon parameters such as population surrounding the sites, the hydrogeology of disposal sites, and the number of vehicle accidents that are expected to occur during transportation of waste.
Implementation Flexibility	Favors alternatives that maximize DOE's ability to modify activities at selected sites as circumstances change, e.g., to potentially manage large volumes of ER wastes.
Mitigation	Favors alternatives that increase DOE's ability to mitigate adverse impacts and that reduce the cost of mitigation.

Regulatory Compliance	Favors alternatives that comply with regulatory requirements, DOE Orders, and commitments made under the FFCAct or in compliance agreements with States and other regulators.
Regulatory Risk	Considers the potential for changes in statutes and regulations when evaluating alternatives and siting options.
Site Mission	Favors alternatives that are consistent with site capabilities and feasible for each waste type, particularly capacities and availability of technologies for treatment, storage, and disposal.
Transportation	Favors alternatives that balance the amount of transportation needed to transport wastes to the sites considered in the alternatives with potential environmental and human health risks, vehicle accidents, public concerns, mission needs, and costs.

Programmatic Decisions. The preferred alternatives are not decisions. Rather, they are the Department's preliminary preferences, which are subject to further discussion and deliberation. No sooner than 30 days after the issuance of this WM PEIS, DOE will begin to make decisions regarding each waste type, using the factors and criteria described above and the evaluations in the WM PEIS. DOE will issue a Record of Decision that will explain the decisions DOE made, why it made these decisions, and what alternatives it considered.

Decisions on waste management sites will be based on the information and analyses in the WM PEIS and other considerations such as regulatory compliance, budget constraints, schedules, compliance with regulatory agreements, including public input on each of the preferred alternatives for each waste type, national priorities, and other DOE studies. For example, DOE will continue to work with the DOE Disposal Workgroup and with state representatives in the National Governors Association to evaluate and discuss the issues related to the potential disposal of residuals from treatment of LLMW at sites subject to the FFCAct. DOE will work with interested members of the public and the National Governors Association to explore principles that may help DOE in making decisions that reflect public concerns.

Site-Specific Decisions. The Records of Decision issued on the basis of the WM PEIS will identify sites at which waste management activities will occur. However, a decision on the specific technology and the particular location of a waste management facility at a site will be made on the basis of sitewide or project-level NEPA reviews "tiered" from this PEIS.

1.7.4 Use of Commercial or Privatized Facilities

> ***Helping the Private Sector***
>
> *In April 1995, States asked DOE to consider treating mixed waste generated by public and private entities for which no commercial treatment capacity is available. DOE and the National Governor's Association/Federal Facility Compliance Act Task Force are addressing this issue. States would first need to satisfy several specific DOE conditions before DOE would proceed with such a plan. This "privatization in reverse" would deal with a very small volume of waste (less than 200 cubic meters) and therefore would not affect programmatic alternatives evaluated in this PEIS.*

For purposes of the WM PEIS, a "commercial facility" is defined as one that is owned and operated by a private entity (or a State) and that treats, stores, or disposes of waste from a variety of sources for a fee. Commercial facilities are generally constructed in response to market forces. Commercial facilities are currently available for the treatment and disposal of LLMW, LLW, and HW. DOE expects that the capacity of commercial facilities to treat and dispose of LLMW and LLW will increase in the future in response to increasing demand from the private sector, DOE, and other government agencies. No commercial management of TRUW or HLW currently exists or is anticipated.

At present, DOE uses commercial facilities for the management of HW, LLW and LLMW. DOE's most extensive and prolonged use of commercial facilities is for treatment of HW. For a number of years, the Department has routinely sent nonwastewater HW to commercial facilities. The WM PEIS analyzes the alternative of using DOE facilities for treatment of this category of HW so that the Department can make an informed programmatic decision on whether to continue to use commercial facilities for this purpose. DOE's use of commercial facilities for management of LLW and LLMW is more limited at present, and much of the LLW and LLMW that DOE currently ships to commercial facilities for treatment or disposal consists of environmental restoration wastes rather than wastes from the Department's waste management program. As noted above in Section 1.7.1, environmental restoration wastes are outside the scope of the WM PEIS because DOE has concluded that it would be inappropriate to make programmatic decisions concerning their management.

Much of the LLMW that DOE sends to commercial facilities for treatment is subject to agreements and orders under the FFCAct. Under this Act, Federal and State authorities made decisions regarding treatment of LLMW on the basis of the site treatment plans prepared by the Department, and these plans contain detailed descriptions of the commercial treatments that DOE currently uses. DOE also uses a commercial

facility for disposal of LLMW after treatment. At present, DOE's use of commercial facilities for managing LLW is even more limited than its use of them for LLMW management.

In contrast to the term "commercial facility," the WM PEIS uses the term "privatized facility" to refer to a waste management facility owned by the Department on a DOE site that is operated, maintained, and eventually decontaminated and decommissioned by a private entity. The private entity operates the waste management facility for the exclusive use of DOE, and is reimbursed by the Department on a competitive, fixed-price basis. The term also refers to situations in which a private entity finances, constructs and operates a new waste management facility on a DOE site.[6] For example, the Department is privatizing treatment of some HLW at the Hanford Site; a private entity also operates a LLMW vitrification facility at SRS. There is the potential for DOE to use privatized facilities to manage all five types of waste in the future.

Many DOE sites are exploring opportunities to make greater use of commercial facilities for the treatment and disposal of LLMW and LLW. The WM PEIS does not analyze alternatives that involve extensive use of commercial facilities for managing these two waste types for several reasons.[7] First, DOE's current use of commercial facilities to manage these wastes is limited, and the potential for expanding the use of these facilities in the future is unclear at this time. In particular, DOE cannot predict where new commercial facilities would be located in relation to DOE's sites, what waste streams they would manage, or what their capacity might be. More importantly, DOE does not anticipate that it will make programmatic decisions regarding the use of commercial facilities to manage LLMW and LLW. Instead, each DOE site will decide the extent to which it will use commercial facilities based on the wastes it needs to manage, the capacities and capabilities of the commercial facilities available to the site, and the advantages these facilities offer in comparison to other alternatives, such as using facilities at DOE sites. Sites considering the use of commercial facilities for managing LLMW or LLW may need to include alternatives with such facilities

[6] Outside of the context of the WM PEIS, the term "privatization" is often used to refer to the use of all types of waste management facilities operated by the private sector, including "commercial facilities" as defined in the WM PEIS and facilities constructed and operated by the private sector for the exclusive use of DOE at locations other than DOE's sites.

[7] At this time, the commercial facilities DOE primarily uses for treatment of LLMW include DSSI and SEG in Tennessee and Envirocare in Utah. Envirocare is the only commercial disposal facility for LLMW presently in operation, and DOE sends LLMW to this facility for disposal as well as treatment. The commercial facilities to which DOE currently sends LLW for treatment include SEG and US Ecology in Tennessee and Permafix in Florida. The Department also sends some LLW to commercial facilities for disposal. The vast majority of this goes to Envirocare; a small amount is shipped to the Barnwell Disposal Site in South Carolina. DOE's current use of commercial facilities to manage LLMW and LLW is not explicitly analyzed in the WM PEIS because DOE's present use of these facilities is limited and much of that use is for wastes already analyzed in existing CERCLA or NEPA reviews or is for wastes subject to orders or consent agreements issued by State and Federal regulators under the FFCAct.

in sitewide, project-level, or other NEPA reviews before making a decision on whether to use commercial options. Sites may be able to incorporate aspects of the analyses in the WM PEIS in these reviews. For example, the WM PEIS analyzes the potential transportation impacts associated with shipments of LLMW and LLW; this analysis applies to representative routes and is based on the amounts of waste involved, the number and distance of shipments through representative communities, and the radiological or chemical profile of the waste. Accordingly, the transportation analyses in the WM PEIS may be applicable to some shipments between DOE sites and commercial facilities. Sites may be able to use other aspects of the WM PEIS in any additional NEPA reviews that evaluate the use of commercial facilities to manage LLMW or LLW.

With respect to privatized facilities, the analyses in the WM PEIS would be directly applicable to such facilities located on DOE sites because the impacts of using a privatized facility would be the same as using a DOE facility at that site. Therefore, the alternatives in the WM PEIS include the option of using privatized facilities at the DOE sites analyzed in the WM PEIS.

1.8 WM PEIS Relationship to Other Actions and Programs

1.8.1 Relationship to Other NEPA Reviews and Decisions

Several NEPA documents have been completed recently, are ongoing, or have been proposed that are related to this PEIS. Table 1.8–1 lists these documents, and the following sections briefly discuss the relationship of these documents to this PEIS. Where these other NEPA reviews have identified impacts that could add to the impacts identified in the WM PEIS, these impacts were included in the analysis of cumulative impacts in Chapter 11.

The priorities of DOE have shifted away from nuclear weapon production as discussed in Section 1.2, and the documents referenced in Table 1.8–1 reflect DOE's new and redirected missions. These documents describe selected proposed actions that are important to our nation's defense and energy needs. Consequently, an integrated waste management strategy will remain important to DOE.

Among the actions identified in the following sections, DOE is preparing project-level and site specific NEPA documents that consider waste management facilities in parallel with the preparation of this PEIS.

These parallel NEPA efforts will help to expedite compliance with site-specific agreements and orders issued pursuant to the FFCAct. Prior to reaching decisions on whether to construct waste management facilities evaluated in project-level and sitewide NEPA reviews, DOE will first determine, on a case-by-case basis, whether the implementation of waste management facilities would proceed in accordance with 40 CFR 1506.1(c), which states:

> While work on a required program environmental statement is in progress and that action is not covered by an existing program statement, agencies shall not undertake in the interim any major Federal action covered by the program which may significantly affect the quality of the human environment unless such action (1) is justified independently of the program; (2) is itself accompanied by an adequate environmental statement; and (3) will not prejudice the ultimate decision on the program. Interim action prejudices the ultimate decision on the program when it tends to determine subsequent development or limit alternatives.

Records of Decision on project-level and sitewide NEPA reviews that may be issued prior to decisions on the WM PEIS will reflect DOE's determinations pursuant to 40 CFR 1506.1. However, once decisions are made as a result of the WM PEIS, prior sitewide or project-level decisions may need to be revisited to assure consistency with the programmatic decisions.

Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management EIS (Volume 1). On June 28, 1993, as an outgrowth of civil litigation, the U.S. District Court for the District of Idaho ordered DOE to prepare a comprehensive, sitewide EIS on the direct and indirect environmental effects of all major Federal actions involving spent nuclear fuel at INEL. Subsequent to this order, DOE decided to expand the scope of the in-progress INEL Environmental Restoration and Waste Management EIS to include the programmatic analysis of spent nuclear fuel alternatives that was being considered for inclusion in the WM PEIS.

In April 1995, DOE issued the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE, 1995e), which evaluated alternatives for managing existing and reasonably foreseeable inventories of spent nuclear fuel through the year 2035. Subsequently, DOE in its Record of Decision (ROD) (DOE, 1995f) decided to regionalize spent nuclear fuel management by fuel type

Table 1.8–1. Major Related NEPA Reviews

Title	Document	Status	Site(s)
Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management EIS (Volume 1)	PEIS (DOE/EIS-0203-F)	Final issued April 1995 ROD May 1995	Hanford Site, Idaho National Engineering Laboratory, Nevada Test Site, Oak Ridge Reservation, Savannah River Site, and other locations
Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management EIS (Volume 2)	EIS (DOE/EIS-0203-F)	Final issued April 1995 ROD May 1995	Idaho National Engineering Laboratory
Tritium Supply and Recycling PEIS	PEIS (DOE/EIS-0161)	Final issued October 1995 ROD December 1995	Idaho National Engineering Laboratory, Nevada Test Site, Oak Ridge Reservation, Pantex Plant, Savannah River Site
Storage and Disposition of Weapons-Usable Fissile Materials PEIS	PEIS (DOE/EIS-0229)	Final issued December 1996	Idaho National Engineering Laboratory, Nevada Test Site, Oak Ridge Reservation, Pantex Plant, Savannah River Site, Los Alamos National Laboratory, Hanford Site, Rocky Flats Environmental Technology Site
Stockpile Stewardship and Management PEIS	EIS (DOE/EIS-0236)	Final issued November 1996	Kansas City Plant, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Nevada Test Site, Y-12 Plant at the Oak Ridge Reservation, Pantex Plant, Sandia National Laboratories-New Mexico, and the Savannah River Site
Sitewide EIS for Continued Operation of the Los Alamos National Laboratory	EIS (DOE/EIS-0238)	In preparation	Los Alamos National Laboratory
Nevada Test Site EIS	EIS (DOE/EIS-0239)	Final issued November 1996 ROD December 1996	Nevada Test Site
Rocky Flats Environmental Technology Sitewide EIS	EIS (DOE/EIS-0257)	Deferred	Rocky Flats Environmental Technology Site
Plutonium Interim Storage EIS for the Rocky Flats Environmental Technology Site	EIS (DOE/EIS-0276)	In preparation	Rocky Flats Environmental Technology Site
Solid Residue Treatment, Repackaging, and Storage EA[a]	EA	FONSI[b]	Rocky Flats Environmental Technology Site
Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site EIS	EIS (DOE/EIS-0277)	In preparation	Rocky Flats Environmental Technology Site

Table 1.8–1. Major Related NEPA Reviews—Continued

Title	Document	Status	Site(s)
Savannah River Site Waste Management EIS	EIS (DOE/EIS-0217)	Final issued July 1995 ROD September 1995	Savannah River Site
Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components EIS	EIS (DOE/EIS-0225)	Final issued December 1996	Pantex Plant, Nevada Test Site, Hanford Site, and Savannah River Site
Defense Waste Processing Facility Supplemental EIS	EIS (DOE/EIS-0082-S)	Final issued November 1994 ROD April 1995	Savannah River Site
Interim Management of Nuclear Materials at the Savannah River Site	EIS (DOE/EIS-0220)	Final issued October 1995 ROD December 1995	Savannah River Site
Tank Waste Remediation System EIS	EIS (DOE/EIS-0189)	Final issued August 1996	Hanford Site
Completion of the West Valley Demonstration Project and Closure or Long-Term Management of Facilities at the Western New York Nuclear Services Center EIS	EIS (DOE/EIS-0226-D)	Draft issued March 1996	West Valley Demonstration Project
Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel EIS	EIS (DOE/EIS-0218)	Final issued February 1996 ROD March 1996	Savannah River Site, Idaho National Engineering Laboratory, plus 10 seaports
Disposition of Surplus Highly Enriched Uranium EIS	EIS (DOE/EIS-0240)	Final issued June 1996 ROD July 1996	Y-12 Site at the Oak Ridge Reservation, Savannah River Site, Babcox and Wilcox--Lynchburg Virginia, Nuclear Fuel Services—Erwin, Tennessee
Hanford Plutonium Finishing Plant Complex EIS	EIS (DOE/EIS-0244)	Final issued May 1996 ROD issued July 1996	Hanford Site
Waste Isolation Pilot Plant Disposal Phase Supplemental EIS	SEIS-II (DOE/EIS-0026-S2)	Draft issued November 1996	Waste Isolation Pilot Plant
Long-Term Management of Depleted Uranium Hexafluoride PEIS	PEIS (DOE/EIS-0269)	In preparation	K-25 Site at the Oak Ridge Reservation, Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant
Medical Isotope Production EIS	EIS (DOE/EIS-0249)	Final issued April 1996 ROD issued September 1996	Sandia National Laboratories-New Mexico, Los Alamos National Laboratory, Oak Ridge National Laboratory, Idaho National Engineering Laboratory

Table 1.8-1. Major Related NEPA Reviews—Continued

Title	Document	Status	Site(s)
Management of Spent Nuclear Fuel Currently Stored in the K-Basins EIS	EIS (DOE/EIS-0245)	Final issued February 1996 ROD issued March 1996	Hanford Site
Safe Retrieval, Transfer, and Interim Storage of Hanford Tank Wastes EIS	EIS (DOE/EIS-0212)	Final issued October 1995 ROD December 1995	Hanford Site
Hanford Remedial Action EIS and Comprehensive Land Use Plan	EIS (DOE/EIS-0222)	Draft issued August 1996	Hanford Site
Savannah River Site F-Canyon Plutonium Solutions EIS	EIS (DOE/EIS-0219)	Final issued December 1994 ROD February 1995	Savannah River Site
Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories—California EIS	EIS (DOE/EIS- 0157)	Final issued August 1992 ROD issued January 1993	Lawrence Livermore National Laboratory, Sandia National Laboratories-California
Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain EIS	EIS (DOE/EIS-0250)	In preparation	Yucca Mountain, Nye County, Nevada
Evaluating Container Systems for the Management of Naval Spent Nuclear Fuel EIS	EIS[c] (DOE/EIS-0251)	Final issued November 1996	Idaho National Engineering Laboratory
Disposal of Decommissioned, Defueled Cruiser Ohio Class and Los Angeles Class Naval Reactor Plants EIS	EIS[c] (DOE/EIS-0259)	Final issued April 1996 ROD issued July 1996	Hanford
S1C Prototype Reactor Plant Disposal EIS	EIS (DOE/EIS-0275)	Final issued November 1996	KAPL-W

[a] EA = Environmental Assessment.
[b] FONSI, a Finding of No Significant Impact, was determined for this EA.
[c] The Department of the Navy was the lead agency for these NEPA reviews. DOE was a cooperating agency.

at three sites: the Hanford Site, INEL, and the Savannah River Site (SRS) pending disposal in a geologic repository. Under this decision, the fuel distribution would be as follows:

- Hanford production reactor fuel will remain at the Hanford Site.
- Aluminum clad fuel will be consolidated at the SRS.
- Nonaluminum-clad fuels (including spent nuclear fuel from the Fort St. Vrain Reactor and Naval spent nuclear fuel) will be consolidated at INEL.

In addition to regionalizing the management of spent nuclear fuel, DOE also decided to resume the shipments of Naval spent nuclear fuel to INEL immediately, upon the staying or dissolution of an injunction order by the United States District Court for the District of Idaho.

The cumulative impact analysis of the waste management alternatives in Chapter 11 of this PEIS includes the environmental impacts resulting from this decision on spent nuclear fuel management.

Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management EIS (Volume 2). In April 1995, DOE issued Volume 2 of the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE, 1995e), which in addition to evaluating programmatic spent nuclear fuel alternatives, evaluated sitewide alternatives for environmental restoration and waste management programs at INEL. Subsequently, DOE in its ROD (DOE, 1995f) decided to implement the Modified Ten-Year Plan, or the preferred alternative, for INEL as evaluated in the Final EIS. Commensurate with this decision, INEL would accept nonaluminum-clad spent nuclear fuel for management; continue the restoration of priority sites and the stabilization of sites based on health and environmental risks and budget; develop cost-effective waste treatment technologies; and implement projects and facilities to prepare waste and spent nuclear fuel for final disposition and allow more efficient examination of naval spent nuclear fuel.

Implementation of certain projects and facilities for preparing and managing waste at INEL would be subject to further reviews under NEPA and decisions to be reached as result of the WM PEIS. The cumulative impact analysis of the waste management alternatives in Chapter 11 of the WM PEIS includes the environmental impacts resulting from the decision to implement the Modified Ten-Year Plan at INEL.

Tritium Supply and Recycling PEIS. In 1991, DOE was actively considering the reconfiguration of its nuclear weapons complex and proposed to evaluate the environmental consequences of that reconfiguration in a PEIS. In 1994, as a result of reevaluating current and projected future requirements for the nuclear weapons complex in light of a number of recent world and national developments, DOE proposed to divide its previously planned Reconfiguration PEIS into two separate PEISs: a Tritium Supply and Recycling PEIS and a Stockpile Stewardship and Management PEIS (DOE, 1994c). The Tritium Supply and Recycling Final PEIS, issued in October 1995 (DOE, 1995g), evaluates alternatives associated with new tritium production and recycling of tritium recovered from weapons retired from service. The ROD, issued in December 1995, selected the Savannah River Site for tritium production should that technology be adopted, and also for the upgrade and consolidation of tritium recycling activities. The Tritium Supply and Recycling EIS will consider decisions regarding waste management resulting from the WM PEIS

Storage and Disposition of Weapons-Usable Fissile Materials PEIS. The *Storage and Disposition of Weapons-Usable Fissile Materials PEIS* (DOE 1996a) analyzes the environmental impacts of alternatives being considered for the long-term storage of weapons-usable plutonium and highly enriched uranium (HEU), and the disposition of weapons-usable plutonium that has been declared surplus to national security needs. Three alternatives, in addition to the No Action Alternative, are being considered for long-term storage: upgrade at multiple sites, consolidation of plutonium at one site, and collocation of plutonium and HEU at one site. Six sites are being considered for long-term storage: Hanford Site, INEL, NTS, ORR, Pantex, and SRS. All of the alternatives considered the removal of all weapons-usable fissile materials from the RFETS and removal of the surplus fissile materials from the LANL.

There are nine alternatives in three categories being analyzed for the disposition of surplus plutonium. The three disposition categories are "deep borehole," "immobilization," and "burn in reactors." For disposition, decisions will be made on the strategy and technologies for disposition of surplus weapons-usable plutonium. Until other environmental analyses are completed, no specific location will be selected for any disposition alternative action (DOE, 1996a).

Any waste type resulting from actions taken in the Storage and Disposition PEIS would be treated, stored, and disposed of in accordance with the decisions resulting from the WM PEIS. There is no expectation that the storage and disposition actions will result in a waste form that is not addressed in the WM PEIS.

In the event that the "burn in reactors" option is selected, any resultant spent fuel would be disposed of in accordance with the Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain EIS (see narrative).

Stockpile Stewardship and Management PEIS. Stockpile stewardship refers to activities associated with research, design, development, and testing of nuclear weapons and the assessment and certification of the safety and reliability. The stockpile stewardship portion of the PEIS evaluates the potential impacts of three proposed facilities: the National Ignition Facility, the Contained Firing Facility, and the Atlas Facility. The Stockpile Stewardship alternatives involving these facilities could affect four sites: LANL, LLNL, SNL, and Nevada Test Site (NTS) (DOE, 1996b).

Stockpile management refers to activities associated with the production, maintenance, surveillance, refurbishment, and dismantling of the nuclear weapons stockpile. The stockpile management portion of this PEIS evaluates the potential impacts of carrying out Stockpile Management Alternatives at eight sites: Oak Ridge Reservation (ORR), SRS, Kansas City Plant (KCP), Pantex Plant, LANL, LLNL, SNL, and NTS. The Management Alternatives are assessed for nuclear weapons assembly/disassembly and for fabricating pits, secondaries and cases, high explosives, and nonnuclear components. The Stockpile Stewardship and Management PEIS also evaluates the No Action Alternative of relying on existing facilities in their current configuration and continuing the missions at current sites to achieve both the stockpile stewardship and management missions.

DOE has identified the preferred alternatives in the final *Stockpile Stewardship and Management PEIS*. The preferred alternatives for the stockpile stewardship portion of the PEIS include the construction and operation of the National Ignition Facility and Contained Firing Facility at LLNL and the construction and operation of the Atlas Facility at LANL. The preferred alternative for the stockpile management portion includes secondary and case component fabrication at ORR, pit component fabrication at LANL, assembly and disassembly and high explosives fabrication at Pantex, and nonnuclear component fabrication at KCP. The *Stockpile Stewardship and Management PEIS* also includes the preferred alternative for strategic reserve storage; however, this may change based upon decisions to be made with regard to the final *Storage and Disposition of Weapons-Usable Fissile Materials PEIS*.

Evaluation of impacts on waste management is included in the assessment, and wastes generated as a result of the stockpile stewardship and management activities are compatible with treatment, storage, and disposal decisions resulting from the WM PEIS.

Sitewide EIS for Continued Operation of the Los Alamos National Laboratory. DOE is preparing a sitewide EIS for the Los Alamos National Laboratory (LANL) that will provide an analysis of existing and planned activities at that site within the next 5 to 10 years (DOE, 1994e). This EIS is currently in the scoping process, but the EIS is expected to explore environmental impacts caused by LANL facilities and operations, mitigation opportunities for impacts identified, strategies for waste management, and projects reasonably expected over the next 5 to 10 years. Completion of the draft LANL sitewide EIS is anticipated in spring 1996. Wastes expected to be generated from continuing activities at LANL are considered in the WM PEIS, and waste management activities will consider results of the WM PEIS.

Nevada Test Site Environmental Impact Statement. NTS has prepared a sitewide EIS to evaluate the potential impacts that could result from future mission activities (DOE, 1996c). Similar to the INEL Environmental Restoration and Waste Management EIS and the LANL Sitewide EIS, the NTS EIS evaluates both waste management and environmental restoration activities as well as other existing mission activities for the next 10 years. The final NTS EIS was released early in 1996. Waste generation from future activities at NTS was considered and included in the WM PEIS, and waste management activities at NTS will consider decisions arising from the WM PEIS.

Sitewide Environmental Impact Statement for the Rocky Flats Environmental Technology Site. DOE has issued a Notice of Intent (DOE, 1994g) to prepare a sitewide EIS for RFETS. The Notice described the intended scope of the sitewide EIS as providing a basis for selection of a sitewide strategic approach for nuclear materials storage, waste management, cleanup, and economic conversion, as well as project-level decisions for land use, management of nuclear materials, deactivation of RFETS facilities, decontamination and decommissioning of existing facilities, and possible onsite and offsite transportation of radioactive, hazardous, and mixed waste. The scope of the SWEIS has been modified so that issues associated with the safe interim storage of plutonium at RFETS will be analyzed in the Plutonium Interim Storage EIS, and completion of the sitewide EIS has been deferred pending completion of a new RFETS cleanup agreement and decisions based on completion of the WM PEIS.

Plutonium Interim Storage EIS for RFETS. DOE has issued a Notice of Intent (DOE, 1996m) to prepare an EIS for safe interim storage of approximately 10 metric tons of plutonium in inventory at RFETS. The plutonium consists of metals and oxides that were generated during weapons production and oxides generated from stabilization of plutonium-bearing residues. Even though DOE is engaged in a programmatic (Departmentwide) evaluation of alternatives for the long-term storage and disposition of plutonium, no decisions regarding long-term storage and disposition have been made and the Department needs to improve the interim storage arrangements for the plutonium. This EIS will analyze interim storage issues and will serve to ensure that decisions on safe and cost-effective interim storage can be made and implemented in the event that long-term storage and disposition decisions, or the implementation of these decisions, should be delayed for any reason. This EIS will take into consideration any decisions resulting from the completion of the WM PEIS or the *Storage and Disposition of Weapons-Usable Fissile Materials PEIS*.

Environmental Assessment—Solid Residue Treatment, Repackaging, and Storage. The proposed action is to stabilize, if necessary, and repackage approximately 106,600 kilograms of plutonium-contaminated residues (containing approximately 3,100 kilograms of plutonium) for safe interim storage, while awaiting decisions on the further disposition of the materials. Depending on the residue type, stabilization treatment can include oxidation, washing, cementation, calcination, thermal desorption, drying to eliminate liquids, and chemical treatment. Interim storage would be in containers and under conditions appropriate for a period of approximately 20 years, but actual length of storage would be until an appropriate offsite disposal location becomes available. The WM PEIS considers RFETS residues waste for purposes of its programmatic analysis. The subject EA provides greater precision on DOE's plans for managing residues.

Rocky Flats Plutonium Residues and Scrub Alloy EIS. DOE is preparing an EIS that will evaluate the potential environmental impacts associated with reasonable management alternatives for certain plutonium residues and all scrub alloy currently being stored at RFETS in Golden, Colorado (DOE, 1995r). The residues and scrub alloy are materials that were generated during the separation and purification of plutonium or during the manufacture of plutonium-bearing components for nuclear weapons. Preliminary Alternatives are no action, onsite treatment with or without plutonium separation, and offsite treatment with or without plutonium separation. Potential locations for offsite treatment include SRS, LANL, and LLNL.

While SRS appears to be a more likely offsite location for treating the RFETS plutonium residues and scrub alloy due to economies of scale, DOE cannot rule out the possibility that some of these materials might need to be treated at LANL or LLNL. Evaluation of these alternatives at this time will facilitate planning for disposal or other disposition and allow any additional treatment to be integrated with the ongoing stabilization process so that handling the material can be minimized (i.e., by avoiding potential double handling). Minimizing such handling would reduce the worker risk associated with achieving a material form suitable for disposal or other disposition. Any wastes resulting from actions analyzed in the *Rocky Flats Plutonium Residue and Scrub Alloy EIS* would be treated, stored, and disposed of in accordance with the decisions resulting from the WM PEIS.

Savannah River Site Waste Management EIS. The final SRS waste management EIS was issued in July 1995 (DOE, 1995c). It provides a baseline for the analysis of future SRS waste management needs. In the EIS, DOE assessed how to manage over the next 30 years liquid high-level radioactive, low-level radioactive, mixed, hazardous, and transuranic wastes generated during 40 years of past operations and ongoing activities at the Savannah River Site. The wastes are currently stored at SRS. DOE seeks to dispose of the wastes in a cost-effective manner that protects human health and the environment. In the EIS, DOE assessed the cumulative environmental impacts of storing, treating, and disposing of the wastes and examined the impacts on water quality, air quality, ecological systems, land use, geologic resources, cultural resources, socioeconomics, and the health and safety of onsite workers and the public. In the ROD, issued in September 1995, DOE announced its intention to implement the moderate treatment configuration alternative using a phased approach to making decisions on treatment, storage, and disposal facilities identified in the final EIS. The ROD identified decisions regarding continuation of existing activities, current operation of existing facilities, new waste recycling initiatives, operation of the Consolidated Incineration Facility, volume reduction activities for low-level waste, and the operation of a mobile soil sort facility.

Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components EIS. The final EIS issued in December 1996 (DOE, 1996h) evaluates all current and proposed facilities and activities at the Pantex Plant, including weapons dismantlement and storage of the resulting nuclear materials and classified weapons components during the near-term (in a 5- to 10-year period). The sitewide EIS addresses alternative interim storage sites for plutonium pits that result from the Pantex Plant dismantlement activities. Waste generated from activities at the Pantex Plant are considered in the WM PEIS.

Defense Waste Processing Facility Supplemental EIS. DOE issued the final supplemental EIS on completing construction and operation of the Defense Waste Processing Facility (DWPF) in November 1994 (DOE, 1994a). The supplemental EIS assessed the environmental impacts of completing construction and operating the DWPF as modified from the original design addressed in a 1982 EIS. The DWPF includes the HLW pretreatment process, the vitrification facility, saltstone manufacturing and disposal (LLW resulting from the pretreatment of HLW), radioactive glass waste storage facilities, and associated support facilities. The ROD (March 28, 1995) describes the DOE choice to complete construction and start-up testing and begin operation of the DWPF. The ROD also describes additional safety modifications to the DWPF that will substantially reduce or eliminate potential accidental releases of radioactive material and chemicals in the unlikely event of a severe earthquake. When the WM PEIS is completed, DOE will review this supplemental EIS to determine whether a further supplemental or a revised ROD is needed to conform to the HLW canister storage decisions arising from the WM PEIS.

Interim Management of Nuclear Materials at the Savannah River Site (IMNM) EIS. The final EIS was issued in October 1995 (DOE, 1994f, 1995d). In this EIS, DOE assessed the environmental impacts of actions necessary to manage nuclear materials at Savannah River Site until it can make and implement decisions on their ultimate disposition. The actions evaluated in the EIS would stabilize SRS materials that represent environmental, safety, and health vulnerabilities in their current storage conditions or that might represent a vulnerability within the next 10 years. These vulnerabilities are the result of the suspension of nuclear materials production and processing operations that accompanied the end of the Cold War. Although DOE has initiated programmatic and project-specific environmental evaluations on the ultimate disposition of nuclear materials in the DOE complex that are now surplus to national defense requirements, the implementation of decisions on ultimate disposition will take several years, and the decisions themselves are the subject of several ongoing programmatic EISs. In the interim, DOE wants to eliminate vulnerabilities associated with certain current nuclear material nuclear configurations to protect the environment and the health and safety of workers and the public. The first ROD (December 12, 1995) describes the types of materials and methods of processing them in F- and H-Canyon facilities. The second ROD (February 8, 1996) describes fuel elements to be stabilized in F- and H-Canyon facilities and vitrified in the DWPF. The RODs will be reviewed based on decisions resulting from the WM PEIS to determine whether revisions should be made to conform with WM PEIS results.

Tank Waste Remediation System EIS. The Final Tank Waste Remediation System (TWRS) EIS, issued in August 1996 (DOE, 1996q), satisfies the DOE commitment made in the 1988 Hanford Defense Waste

EIS Record of Decision to prepare a supplemental NEPA analysis (DOE, 1994d). The TWRS EIS was prepared in response to several important changes since the 1988 Record of Decision, including a revised strategy to manage and dispose of tank waste and encapsulated cesium and strontium. The approach for achieving environmental compliance at the Hanford Site, including specific milestones for the retrieval, treatment, and disposal of tank waste, is contained in a legally enforceable agreement among DOE, the Washington State Department of Ecology, and EPA, known as the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement).

The TWRS EIS evaluated, as a part of the proposed action: the continued operation and management of the tank farms, including the use of existing and planned facilities such as the Cross-Site Transfer System; waste transfer system upgrades; and the retrieval and treatment of the tank waste, which would include vitrification of HLW and immobilization of the low-activity waste (LAW). The HLW would be stored onsite pending disposal at a geologic repository and the LAW would be disposed of onsite. A range of alternatives was evaluated for the encapsulated cesium and strontium. An ROD is anticipated in October 1996. When the WM PEIS is completed, DOE will review this EIS to determine whether actions stemming from waste generation and disposal conform with decisions arising from the WM PEIS.

Completion of the West Valley Demonstration Project and Closure or Long-Term Management of Facilities at Western New York Nuclear Service Center EIS. DOE and the New York State Energy Research Development Authority have prepared a draft EIS (DOE, 1996d) that evaluates alternatives for completing West Valley Demonstration Project (WVDP) activities and managing nuclear waste at the Western New York Nuclear Service Center near West Valley, New York. Radioactive wastes would be produced from vitrifying HLW and from decontaminating and decommissioning tanks, facilities, and hardware associated with the WVDP, and long-term management or closure of the balance of the site. The alternatives being evaluated range from shipping all stored, buried, and newly-generated wastes to other DOE and commercial facilities, to discontinuing operations. The alternatives would be implemented in the 2000 to 2030 time frame. The EIS will take into consideration decisions resulting from the completion of the WM PEIS.

Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel EIS. DOE issued the final Foreign Research Reactor EIS (DOE, 1996e) to adopt a policy to manage SNF from foreign research reactors in a manner consistent with United States nuclear weapons nonproliferation policy. The EIS evaluates the proposed policy which, in part, encourages research reactors

to convert from the use of highly enriched uranium (HEU) to low enriched uranium (LEU). The EIS involves the selection of a United States policy on how to manage the spent fuel elements containing United States-origin enriched uranium from 41 nations during a period of up to 13 years. Depending on fuel type, the preferred alternative would be to manage this spent nuclear fuel at the Savannah River Site and the Idaho National Engineering Laboratory. The preferred alternative includes acceptance and management of spent nuclear fuel from the foreign research reactor in the United States. This would include wet or dry storage, processing or chemical separation, if necessary, or a combination of both to stabilize it for either storage or disposal. A review of proposed waste disposal activities in this EIS will be made after considering WM PEIS decisions.

Disposition of Surplus Highly Enriched Uranium EIS. DOE issued the Final Disposition of Surplus Highly Enriched Uranium EIS in June 1996 (DOE, 1996j). This EIS addresses the disposition of a nominal 200 metric tons of surplus HEU (175 metric tons has been declared surplus to defense needs to date) to make the material nonweapons-usable and to recover its economic value where possible. The EIS analyzes a range of alternatives, all of which (other than the "No Action" Alternative) involve blending the HEU down to low-enriched uranium (through isotopic dilution) to make it nonweapons-usable. The EIS analyzes blending the HEU down to an enrichment level suitable for commercial use in nuclear reactors (nominally 4%), or blending it down to an enrichment level suitable for disposal as LLW (nominally 0.9 percent). Four action alternatives are identified that involve blending different portions of the material for commercial use or for disposal as waste, using various combinations of two DOE and two commercial candidate blending sites. All of the commercial use alternatives include the proposal to transfer 50 metric tons of HEU to the United States Enrichment Corporation for blending to LEU and subsequent use in commercial reactor fuel. The ROD based upon the final EIS calls for a blending, over time, of as much of the material as possible (up to 85%) for commercial use, and blending the remainder for disposal as waste. The potential waste loads from the surplus HEU disposition decision are bounded by the inventory projections provided in the WM PEIS.

Hanford Plutonium Finishing Plant Stabilization EIS. DOE issued the *Final Plutonium Finishing Plant Stabilization Draft Environmental Impact Statement* in May 1996 (DOE, 1996i). This EIS evaluates the potential environmental impacts associated with alternative approaches for: (1) stabilization of residual, plutonium-bearing materials at the Plutonium Finishing Plant to a form suitable for long-term storage; (2) removal of readily retrievable, plutonium-bearing material left behind in process equipment, process areas, and air quality and liquid waste management systems as a result of historic uses; and (3) interim

storage of stabilized fissile material in existing vaults at the Plutonium Finishing Plant pending the WM PEIS decision on ultimate storage and disposition of the material. The ROD, issued in July 1996, will be reviewed based on decisions made from the WM PEIS.

Waste Isolation Pilot Plant Disposal Phase Supplemental EIS (SEIS-II). WIPP is the planned repository for retrievably stored defense TRUW. In October 1980, DOE issued a final EIS on proposed development of WIPP (DOE, 1980). The January 1981 ROD called for phased development of WIPP, beginning with construction of the WIPP facility. In 1990, DOE issued a supplemental EIS that considered previously unavailable information (DOE, 1990). Based on this supplemental EIS, DOE decided to continue phased development of WIPP by implementing test phase activities. On October 30, 1992, the Waste Isolation Pilot Plant Land Withdrawal Act (WIPP LWA) transferred the WIPP site from the U.S. Department of Interior to DOE. The 1997 Defense Authorization Act, which was signed on September 23, 1996, contains amendments to the WIPP LWA. The amendments make RCRA LDRs inapplicable to WIPP, thus eliminating the need to obtain a No Migration Determination before beginning disposal operations.

DOE has prepared a second supplemental EIS (SEIS-II; DOE, 1996n), which updates the information contained in the previous EIS and Supplemental EIS for WIPP, incorporates the PEIS analysis of various treatment alternatives for TRUW, and examines changes in environmental impacts due to new information or changed circumstances.

The WM PEIS is intended to provide environmental information to assist DOE in determining at which sites it should modify existing TRUW storage and treatment facilities or construct new facilities. DOE intends to select sites for TRUW treatment and storage facilities using the WM PEIS analysis but will not select the level of treatment needed. The WIPP SEIS-II will be used to support decisions on whether to dispose of TRUW at WIPP, the treatment level of TRUW, mode of transportation, and other activities associated with TRUW disposal.

Although the Draft SEIS-II incorporates by reference, and where appropriate, updates and adjusts information from the Draft WM PEIS, the potential actions analyzed in SEIS-II are not connected to the potential actions analyzed in the Draft WM PEIS. The WM PEIS evaluates alternative configurations for managing five types of waste, including TRUW, that are at DOE sites or are otherwise under DOE's control or responsibility. The alternative configurations range from managing the wastes where they are presently located to transporting them to one centralized site for management. The WM PEIS evaluates

trends in various impacts under alternative configurations become more or less centralized. The WM PEIS postulates three generic types of treatment for TRUW in order to analyze the impacts of treating and storing TRUW under the various configurations. These generic treatments allow DOE, in the WM PEIS, to compare the relative impacts of centralized, regionalized, and decentralized treatment and storage. To reduce the potential impacts of storing untreated wastes, DOE must decide, pursuant to the WM PEIS, where to treat and store TRUW regardless of whether the Department decides to dispose of this waste at WIPP.

It is important to note that the analysis in the second WIPP SEIS-II will differ from the WM PEIS analysis in several significant aspects. These differences should not be misconstrued as being inconsistent with the WM PEIS, rather the product of different purpose and scope. Again, the impacts of TRUW disposal at the WIPP are not analyzed in the WM PEIS. This information is presented in the WIPP SEIS-II. In addition, the long-term environmental impacts of indefinite storage are also not included in the WM PEIS analysis.

Also, for purposes of bounding the WM PEIS analysis, certain assumptions were made that are inconsistent with current WIPP planning bases and assumptions. For example, although WIPP does not currently have statutory authority to accept nondefense-generated waste, the WM PEIS assumes that all TRUW would be disposed of at WIPP. The WIPP SEIS-II will examine disposal of all TRUW, but only as alternatives to the proposed action that involves disposal of only defense TRUW.

Long-Term Management of Depleted Uranium Hexafluoride EIS. This PEIS will evaluate alternative strategies for long-term management of DOE-owned DUF_6 currently stored at the K-25 site in Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio. The Notice of Intent was published on January 25, 1996 (DOE, 1996s), and the Draft PEIS is scheduled to be available for public review in February 1997. The alternatives are No Action (continued storage until 2020 followed by conversion to uranyl uranate [U_3O_8] and disposition through 2040), long-term storage (beyond 2020) as uranium hexafluoride (UF_6), conversion to an oxide followed by continued storage, conversion to uranium dioxide (UO_2) or metal followed by use, and conversion to an oxide followed by disposal as LLW. The PEIS will consider any decisions resulting from the completion of the WM PEIS.

Medical Isotopes Production EIS. DOE issued the final *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE/EIS-0249F) in April 1996. The EIS identified alternatives and evaluated the potential for significant impacts to the public and the

environment of producing molybdenum-99 (Mo-99) domestically. Mo-99 is a precursor of the isotope technetium-99m, which is used approximately 36,000 times each day in the United States for a variety of medical diagnostic purposes. The United States is currently dependent upon a single, aging reactor in Canada for its supply. DOE identified alternative Mo-99 production facilities in four locations: SNL-NM, LANL, ORNL, and INEL. The analysis for each alternative included the identification and description of the waste generated by the Mo-99 process. A combination of facilities at SNL-NM and LANL is identified as the preferred alternative (DOE, 1996f). The ROD, issued in September 1996, will be reviewed based on decisions made in the WM PEIS.

Management of SNF From the K-Basins at the Hanford Site EIS. The final EIS, issued in February 1996 (DOE, 1996g), evaluated whether and how to take action to reduce risks associated with SNF and sludge currently stored in the water-filled K-East and K-West storage basins at the Hanford site. Decisions regarding management of K-Basins SNF were made and implemented in a manner consistent with the Record of Decision for the Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs EIS. Management Alternatives will be reviewed upon completion of the WM PEIS.

Safe Retrieval, Transfer, and Interim Storage of Hanford Tank Wastes. DOE issued the EIS for final safe interim storage of Hanford tank waste (DOE, 1995j) in October 1995. This EIS dealt with urgent tank waste safety concerns that required action before implementing decisions based on the EIS for tank waste remediation system. Alternatives evaluated in the EIS included the construction of new HLW storage tanks and a replacement cross-site transfer line. In the ROD issued in November 1995 (60 FR 61687), DOE decided that existing mitigation measures and tank farm waste inventory management strategies had alleviated the need for additional HLW storage capacity. Therefore, DOE decided not to construct additional double-shell tanks. DOE also decided that the safe interim storage of tank waste did require the construction of a replacement cross-site transfer line between the 200 West Area and 200 East Area of the Hanford site. The transfer line would allow for operational flexibility and permit DOE to continue to stabilize single-shell tank waste in the 200 West Area. These waste management activities will be reviewed pending completion of the WM PEIS.

Hanford Remedial Action EIS and Comprehensive Land Use Plan. The draft Hanford remedial action EIS was published in August 1996 (DOE, 1996p). It establishes future land-use objectives to assist DOE in developing a cost-effective, technically sound remediation strategy for the Columbia River, Central

Plateau, and all other geographic areas of the Hanford Site. The EIS analyzes the impacts of remediating past-practice waste sites that are DOE's responsibility under CERCLA. RCRA past-practice sites that are covered under the provisions of the Hazardous and Solid Waste Amendments of 1984 were also analyzed. In addition, impacts from decontamination and decommissioning of selected surplus facilities were analyzed along with remediation of some miscellaneous RCRA units on or near the primary past-practice remediation sites. The EIS analyzes the impacts of remediation for each future land-use alternative, as well as the cumulative impacts for waste management facilities, such as the Environmental Restoration Disposal Facility.

Savannah River Site F-Canyon Plutonium Solutions EIS. The final F-Canyon Plutonium Solutions EIS was issued in December 1994 (DOE, 1994h). After issuing the Notice of Intent to prepare the EIS on interim management of nuclear materials at SRS, DOE determined that there is a potentially significant safety concern associated with about 85,000 gals of solutions containing plutonium-239. Accordingly, DOE initiated a separate EIS on an urgent schedule for the proposed stabilization of these solutions. The EIS evaluated potential environmental impacts over the next 10 years of alternatives for the stabilization of plutonium solutions stored in F-Canyon. The solutions remain from chemical separations operations that DOE suspended in 1992. The ROD (February 1, 1995) describes the DOE choice to implement the preferred alternative, processing the F-Canyon plutonium solutions to metal, as discussed in the final EIS. Waste management activities described in the EIS will be reviewed based on WM PEIS decisions.

Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories-California. DOE issued a final EIS in August 1992 that evaluates all activities at the Laboratories, including the minimization, treatment, and storage of radioactive and hazardous wastes. The EIS supports decisions on the operation of Laboratory facilities, including specific waste treatment and storage in the near-term (10 years and less), and provides a baseline for analyzing environmental impacts of future waste management activities at the sites (DOE, 1992a). Wastes expected to be generated from LLNL and SNL are included in the WM PEIS analysis. Decisions regarding waste management will be made pending the completion of the WM PEIS.

Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain EIS. The Notice of Intent, published August 1995 (DOE, 1995l), describes Yucca Mountain as the candidate site for disposing of spent nuclear fuel and defense HLW. The Nuclear Waste Policy Act was intended to solve the national problem created by the accumulation of spent nuclear fuel and

defense HLW. The Nuclear Waste Policy Act made DOE responsible for managing the disposal of this spent nuclear fuel and HLW, specified the siting process, and authorized the construction of one geologic repository. Under the Nuclear Waste Policy Amendments Act of 1987, the process for selecting this repository was streamlined, and the Yucca Mountain Site in Nevada was selected for detailed study as the candidate site for the nation's first geologic repository. A draft EIS is scheduled for July 1999.

Because the environmental evaluation process for geologic disposal was established by the Nuclear Waste Policy Act, the WM PEIS does not analyze environmental impacts of disposal at Yucca Mountain or alternative locations for a geologic repository. However, the WM PEIS does analyze the environmental impacts of the longer term storage of treated HLW in the event that the construction and operation of a national geologic repository is delayed.

Evaluating Container System for the Management of Naval Spent Nuclear Fuel EIS. *The Department of the Navy Final Environmental Impact Statement for a Container System for the Management of Naval Spent Nuclear Fuel*, issued in November 1996 (Navy, 1996a), evaluates the environmental impacts of alternative container systems for the management of naval SNF following examination at INEL. A container system is needed to place naval SNF in dry storage at INEL and to transport it to a centralized interim storage facility if authorized by Congress or to a geologic repository when one becomes available. The Final EIS specifically addresses the need, alternatives, and environmental impacts of manufacturing containers; loading containers; handling and storage of naval SNF at INEL; transportation of naval SNF loaded containers to a notional repository or centralized interim storage site; and the storage, handling, and transportation of special case waste associated with naval SNF management. The Final EIS demonstrates that the environmental and health impacts are small and comparable among alternatives. The Navy identified a preferred alternative in the Final EIS but will not select an alternative until the Record of Decision is issued. Decisions regarding waste management will be made pending the completion of the WM PEIS.

Disposal of Decommissioned, Defueled Cruiser, OHIO Class, and LOS ANGELES Class Naval Reactor Plants EIS. *The Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, OHIO Class, and LOS ANGELES Class Naval Reactor Plants*, issued in April 1996 (Navy, 1996b), analyzes the alternate ways for disposing of decommissioned, defueled reactor compartments from those classes of U.S. Navy vessels. A disposal method for the defueled reactor compartments is needed when the cost of continued operation is not justified by the ships' military capability or when the ships are no longer needed. The preferred alternative is land burial of the entire reactor

compartment at the DOE Low Level Waste Burial Grounds at Hanford, Washington. The Record of Decision was published in the *Federal Register* (61 FR 41596) on August 9, 1996, and selects the preferred alternative. The ROD, issued in July 1996, will be reviewed pending completion of the WM PEIS.

S1C Prototype Reactor Plant Disposal EIS. The S1C Prototype reactor plant was permanently shut down in March, 1993, reflecting the end of the Cold War and projected downsizing of the U.S. Naval fleet. All SNF was removed from the S1C Prototype reactor and has been shipped off site. The DOE gave notice of the availability of the Draft EIS in the July 1, 1996, *Federal Register* (61 FR 33908). The Final EIS evaluates in detail three alternatives for the disposal of the S1C Prototype reactor plant (DOE, 1996o). These alternatives include prompt dismantlement and disposal of the entire S1C Prototype reactor plant, deferred dismantlement, and "no action," or continued surveillance and monitoring for an indefinite period of time. The EIS demonstrates that the environmental and health impacts are small and comparable among alternatives. The Navy will select an alternative in the Record of Decision. This EIS will be reviewed based on decisions made in the WM PEIS.

1.8.2 Related DOE Actions and Programs

Environmental Management Accelerating Cleanup: Focus on 2006. The DOE Environmental Management Program is continually working to accelerate cleanup schedules, increase efficiency, and foster cooperative relationships with its regulators and other stakeholders. However, there is concern whether support can be sustained for a program that may stretch beyond 70 years with an estimated cost of more than $200 billion (DOE, 1996l). DOE wants to accelerate reduction of this "cleanup mortgage" of the Cold War to reduce long-term economic and environmental liabilities. DOE is working on a 2006 Plan (previously known as the Ten-Year Plan) to meet this challenge. The vision of this plan is that within the next decade most DOE facilities will be able to treat and dispose of their backlog of nuclear materials and wastes safely and clean up the land and buildings onsite. These steps would dramatically reduce long-term costs and open a large portion of the lands and other resources controlled by DOE for other purposes.

However, some aspects of the Environmental Management Program will demand additional time and resources. For example, DOE will not be able to complete the treatment and disposal of certain wastes such as high-level radioactive waste stored in tanks at Hanford or transuranic waste stored throughout the complex. Also, there will be ongoing groundwater cleanup projects, decontamination of buildings, and

surveillance and maintenance activities. At a small number of sites, DOE will continue treatment of a few remaining waste streams.

The 2006 Plan will be used to inform the budget decisions, sequencing of projects, and actions taken to meet program objectives. EM will implement this vision in collaboration with regulators and the public. Development of the 2006 Plan will be guided by the following seven principles:

- Eliminate urgent risks
- Reduce mortgage and support costs to free up funds for further risk reduction
- Protect worker health and safety
- Reduce the generation of waste
- Create a collaborative relationship between DOE and its regulators and stakeholders
- Focus technology development on cost and risk reduction
- Integrate waste treatment and disposal within the complex.

DOE's sites have already prepared initial draft site plans, and DOE is now developing a national discussion draft based upon these principles. The discussion draft will be distributed for public comment to elicit feedback on the strategic approaches for accomplishing compliance and completion goals, and on DOE's management strategies to accomplish these goals. This approach will ensure that DOE has a broad perspective when developing a draft National 2006 Plan later this year. The 2006 Plan will be a living document, evolving to reflect revised assumptions, stakeholder viewpoints, and newly obtained information.

The Final WM PEIS evaluates many potential waste management activities that may become components of the 2006 Plan. To conduct the WM PEIS analysis, DOE assumed that all waste management facilities necessary to implement a given alternative would be constructed in an initial 10-year period, followed by a 10-year operations period. As a result, 20 years of waste generation was analyzed in the WM PEIS. On the other hand, the 2006 Plan will set a goal that waste will be substantially treated and disposed within a 10-year period. Therefore, the WM PEIS considers more waste (existing inventory plus 10 years' new generation) in a period of time similar to the time covered by the 2006 Plan.

Baseline Environmental Management Report. In the Fiscal Year 1994 National Defense Authorization Act, Congress required DOE to submit a report that specified all the activities and projects within the Environmental Management Program. *The 1996 Baseline Environmental Management Report* (BEMR) (DOE, 1996l) includes waste management, transition of operational facilities to safe shutdown status,

technology research and development, pollution prevention, and environmental restoration. The report includes an estimate of the total cost of the Environmental Management Program, describes each project or activity at each site, describes the environmental problems, specifies the proposed remedy, and provides a schedule and estimated completion date for each project.

The BEMR was based on a broad range of assumptions regarding the outcomes of various decision-making processes that will determine the ultimate disposition of DOE facilities and sites and thus the scope and pace of the program. One of the key assumptions was related to the location of sites for treatment, storage, and disposal facilities. Current plans and agreements were used to define where waste would be treated and disposed. The WM PEIS examines additional configurations, such as pollution prevention, to that which was used to develop the baseline cost estimate.

Of particular importance to the cost of Environmental Management Programs are the complexwide savings from expanded pollution prevention efforts over the period covered in the BEMR. Results and projections from specific projects demonstrate that the savings from pollution prevention activities could reach tens of billions of dollars, surpassing the initial cost of implementation of these activities. DOE will continue to pursue pollution prevention activities as they relate to the WM PEIS because they result in an efficient use of limited resources by reducing site operating costs, and they maintain consistency with DOE's commitment to respecting the environment.

Environmental Restoration Program. A legacy of the Nuclear Weapons Program is environmental contamination at the sites where research, development, test, and production of nuclear weapons took place. The volumes of contaminated media at some locations are quite large. The Environmental Restoration Program was established to address this problem. "Environmental restoration" refers to activities undertaken pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA) and can include removal and treatment of hazardous substances, containment of a source of contamination, or placement of land use restrictions on a contaminated site. It encompasses a wide range of activities such as stabilizing contaminated soil, treating groundwater, decommissioning process buildings, including nuclear reactors and chemical separations plants, and exhuming buried drums of waste. The extent to which a site is "cleaned up" will depend largely on assumptions regarding future land use. For most sites, the process of determining future site use has just begun.

The CERCLA process is generally implemented at specific sites through agreements among the DOE, EPA, and frequently the host state. The process can be described as follows:

First, a site or portion of a site is "characterized" to identify contaminants, determine the extent of contamination, and assess potential threats to public health and the environment. If significant contamination is indicated, and limited action will result in mitigation of risk, an expedited response action or interim action may be conducted as a means to quickly address the problem. Upon completion of characterization, a detailed analysis is performed to quantify risk and evaluate remedial alternatives. The analysis is followed by a formal decision process including public hearings and formal comment period.

If the results of the analysis indicate that a potential release site is not a threat to health and the environment or that an interim action adequately remediated the contamination, a recommendation of no further action is made to the regulators. If, however, a threat is deemed to be present, the appropriate remediation is identified, and a recommendation is submitted for formal approval. In either case, DOE makes a recommendation on what action is to be taken. The decision on what action will be taken is made by the regulator, not DOE.

During each stage of environmental restoration from characterization of contaminated media to final remediation, waste may be generated. The projected volumes of waste that might be generated by environmental restoration were analyzed by each DOE site during development of the BEMR. These analyses included consideration of treatment, storage, and disposal capabilities, specific restoration requirements, and negotiations with state and Federal regulatory agencies in order to estimate how much of the contaminated media would need to be managed as waste. Estimates and descriptions of total quantities of the contaminated media to be managed, and the wastes that will be generated during environmental restoration are contained in Appendix B. Although most wastes that are generated as a result of DOE's environmental restoration activities would be managed outside of the alternatives evaluated in the WM PEIS, some of the wastes generated by environmental restoration may be transferred to the Waste Management Program. However, given the incomplete information about the final volumes and composition of the transferred wastes, it was not possible to analyze the potential impacts of managing these wastes in the WM PEIS (see Section 1.7.1). The evaluation of waste management facilities in Chapters 6, 7, and 8 does contain information on the anticipated volumes of environmental restoration transferred waste and qualitative analyses of the extent to which these wastes may affect alternatives in the WM PEIS. Appendix B contains a more detailed discussion of ER waste volumes and the potential effects of these wastes on

WM PEIS waste management facilities and alternatives. Decisions based on the WM PEIS are not expected to impact environmental restoration activities at individual sites.

Pollution Prevention Program Plan. The Pollution Prevention Program Plan serves as the principal crosscutting guidance to DOE Headquarters, Operations Office, laboratory, and contractor management to fully implement pollution prevention programs within the DOE complex between now and 2000.

To demonstrate DOE's commitment to pollution prevention, the Secretary of Energy established goals, to be achieved by December 31, 1999, that will reduce DOE's routine generation of radioactive, mixed, and hazardous wastes, and total releases and transfers of toxic chemicals by at least 50%. The Secretary also has established sanitary waste reduction, recycling, and affirmative procurement goals. Site progress in meeting these goals will be reported annually to the Secretary in the *Annual Report on Waste Generation and Waste Minimization Progress*, using 1993 as the baseline year.

Pollution prevention is defined as the use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and wastes into land, water, and air. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water, and other resources along with practices that protect natural resources through conservation or more efficient use.

The Department is faced with the challenge of removing and treating wastes already generated from past production and manufacturing operations. Facility and equipment stabilization, deactivation and decommissioning, and weapons dismantlement activities will also result in significant amounts of wastes that must be handled. Many pollution prevention techniques may not directly apply to wastes that were generated and media that were contaminated by previous practices (nonroutine wastes). However, two techniques, waste segregation and recycling, will be key to reducing the amount of such wastes that would otherwise require additional treatment and disposal.

Additional waste and pollutants will be generated in the process of conducting restoration and dismantlement activities. Pollution prevention is applicable to the generation of secondary wastes and will be incorporated into remedial investigations, feasibility studies, design, and execution of all restoration and dismantlement projects. Restoration projects will be performed in a manner that reduces or prevents the generation of new waste and pollutants and reduces the further release or spread of contamination.

Today, a major barrier impeding the DOE pollution prevention program is the inadequacy of generator involvement in site planning and the shortage of generator project funds to implement pollution prevention opportunities. The DOE pollution prevention program relies on the establishment and maintenance of strong site programs with commitment and support from Headquarters. The success of the overall program hinges on the ability of the sites to reduce pollutant generation and increase recycling rates. Many sites have already achieved positive results from implementing pollution prevention programs. Details on specific pollution prevention programs at the various sites addressed in this PEIS can be obtained from local DOE officials.

In order to provide a conservative analysis of the impacts of DOE's future waste management program, the projected volumes of future waste loads contained in Chapters 6–10 did not assume significant minimization of current waste generation. Appendix G discusses how DOE's pollution prevention program practices may affect waste loads, and consequently the need for facilities. Appendix G contains estimates of reductions in waste loads and associated impacts.

Site Treatment Plans for Mixed Waste Required by the Federal Facility Compliance Act. The FFCAct, which amended RCRA, required DOE to prepare Site Treatment Plans for the development of capacity and technologies for treating mixed waste to RCRA land disposal restriction standards, and to submit them to the State or EPA for approval. A plan is required for each facility at which DOE stores or generates mixed waste.

The FFCAct also subjects Federal facilities to fines and penalties for violations of RCRA. However, DOE was not subject to fines and penalties for violations of the land disposal restrictions for mixed waste until October 6, 1995, and is not subject to fines and penalties after that if it is in compliance with approved plans and compliance orders issued by the appropriate regulator.

DOE followed a three-phased approach for developing the Site Treatment Plans. In October 1993, DOE sites submitted Conceptual Plans to their regulators, which identified a broad range of options for treating DOE's mixed waste. Draft plans, submitted in August 1994, presented the individual sites' proposed treatment option for its mixed waste. Proposed Plans were submitted in April 1995 to the appropriate regulatory agency for approval, approval with modification, or disapproval, as required by the FFCAct.

DOE worked closely with the regulatory agencies and the public throughout the process. The National Governors' Association coordinated representatives from 20 states and EPA to assist DOE in evaluating candidate treatment options and developing mixed waste treatment plans. The conceptual, draft, and proposed plans were also made available to the public, with additional opportunities provided for information and input on the plans at the site and national levels.

Negotiations were completed for 28 plans on October 6, 1995; four additional plans have been finalized since then. Negotiations are ongoing for another three sites; plans for these sites are expected to be finalized in 1997. These plans, taken together, establish a complexwide treatment configuration, including schedules for bringing new treatment facilities into operation. Sixteen of the 17 major sites analyzed in the WM PEIS are required to prepare STPs. Each of these sites has submitted an STP and all but three (ANL-E, BNL, and LLNL) have been approved by the appropriate agencies. Compliance orders or agreements have been made or issued for the approved sites.

The approved plans contain the treatment configuration that resulted from discussions among States, EPA, tribal governments, and the public, and from DOE's evaluation of its treatment needs. However, the evaluation will continue as the plans are implemented to streamline and improve the configuration. For example, individual sites continue to pursue commercial and privatized treatment options for some waste streams. The Compliance Orders that govern implementation of the Plans all provide for modification and changes as new technical and cost information becomes available. Any changes to the configuration or to schedules will be made through formal modification processes.

The Final WM PEIS preferred alternative for LLMW treatment is consistent with the configuration established through the FFCAct process.

DOE Disposal Workgroup Process for Evaluating Potential Mixed Low-Level Waste Disposal Sites. Although the FFCAct does not specifically address disposal of treated mixed wastes, both DOE and the States have recognized that disposal issues are an integral part of treatment discussions. A process was established by the DOE Disposal Workgroup in conjunction with state representatives in the National Governor's Association to evaluate and discuss the issues related to the potential disposal of the residuals from the treatment of DOE LLMW at the sites subject to the FFCAct.

The focus of this process has been to identify sites that are suitable for further evaluation of their potential as disposal sites from the sites that currently store or are expected to generate mixed waste. The evaluation is intended to increase understanding of the strengths and weaknesses of a site's potential for disposal but is not a site selection process. Ultimately the identification of sites that may receive mixed waste for disposal will follow state and Federal regulations for siting and permitting, and will include appropriate public involvement.

Of the DOE sites considered under the process, sites determined to have marginal or no potential for disposal were removed or deferred from further evaluation using the following criteria:

- Grouping of sites in close, geographic proximity
- Screening sites using criteria derived from Federal and state requirements regarding the siting of waste treatment, storage, and disposal facilities
- The application of risk-based criteria related to technical, potential receptor and practical considerations to determine site suitability
- Deprioritization of further evaluation of selected sites with the agreement of states

The remaining sites were evaluated more extensively using site performance evaluations. These 15 sites reflect the same set analyzed for LLMW disposal under the EM PEIS with the exception that the WM PEIS analysis includes Brookhaven. The performance evaluation was used to review site characteristics related to disposal potential and estimate the radionuclide concentration limits of waste that may be disposed at a given site.

Future activities being undertaken by DOE that are either ongoing or are to be completed to facilitate an informed decision about the disposal of DOE LLMW include:

- Develop estimates of waste volumes and radionuclide concentrations in treated residuals
- Compare estimates of radionuclide concentration in treated residuals to performance evaluation-derived radionuclide concentration guides
- Develop sample configurations for disposal of treated residuals
- Develop a draft disposal system configuration

Information obtained through the Disposal Workgroups Process will be considered with information contained in the WM PEIS during the development of an ROD. Following the issuance of the ROD for the WM PEIS, DOE may (1) initiate site-specific NEPA evaluations for new proposed disposal facilities; (2) initiate performance assessment analyses for compliance with DOE Order 5820.2A; and (3) initiate

processes for permitting disposal facilities. Coordination with the states and stakeholders will continue to ensure stakeholder input and to resolve concerns at the earliest possible stage.

National Dialogue. DOE recognizes the need to develop an effective decision-making process to integrate not only waste storage, treatment, and disposal decisions, but also other radioactive materials disposition and cleanup decisions as well. In 1995, DOE began an ongoing "national dialogue" on radioactive waste and materials disposition through discussions with interested states, site-specific advisory boards, and other forums. The National dialogue is intended to promote openness, increase trust and confidence in DOE decision making, and complement traditional public outreach efforts conducted under the NEPA process. This effort will allow DOE and stakeholders, especially affected States, to explore decision-making processes that may benefit DOE and host communities. The dialogue will focus on major decisions DOE needs to make over the next few years, principles to be considered in the decision process, and stakeholder involvement. DOE will strive to reach traditional and nontraditional stakeholders in an open and inclusive manner to effectively integrate all potential decision-making processes.

Future Use Project. DOE initiated the Future Use Project in 1994 to begin to evaluate future use options at its sites. The primary purpose of the Future Use Project is to develop stakeholder future use recommendations that can serve as input to efforts and decisions concerning environmental management, site comprehensive planning and stewardship responsibilities, and reuse of excess land and facilities. In light of these goals, the Future Use Project encourages sites to address a number of factors as part of their future use planning processes. In order to develop recommendations that reflect both internal and external preferences, sites should undertake planning processes that include tribal and local governments, regulators, internal program representatives, advisory boards, and advocacy groups, among others. Sites must work with interested individuals and groups to consider data that might influence the development of appropriate recommendations. Relevant information includes existing regulatory agreements, site characteristics, natural resources, cultural and historic resources, contamination profiles, technological feasibility, and cost implications.

Four new areas of focus, in particular, compelled the Department to reconsider and define future uses for its sites with significant involvement by affected governments and the public. As the first new focus, the Department adopted environmental management as a primary mission in response to growing recognition of environmental contamination and the legacy of wastes. Second, the Department has emphasized a new commitment to disclosing information to the public so that the public can make more informed decisions

about DOE sites. The Department is also actively involving governmental partners, organizations, and citizens in its decisions. Third, in 1994, the Department issued a secretarial policy on land use that formally recognized its responsibility to act as a steward of national resources. Finally, as defense activities declined and the Environmental Management program matured, the Department recognized the need to define reuse strategies for many of its facilities and buffer areas that are now or will be excess to Departmental mission needs. The overall findings and site recommendations are summarized in *Charting the Course* (DOE, 1996k).

Draft Risk Report. The Draft Risk Report to Congress, entitled *Risks and The Risk Debate: Searching For Common Ground, "The First Step,"* was requested by Congress under the Fiscal Year 1994 House and Senate Conference Committee Report on Energy and Water Development Appropriations. In June 1995, DOE submitted the draft risk report to Congress. The report provides the first link between budget, compliance agreements, and risk. DOE field program managers evaluated the risks associated with all types of environmental management work in a qualitative fashion. The results of that evaluation allowed DOE to capture the spectrum of risks and to link risk to compliance and budget information.

The draft report sets the foundation for a consistent approach in evaluating risks posed by conditions at DOE sites and facilities and in establishing priorities for human health, worker safety, and the environment. In addition to responding to Congress, this report provides public access to risk data, develops recommendations to fill gaps in the available risk information, advances the national debate on the use of risk in decision making, and provides data for establishing priorities among competing requirements.

The Risk Report evaluates the full range of DOE environmental management programs and the activities associated with those programs including waste characterization, treatment, storage, disposal, and minimization; program management; and technology development. Actual or planned activities are evaluated. The Risk Report provides a qualitative summary of the risks and potential risk reduction associated with an activity within six risk categories: public safety and health, worker safety and health, environmental protection, compliance, cost-effective risk management, and site mission completion. However, the focus of the WM PEIS hypothetical programmatic receptor census can be used to support the qualitative risk evaluation provided by the Risk Report.

Nuclear Materials and Facility Stabilization. DOE is responsible for certain nuclear materials that are surplus to the current mission and which may have residual quantities of enriched uranium, plutonium, and

other transuranics that may preclude direct disposal of the material at WIPP. These materials are commonly referred to as "residues."

Residues are a byproduct of nuclear weapons material production. Large quantities were generated as a result of the chemical and thermal processes applied to separate and purify plutonium at RFETS, Richland, LANL, LLNL, and SRS. Examples of residue forms include impure oxides and metals, halide salts, combustibles, ash, sludges, and contaminated glass. These materials may also contain RCRA-regulated waste. When nuclear weapons were being produced and the stockpile was growing, the vast majority of these residues were recycled back into the weapons production process. These materials were designed, handled, and packaged for short-term storage. When the weapons production lines were halted in the late 1980s, many materials were left in conditions unsuitable for long-term storage.

Recently, DOE and the Defense Nuclear Facilities Safety Board (DNFSB) initiated activities to investigate the conditions of nuclear materials within the Department. Numerous plutonium packaging and facility vulnerabilities were identified and documented in the DOE *Plutonium Working Group Report* (DOE/EH-0415), *Plutonium Vulnerability Management Plan* (DOE/EM-0199), and DNFSB Recommendation 94-1.

The Department has responded by developing a complexwide implementation plan to address the plutonium vulnerabilities and ensure safe storage of nuclear material until it can be ultimately dispositioned. As part of that plan, some residues throughout the complex will need to undergo some type of treatment process. These processes could include separation of nuclear material, which, if considered weapons-usable, would then become part of the decision-making process associated with the *Storage and Disposition of Weapons-Usable Fissile Material PEIS*. During these processes, secondary TRUW may be generated. Other residues may be designated waste and will need to be treated (along with any secondary wastes) to meet WIPP waste acceptance criteria.

An EIS is currently being developed to address the environmental impacts of alternatives associated with residue processing. Waste volumes for the different alternatives have not been determined but are bounded in both the WM PEIS and the WIPP Supplemental EIS.

Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-2. The DNFSB was established and authorized by Congress to oversee DOE. On September 8, 1994, the DNFSB issued

Recommendation 94-2, "Conformance with Safety Standards at Department of Energy Low-Level Nuclear Waste and Disposal Sites." Recommendation 94-2 concluded that DOE's LLW program has not kept pace with the evolution of commercial practices, that no radiological performance assessments for LLW disposal facilities required by the DOE Order on Radioactive Waste Management had been approved, and that the Department's radiological performance assessments do not account for other source terms that potentially add to the dose projected for LLW disposal facilities. The Board recommended that DOE conduct a complexwide review to establish the dimensions of the LLW problem, take steps to complete the radiological performance assessments, and include in these assessments all interacting source terms. The Board also recommended that DOE issue new standards, requirements and guidance for LLW management and perform a number of studies to improve the management of LLW. To respond to the Board's recommendations, DOE set up tasks in six areas.

- **Systems Engineering for the LLW Program**, which will document LLW system requirements and functions and identify the need for any additional requirements and functions necessary to integrate the program across the complex and accomplish the mission. A study will also be conducted under this task to evaluate the safety merits and demerits of privatizing LLW disposal as one scenario for process improvement.
- **Complexwide Review**, which involved an evaluation of LLW management activities at the 38 DOE facilities that actively manage LLW and LLMW to identify vulnerabilities associated with DOE's management of LLW. Onsite assessments were conducted at the eight DOE sites which manage 80% of the LLW currently being managed. The remaining sites were evaluated through a review of available site information and interviews with DOE headquarters and DOE field and contractor LLW management personnel.
- **DOE Regulatory Structure and Process**, which will provide the policies and requirements needed to improve the management of DOE LLW. Essential requirements for the management of LLW will be identified, developed, and technically justified for functions and activities that are necessary to meet the mission of the LLW Program, and to satisfy the top-level requirements for safety and health of the workers, the public, and protection of the environment. Commercial and international standards will be evaluated and considered for potential adoption by DOE.
- **Radiological Assessments**, which will address the completion and approval of Performance Assessments for LLW disposal facilities and the groundwork for addressing interacting source terms.
- **Low Level Waste Projections**, which will provide a report on current and planned LLW disposal capacity, develop a routine program for projecting waste volumes, and develop a waste minimization strategy.

- **Research and Development**, which will provide the framework to support necessary technology development for LLW.

1.9 DOE Public Reading Rooms

The public reading rooms listed on the following pages are available for referencing documentation related to the WM PEIS. Information regarding the status of this EIS as well as some related EISs can be found at these sites. When a decision regarding the WM PEIS is made, it will be made available to the public at these sites. Information not available at these sites can be accessed through the Office of NEPA Policy and Assistance at 202-586-4600 or the Department of Energy NEPA Information Line at 800-472-2756.

California

DOE Reading Room
1301 Clay Street
Oakland, CA 94612

The State (DTSC) Library
Lincoln Plaza Building
4th and P Street
Sacramento, CA 92410

The State (DTSC) Library
State of California
P.O. Box 806
Sacramento, CA 95812-0806

Lawrence Livermore Eastgate Visitors Center
Greenville Road
Livermore, CA 94550

Simi Valley Public Library
Tapo Canyon Road
Ventura, CA 93001

Davis Public Library
14th Street
Davis, CA 95617

Berkeley Public Library
Kittredge and Shattuck
Berkeley, CA 94794

MINSY Public Affairs
Office Code 1160–Building 47
Vallejo, CA 94592-5100

Concord Branch Library
2900 Salvio Street
Concord, CA 94519

SNL/CA Public Reading Room
7011 East Avenue
Building 901
Livermore, CA 94550

Colorado

Government Reference Center
Mesa County Public Library
530 Grand Avenue
Grand Junction, CO 81503

Technical Resource Center
Grand Junction Project Office
2597 B 3/4 Road
Grand Junction, CO 81503

Rocky Flats Environmental Technology
Site Reading Room
Front Range Community College Library
3645 West 112th Avenue
Westminster, CO 80030

Rocky Flats Citizens Advisory Board
Attn: Ken Korkia
9035 Wadsworth Parkway
Suite 2250
Westminster, CO 80021

U.S. EPA Region VIII
Attn: Michelle Bontrager
999 18th Street, Suite 500
Denver, CO 80202-2405

Colorado Department of Health
Attn: Dan Scheppers
4300 Cherry Creek Drive,
South Denver, CO 80222-2405

Standley Lake Library
Attn: Kathy Hollaran
8485 Kipling Street
Arvada, CO 80005

Connecticut

Windsor Public Library
Attn: Mary Ellen Johnson
323 Broad Street
Windsor, CT 06095

Florida

Jacksonville Public Library
Documents Department
122 North Ocean Street
Jacksonville, FL 32202

Largo Public Library
351 East Bay Drive
Largo, FL 34640

Martin Marietta Specialty Components
Community Relations Center
7381 114th Avenue, North
Suite 403A
Largo, FL 34643

Pinellas Park Public Library
7770 52nd Street, North
Pinellas, FL 34665

Georgia

Atlanta Public Library
Government Documents Section
Attn: Gene Hughs
1 Margaret Mitchell Square
Atlanta, GA 30303

Chatham County Public Library
2002 Bull Street
Savannah, GA 31401

Reese Library
Attn: Elfriede McLean
Document Center
Augusta College
2500 Walton Way
Augusta, GA 30904-2200

Hawaii

Pearl Harbor Naval Base Library
Code 90L
1614 Makalapa Drive
Pearl Harbor, HI 96860-5350

Aiea Public Library
99-143 Monanalua Road
Aiea, HI 96701

Hawaii State Library
478 South King Street
Honolulu, HI 96813

Pearl City Public Library
1138 Waimano Home Road
Pearl City, HI 96782

Idaho

Boise Basin District Library
Attn: Elizabeth Prusha-Parlor
411 Montgomery Street
P.O. Box 219
Idaho City, ID 83631

Boise Public Library
Attn: Julie Davis
Government Documents
715 South Capitol Boulevard
Boise, ID 83702

INEL Oversight Program Library
Department of Health and Welfare
Attn: Nancy Quirk
1410 North Hilton, 3rd Floor
Boise, ID 83706

State Library
Attn: Stephanie Kirkay
325 West State Street
Boise, ID 83702

Library and Archives
State Historical Society
Attn: Wm. E. Tydeman
450 North Fourth Street
Boise, ID 83209

INEL Boise Outreach Office
Attn: Cheryl Burgess
816 W. Bannock, Suite 306
Boise, ID 83702

City of Burley Public Library
Attn: Mona Kenner
1300 Miller Avenue
Burley, ID 83318

Clearwater Memorial Library
Attn: Jill Lynch
402 Michigan Avenue
P.O. Box 471
Orofina, ID 83544

INEL Technical Library
1776 Science Center Drive
P.O. Box 1625
Idaho, ID 83415-2300

Idaho Falls Public Library
Attn: Ginny Atwood
457 Broadway
Idaho Falls, ID 83402

State University Library
Documents Department
Attn: Larry Murdock
P.O. Box 8089
Pocatello, ID 83209

Pocatello Public Library
Attn: Gaila Clough
113 South Garfield
Pocatello, ID 83204

Shoshone-Bannock Library
Attn: Ardith Peyope
Bannock and Pima Streets–HRDC Building
Fort Hall, ID 83203

Twin Falls Public Library
Attn: Linda Parkinson
434 Second Street, East
Twin Falls, ID 83301

Consolidated Free Library
Hayden Branch
Attn: Lee Starr
8385 North Government Way
Hayden Lake, ID 83835

City of Emmett Public Library
Attn: Marsha Werle
275 South Hayes
Emmett, ID 83617

Illinois

Lemont Public Library
Attn: Jackie
810 Porter Street
Lemont, IL 60439

U.S. DOE Public Document Room
Document Department
University Library
3rd Floor Center
University of Illinois at Chicago
801 South Morgan Street
Chicago, IL 60607

Bedford Park Public Library
Attn: Head Librarian
7816 West 65th Place
Bedford Park, IL 60510

Bridgeview Public Library
Attn: Head Librarian
7840 West 79th Street
Bridgeview, IL 60455

Iowa

Ames Laboratory
111 T.A.S.F.
Attn: Steve Karsjen
Ames, IA 50011

Ames Public Library
515 Douglas Avenue
Ames, IA 55001

Kentucky

Environmental Information Center
175 Freedom Boulevard
Kevil, KY 40253

Maine

Rice Public Library
8 Westworth Avenue
Kittery, ME 03904

Missouri

Red Bridge Branch
Mid-Continent Library
11140 Locust Street
Kansas City, MO 64108

U.S. Department of Energy
Attn: Martha Carey
7295 Highway 94 South
St. Charles, MO 63304

Columbia Public Library
Attn: Marilyn McCleod
100 West Broadway
Columbia, MO 65203

Nevada

Carson City Public Library
Attn: Wendell Huffman
900 North Roop Street
Carson City, NV 89701

Nevada State Library
Attn: Patricia Deadder
Capitol Complex
Carson City, NV 89710

Nevada Test Site Reading Room
Coordination and Information Center
Attn: Cinde Ashley
3084 South Highland Drive
Las Vegas, NV 89109

New Hampshire

Portsmouth Public Library
8 Islington Street
Portsmouth, NH 03601

New Jersey

Maywood DOE Public Information Center
43 West Pleasant Avenue
Maywood, NJ 07607

Middlesex County Library
Plainsboro Branch
P.O. Box 278
Plainsboro, NJ 08536

New Mexico

National Atomic Museum
Kirkland Air Force Base
20358 Wyoming Boulevard, South
Albuquerque, NM 87116

Albuquerque Technical Vocational Institute
Main Campus Library
525 Buena Vista Drive, Southeast
Albuquerque, NM 87106

Museum Park Complex
15th and Central
Suite 101
Los Alamos, NM 87544

New York

Longwood Public Library
800 Niddle County Road
Middle Island, NY 11953

Records Center
26 Federal Plaza
29th Floor, Room 2900
New York, NY 10278

EPA Records Center
290 Broadway
New York NY 10007-1866

Mastics-Moriches-Shirley Community Library
425 William Floyd Parkway
Shirley, NY 11967

Brookhaven National Laboratory
Research Library–Building 477A
Upton, NY 11973

Colonie Library
629 Albany-Shaker Road
Loudenville, NY 12211

Saratoga Springs Library
Attn: Claudia Hayes
320 Broadway
Saratoga Springs, NY 12866

Schenectady Public Library
Attn: Tim McGowan
Main Branch
99 Clinton Street
Schenectady, NY 12305-2093

Jennifer Nelson, Public Affairs
MS-Trailer A
10282 Rock Springs Road
West Valley, NY 14171

Buffalo & Erie County Public Library
Science and Technology Department
Lafayette Square
Buffalo, NY 14203

Town of Concord Library
23 North Buffalo Street
Springville, NY 14141

Olean Public Library
Attn: Lance Chaffee
134 North 2nd Street
Olean, NY 14760

North Carolina

Brunswick County Government Center
Attn: Andrea Merklinger
45 Court House Drive, Northeast
Bolivia, NC 28422

New Hanover County Public Library
Attn: Daniel Horn
201 Chestnut Street
Wilmington, NC 28401

Ohio

Columbus Metropolitan Library
Main Branch
96 South Grant Avenue
Columbus, OH 43215

Northside Branch Library
1423 North High Street
Columbus, OH 43201

State Library of Ohio
Attn: Clyde Hordusky
65 South Front Street
Columbus, OH 43215

West Jefferson Public Library
Attn: Sharon Shrum
270 Lily Chapel Road
West Jefferson, OH 43162

Kent State University
Ashtabula Campus Library
3431 West 13th Street
Ashtabula, OH 44004

Public Environmental Information Center
10845 Hamilton Cleves Highway
Harrison, OH 45030

Miamisburg Senior Adult Center
Public Reading Room
305 Central Avenue
Miamisburg, OH 45343

DOE Environmental Information Center
505 West Emmitt Avenue, Suite 3
Waverly, OH 45690

Oregon

Portland State University
Branford Price Millar Library
Attn: Michael Bowman
SW Harrison and Park
Portland, OR 97202

Pennsylvania

Carnegie Library
Attn: James Bobick
Science and Technology Department
4400 Forbes Avenue
Pittsburgh, PA 15213

South Carolina

Charleston County Library
Attn: Nancy Woodward
404 King Street
Charleston, SC 29403

Gregg-Graniteville Library
University of South Carolina-Aiken
Attn: Allison Johnson
171 University Parkway
Aiken, SC 29801

DOE/SRS Public Reading Room
Savannah River Operations Office
Attn: Becky Craft
P.O. Box A
Aiken, SC 29802

South Carolina State Library
Attn: Mary Bostick
1500 Senate Street
Columbia, SC 29201

Tennessee

DOE Environmental Information Resource Center (IRC)
105 Broadway
Oak Ridge, TN 37830

DOE Public Reading Room
Oak Ridge Operations Office
Attn: Amy Rothrock
Room 112B
55 Jefferson Circle
Oak Ridge, TN 37831

Oak Ridge Public Library
Civic Center
1401 Oak Ridge Turnpike
Oak Ridge, TN 37830

Clinton Public Library
Attn: Jane Giles
118 South Hicks Street
Clinton, TN 37716

Lawson McGhee Public Library
Attn: Nelda Hill
500 West Church Avenue
Knoxville, TN 37902

Oliver Springs Public Library
Attn: Jennifer Newcome
607 Easterbrook Avenue
Oliver Springs, TN 37840

Memphis/Shelby County Public Library and Information Center
Attn: Government Publications
1850 Peabody Avenue
Memphis, TN 38104

Rockwood Public Library
Attn: Margaret Marrs
117 North Front Avenue
Rockwood, TN 37854

Texas

Amarillo College Library
Attn: Karen McIntosh
Lynn Library
DOE Reading Room
2201 South Washington
Amarillo, TX 79109

Carson County Library
Public Reading Room
Attn: Teri Keotting
P.O. Box 339
401 Main Street
Panhandle, TX 79060

Mae S. Bruce Public Library
Attn: Rose Holloway
P.O. Box 950
13302 6th Street
Santa Fe, TX 77510

Friendswood Public Library
Attn: Mary Perroni
416 South Friendswood
Friendswood, TX 77546

LaMarque Public Library
Attn: Greg Burns
1011 Bayou Road
La Marque, TX 77568

Genevieve Miller Public Library
Attn: Kathleen Brooks
8005 Barry Street
Hitchcock, TX 77563

Moore Memorial Public Library
Attn: Joanne Turner
1701 9th Avenue North
Texas City, TX 77590

Rosenberg Library
Attn: Jackie Kinsey
2310 Sealley Avenue
Galveston, TX 77550-2296

Helen Hall Public Library
Attn: Shelly Leader
400 West Walker
League City, TX 77537

Houston Public Library
Attn: Carol Johnson
500 McKinney
Houston, TX 77002

Virginia

Portsmouth Public Library
601 Court Street
Portsmouth, VA 23704

Washington

Gonzaga University, Foley Center
Attn: Joyce Cox
East 502 Boone
Spokane, WA 99258

Westinghouse Hanford Company
Environmental Data Management Center
Attn: Debbie Isom
2440 Stevens Center Place
Room 1101
Richland, WA 99352

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Chapter 1
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CHAPTER 2
Purpose and Need for Action

In accordance with the Council on Environmental Quality (NEPA) regulations, this chapter identifies the Department of Energy's (DOE) proposed action and the purpose and need for DOE action with respect to each of the five waste types analyzed in this Programmatic Environmental Impact Statement (PEIS).

2.1 Proposed Action

DOE is proposing to improve the management (treatment, storage, or disposal) of five types of waste. The Department will comply with all applicable Federal and State laws, to protect public health and safety as well as the environment. In the context of this WM PEIS, management includes:

- Pollution prevention
- Identifying/contracting with private vendors to manage waste
- Modifying existing waste management facilities or constructing new facilities at particular sites
- Operating modified or new waste management facilities at those sites
- Transporting wastes between waste management sites, as necessary
- Handling, surveillance, and maintenance

The WM PEIS will help DOE identify the optimal national configuration for the following waste management activities:

- Treatment and disposal of LLMW
- Treatment and disposal of LLW
- Treatment and storage of TRUW
- Storage of treated (vitrified) HLW canisters until a geologic repository is available
- Treatment of nonwastewater HW

This focus on a national configuration in the first attempt made by DOE to conduct an integrated examination of impacts across the Department's waste management complex and the specific cumulative impacts from all the waste facilities at a given site.

2.2 Purpose and Need for DOE Action

DOE needs to manage its current and anticipated volumes of LLMW, LLW, TRUW, HLW, and HW in order to comply with all applicable Federal and State laws and to protect public health and safety, and to enhance protection of the environment.

DOE is required by the Atomic Energy Act (42 USC 2011 *et seq.*) to manage the radioactive wastes that it generates. LLMW, LLW, TRUW, and HLW have radioactive components. In addition, DOE needs to make waste management decisions concerning HW and hazardous components in mixed wastes (waste that is both hazardous and radioactive) in order to comply fully with the Resource Conservation and Recovery Act (RCRA) (42 USC 6901 *et seq.*). RCRA sets forth requirements for managing HW including mixed waste. HLW, LLMW, and some TRUW are all mixed wastes and thus are subject to RCRA. RCRA requires the U.S. Environmental Protection Agency (EPA) to issue land disposal restrictions (40 CFR 268), which prohibit storage of hazardous and mixed wastes, except to facilitate proper recovery, treatment, and disposal.

The Federal Facility Compliance Act (FFCAct) (42 USC 6961 *et seq.*) amended RCRA to allow EPA and individual States to impose fines and penalties on Federal facilities for RCRA violations. The FFCAct requires DOE to prepare site treatment plans (STPs) for developing treatment capacity for its mixed wastes (waste containing both radioactive and hazardous components subject to RCRA requirements). Sixteen of the 17 major sites analyzed in the WM PEIS are required to prepare STPs. Each of these sites has submitted an STP, and all but three (ANL-E, BNL, and LLNL) have been approved by the appropriate agency. Compliance orders or agreements have been issued or made for the approved STPs. The FFCAct subjects DOE to fines after October 6, 1995, for violations of RCRA's LDRs for waste storage, unless the site is otherwise in compliance with an approved STP and compliance order issued by the appropriate waste regulator. The WM PEIS provides the NEPA basis for the FFCAct LLMW treatment configuration, while the FFCAct STPs detail the LLMW treatment program.

DOE manages each waste type separately and therefore will make waste management decisions by waste type.

2.2.1 Low-Level Mixed Waste

This PEIS examines the potential environmental impacts of treatment and disposal of LLMW. Although existing commercial and DOE capacity is insufficient to treat DOE's LLMW it is possible that some portion of the inventory could be treated at commercial facilities and that overall capacity could increase to meet demand. To comply with the land disposal restrictions and the FFCAct, DOE has developed site-specific plans for developing treatment capacities for the LLMW stored, generated, and disposed of at its sites. Although the FFCAct does not require DOE to develop plans for LLMW disposal, DOE also needs to determine where to dispose of treated LLMW.

2.2.2 Low-Level Waste

This PEIS examines the potential environmental impacts of treatment and disposal of LLW. Currently, LLW is packaged to meet waste acceptance criteria where it is generated and is disposed of at six DOE sites. This arrangement for disposing of LLW at a limited number of sites has evolved based on past research and weapons production operations, without considering either the total quantities of LLW generated or the sites at which it is generated. Accordingly, DOE needs to re-examine its management of LLW and determine where to dispose of LLW in the future. As part of this decision, DOE also needs to consider where LLW should be treated before disposal.

2.2.3 Transuranic Waste

This PEIS examines the potential environmental impacts of treatment and storage of TRUW. Since 1970, DOE has stored all of its TRUW, including TRUW containing hazardous components that are subject to RCRA. DOE is proposing to dispose of its retrievably stored defense TRUW in a geologic repository known as the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, if acceptable disposal performance can be demonstrated and regulatory requirements are met. Several studies are under way to characterize and understand more fully the potential long-term behavior of the disposal of TRUW at WIPP. Based on the results of these studies and independent of this PEIS, DOE will determine whether to dispose of TRUW at WIPP. To reduce the potential for delays in future TRUW disposal at WIPP, DOE needs to identify those sites where TRUW would be treated and stored.

2.2.4 HIGH-LEVEL WASTE

This PEIS examines the potential environmental storage impacts of treated (vitrified) HLW canisters. DOE is proceeding with plans at four sites to treat HLW by processing it into a glass form that would not be readily dispersible into the air or leachable into ground or surface water. Under the Nuclear Waste Policy Act (42 USC 10101–10270), treated HLW is to be disposed of in a geologic repository. Because of delays in opening this repository (now scheduled to open in 2010, with acceptance of DOE-managed HLW beginning in 2015), the quantity of treated HLW requiring storage will be more than originally anticipated, and the post-treatment storage time will also be greater. Thus, DOE needs to decide whether storage facilities for treated HLW should be constructed at the four HLW sites or whether larger storage facilities should be built at fewer sites. Treated HLW would be stored at these facilities until a geologic repository becomes available for permanent disposal.

2.2.5 HAZARDOUS WASTE

This PEIS examines the potential environmental impacts of treatment of nonwastewater HW. Currently, DOE uses a combination of its own and commercial treatment, storage, and disposal facilities for HW, as determined by each site that generates this material. DOE treats about 99% of its HW (primarily wastewater) onsite, and ships about 1% (primarily organic substances such as solvents and cleaning agents) to commercial HW facilities. DOE needs to decide the extent to which it should rely on commercial facilities for the treatment of nonwastewater HW.

CHAPTER 3
Alternatives

This chapter describes the four categories of waste management alternatives analyzed in the Waste Management Programmatic Environmental Impact Statement (WM PEIS). It also describes the methodology used to develop the alternatives and the alternatives considered but not analyzed in detail. A comparison of the impacts of the alternatives can be found in the waste-type Chapters 6 through 10.

3.1 Introduction

This chapter describes the waste management alternatives considered in the WM PEIS. These alternatives reflect different national configurations of particular sites evaluated in this document for the management of low-level mixed waste (LLMW), low-level waste (LLW), transuranic waste (TRUW), high-level waste (HLW), and hazardous waste (HW). The alternatives considered for each waste type fall within four broad categories: the No Action Alternative and the Decentralized, Regionalized, and Centralized Alternatives. Under each of the four broad categories for each of the five waste types, there are one or more alternatives that vary by the number and location of U.S. Department of Energy (DOE) sites at which waste management facilities could be located.[1] As shown in Table 3.1-1, 36 alternatives from the four categories are evaluated for the five waste types. The waste management alternatives eventually selected by DOE may vary among the five waste types. The configurations considered for each waste type, including the name of each site included in a particular configuration, are presented in Section 3.4.

3.2 Regulatory Background

The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) (42 USC 4231 *et seq.*) require Federal agencies to include a discussion of all reasonable alternatives to the proposed action in an environmental impact statement (EIS) (40 CFR 1502.14). An agency must provide sufficient information for each alternative so that reviewers may evaluate the comparative merits of those alternatives.

[1] The alternatives within the four broad categories of alternatives are sometimes referred to as "cases" in the accompanying appendices and technical reports.

Table 3.1–1. Number of Alternatives Analyzed by Waste Type

Category	LLMW	LLW	TRUW	HLW*	HW	TOTAL
No Action	1	1	1	1	1	5
Decentralized	1	1	1	1	1	5
Regionalized	4	7	3	2	2	18
Centralized	1	5	1	1	0	8
TOTAL	7	14	6	5	4	36

* HLW alternatives are analyzed both in terms of final disposal beginning in 2015 and final disposal beginning at some later date. However, the decision of when disposal will begin is not part of the WM PEIS. A separate National Environmental Policy Act (NEPA) document will be prepared in accordance with the HLW candidate program.

In addition, an EIS must include a discussion of the "No Action Alternative." Such a "status quo" alternative would not necessarily comply with applicable laws and regulations, but it provides an environmental baseline against which the impacts of other alternatives can be compared.

For alternatives that were eliminated from detailed study, the agency must briefly discuss the reasons for their elimination. Further, the agency must identify its preferred alternative or alternatives, if one exists, in the draft EIS, and must identify the preferred alternative in the final EIS unless another law prohibits the expression of such a preference.

3.3 Four Categories of Alternatives

In this PEIS, an alternative is the configuration of sites for treating, storing, or disposing of a specific waste type. The categories of alternatives analyzed in this PEIS for each waste type are No Action, Decentralized, Regionalized, and Centralized. These categories are described below:

No Action Alternative. Selection of this alternative would involve using only currently existing or planned waste management facilities at DOE sites or commercial vendors.

Decentralized Alternatives. Selection of these alternatives would result in managing waste where it is or where it will be generated, treated, or disposed of in the future. Unlike the No Action Alternative, the

Decentralized Alternatives may require the siting, construction, and operation of new facilities or the modification of existing facilities. Under the Decentralized Alternatives, the waste management facilities would be located at a larger number of sites than under the Regionalized or Centralized Alternatives.

Regionalized Alternatives. Selection of these alternatives would result in transporting wastes to various numbers of sites (fewer than the number of sites considered for the Decentralized Alternatives but greater than the number of sites considered for the Centralized Alternatives). In general, those sites that now have the largest volumes of a given waste type were considered as regional sites for treatment, storage, or disposal.

Centralized Alternatives. Selection of these alternatives would result in transporting wastes to one or two sites for treatment, storage, or disposal. As with the Regionalized Alternatives, those sites that have the largest volumes of a given waste type were considered as sites for Centralized treatment, storage, or disposal.

3.4 Alternatives Under Each Category

An alternative is the configuration of sites for treating, storing, or disposing of a specific waste type. For example, under "LLMW Regionalized Alternative 2," DOE would transport LLMW to seven sites for treatment and treated LLMW to six sites for disposal. Each alternative specifies the sites involved. The alternatives considered under each category for each waste type are described fully in the subsequent waste-type Chapters 6 through 10. The following tables (3.4–1 through 3.4–5) identify, by alternative for each site, the proposed waste management actions at that site.

The alternatives were developed and defined to incorporate all possible actions of DOE concerning waste management. They were based on waste type origin and character, current and projected volumes and locations within the DOE complex, existing facilities and capabilities, and specialized treatment and disposal requirements. The analysis of the alternatives presented in this PEIS encompass the human health risks; environmental, transportation, and socioeconomic impacts; and costs associated with the range of waste treatment, storage, and disposal activities available to DOE.

Table 3.4–1. Proposed Waste Management Actions at Each Site Under the Low-Level Mixed Waste Alternatives[a]

Alternative	Number of Sites		ANL–E	BNL	FEMP	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	Pantex	PORTS	RFETS	SNL–NM	SRS	WVDP
	CH Nonalpha Treat	Dispose																
No Action	3	0	S	S	S	S	TS	S	S	S	TS	S	S	S	S	S	TS	S
Decentralized	37	16	TD	TD	TD	TD	TD∝[b]	TD∝	TD∝	TD∝	TD	TD	TD	TD	TD∝	TD	TD∝	TD
Regionalized 1	11	12			TD	TD	TD∝	TD∝	TD∝	D∝	TD	TD	TD	TD	TD∝		TD∝	
Regionalized 2	7	6				TD	TD∝	TD∝		D∝	TD			T	T∝		TD∝	
Regionalized 3	7	1				T	T∝	T		D∝	T			T	T∝		T∝	
Regionalized 4	4	6				TD	TD∝	D∝		D∝	TD						TD∝	
Centralized	1	1				TD∝												

Notes: T = treatment to meet land disposal restrictions; D = disposal; S = indefinite storage. All sites have wastewater treatment capability as needed. Treatment, storage and disposal could also take place at a privatized or commercial facility on a site- or project-specific basis. Blanks indicate that treatment, storage, or disposal of LLMW does not occur at a site under the specified alternative.

[a] The actions shown are for contact-handled (CH) wastes. Contact-handled waste is subdivided into two types of LLMW, alpha and nonalpha. These two types of LLMW are generally treated in separate facilities. Remote-handled (RH) wastes would be treated and disposed onsite at the Hanford Site, INEL, ORR, and SRS in all alternatives except No Action. RH waste would be stored under No Action.

[b] Facilities with the ∝ symbol treat or dispose of both contact-handled alpha and nonalpha waste.

Table 3.4–2. Proposed Waste Management Actions at Each Site Under the Low-Level Waste Alternatives

Alternative	Number of Sites		ANL-E	BNL	FEMP	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	Pantex	PORTS	RFETS	SNL-NM	SRS	WVDP
	Treat	Dispose																
No Action	10[a]	6				TD	TD	D	T	D	TD	T			T		TD	
Decentralized		16	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Regionalized 1		12			D	D	D	D	D	D	D	D	D	D	D		D	
Regionalized 2	11	12			TD	TD	TD	TD	TD	D	TD	TD	TD	TD	TD		TD	
Regionalized 3		6				D	D	D		D	D						D	
Regionalized 4	7	6				TD	TD	TD		D	TD			T	T		TD	
Regionalized 5	4	6				TD	TD	D		D	TD						TD	
Regionalized 6		2				D											D	
Regionalized 7		2								D							D	
Centralized 1		1				D												
Centralized 2		1								D								
Centralized 3	7	1				TD	T	T			T			T	T		T	
Centralized 4	7	1				T	T	T		D	T			T	T		T	
Centralized 5	1	1				TD												

Notes: T = treat. "Treat" in the context of LLW means volume reduction using thermal organic destruction, size reduction, and compaction followed by solidification. All sites would do "minimum treatment" in all alternatives, which consists of solidification of liquids and "fines" (powdered material), packaging, and shipment. Treatment, storage, and disposal could also take place at a privatized or commercial facility on a site- or project-specific basis. Blanks indicate that LLW is not treated or disposed at a site under the specified alternative.
D=dispose. Each of the 6-site disposal alternatives uses the 6 same sites; each of the 12-site disposal alternatives uses the same 12 sites.
[a] Ten sites use existing facilities for volume reduction. Three sites (LBL, RMI, and Mound) not listed as major sites above include volume reduction facilities.

Table 3.4–3. Proposed Waste Management Actions at Each Site Under the Transuranic Waste Alternatives

Alternative	Number of Sites		Treat Stand	ANL–E	Hanford	INEL	LANL	LLNL	NTS	ORR	PGDP	RFETS	SNL–NM	SRS	WIPP	WVDP
	CH Treat	RH Treat														
No Action	11	5	WIPP-WAC	TS	TS	TS	TS	TS	S	TS	S	TS	S	TS		S
Decentralized	16	5	WIPP-WAC	TS	TS	TS	TS	TS	TS	TS	T	TS	T	TS		T
Regionalized 1	5	2	Reduced gas		TS[a]	TS	TS			TS[b]		TS		TS		
Regionalized 2	5	2	LDR		TS[a]	TS	TS			TS[b]		TS		TS		
Regionalized 3	3	2	LDR		TS[a]	TS				TS[b]				TS		
Centralized	WIPP	2	LDR		TS[c]					TS[b]					T	

Notes: T = treatment to one of three standards: process to current waste acceptance criteria at WIPP (WIPP-WAC); shred and grout to reduce potential for gas generation at the repository (Reduced Gas); and treat to meet land disposal restrictions using thermal organic destruction and complete treatment train; S = storage after treatment under No Action and Decentralized Alternatives or store current inventory under the No Action Alternative. Blanks indicate that TRUW is not treated or stored at a site under the specified alternative.

[a] The Hanford Site treats both contact-handled (CH) and remote-handled (RH) waste.

[b] ORR treats RH waste only.

[c] The Hanford Site treats RH waste only.

Table 3.4–4. Proposed Waste Management Actions at Each Site Under the High-Level Waste Alternatives

Alternative	Store	Hanford	INEL	SRS	WVDP
No Action	4	S	S	S	S
Decentralized	4	S	S	S	S
Regionalized 1	3	S	S	S	
Regionalized 2	3	S	S	S	
Centralized 1[a]	1	S			

Note: S = storage. Blanks indicate that LLW is not stored at INEL, SRS, and WVDP under the specified alternative.
[a] Canisters generated at WVDP, SRS, and INEL prior to acceptance at the candidate repository in 2015 would be shipped to the Hanford Site for storage. Canisters generated at SRS and INEL after 2015 would be shipped directly to the candidate repository. If acceptance of the DOE-managed HLW is delayed past 2015, then all HLW canisters would be shipped to the Hanford Site for storage.

Table 3.4–5. Hazardous Waste Alternatives

Alternative	Treat	ANL–E	Hanford	INEL	LANL	LLNL	ORR	Pantex	SNL–NM	SRS
No Action	2			T			T			
Decentralized	3			T			T			T
Regionalized 1	5		T	T	T		T			T
Regionalized 2	2			T			T			

Note: T = treatment. Blanks indicate that HW is not treated at a site under the specified alternative. Fermi and KCP were not included in this table because they are not major sites as defined in Section 1.6 of Volume I, and impacts were not evaluated at those sites.

Although the four broad categories of alternatives analyzed for each waste type encompass the range of reasonable alternatives available to DOE, there are many possible combinations for the number and locations of DOE sites for treatment, storage, and disposal facilities. To narrow these combinations to a level where meaningful analysis could occur, DOE selected a range of reasonable alternatives for analysis under each category.

The waste management configuration that DOE ultimately selects for a particular waste type is not necessarily limited to one of the alternatives presented. A hybrid alternative could be developed that would incorporate components from one or more of the alternatives analyzed. For example, DOE may choose to treat a particular waste type on a regionalized basis and dispose of it at a centralized location. Another example would be to select a disposal site analyzed under a centralized alternative and additionally select a second disposal site analyzed under a regionalized alternative.

3.5 Methodology for Selecting and Identifying Alternatives

The PEIS considers alternatives within the four broad categories of alternatives: No Action, Decentralized, Regionalized, and Centralized. However, the number of possible alternatives under these broad categories is vast. For example, LLMW is generated, stored, or projected to be generated at 16 major sites. From one to 16 sites could be possible alternatives for the treatment of LLMW, and from one to 16 sites could be possible alternatives for disposal. The same general multisite scenario holds true for the other waste types.

The three "action" categories of alternatives encompass the range of reasonable alternatives available to DOE for the siting of waste management facilities. The Decentralized Alternatives consider waste management facilities at major sites where the waste is located or could be generated in the future, the Centralized Alternatives consider waste management facilities at one or two major sites, and the Regionalized Alternatives consider waste management activities at a number of major sites in between all and one. More than one Regionalized Alternative is considered for all waste types.

In order to determine reasonable proposed sites for Regionalized or Centralized waste management facilities, DOE determined where the largest waste volumes are located and where transportation requirements would be minimized. Treatment, storage, or disposal facilities were analyzed at those sites. However, total volumes of waste were not the sole criterion used to select Regionalized or Centralized sites. The character of the waste, specialized treatment requirements, and existing facilities were also taken into account. For example, some wastes that require special treatment were analyzed separately, and treatment sites were selected for analysis based on the volumes requiring special treatment rather than on total volumes.

3.6 Alternatives for Specific Waste Types

Complete descriptions of the alternatives, an analysis of the environmental impacts, and a comparison of the impacts are contained in the subsequent waste-type Chapters 6 through 10. Alternatives considered under each category in the WM PEIS are summarized in the following tables (3.6–1 through 3.6–5) for each waste type.

Table 3.6–1. Low-Level Mixed Waste—7 Alternatives

No Action	Sites would use existing and approved treatment facilities; residues from treatment would be stored indefinitely; LLMW would not be transported
Decentralized	All sites with contact-handled wastes would treat, and 16 sites would dispose of contact-handled wastes (remote-handled waste is treated and disposed of at 4 sites)
Regionalized (4 Alternatives)	1 Treatment of contact-handled wastes would occur at 11 sites; disposal would occur at 12 sites 2 Treatment of contact-handled wastes would occur at 7 sites; disposal would occur at 6 sites 3 Treatment of contact-handled wastes would occur at 7 sites; disposal would occur at 1 site 4 Treatment of contact-handled wastes would occur at 4 sites; disposal would occur at 6 sites
Centralized	The Hanford Site would treat and dispose of LLMW (remote-handled wastes would be treated and disposed of at 4 sites)

Table 3.6–2. Low-Level Waste—14 Alternatives

No Action	All sites would transport and dispose of LLW at 6 sites (the Hanford Site, INEL, LANL, NTS, ORR, SRS) under current arrangements; all sites would use existing treatment facilities
Decentralized	16 sites would dispose of all LLW projected to be generated over the next 20 years; a minimum level of treatment at each site is assumed
Regionalized (7 Alternatives)	2, 6, or 12 sites would dispose of all LLW projected over the next 20 years; in three alternatives, treatment to reduce volumes is also assumed, using regional sites 1 Disposal of LLW at 12 sites, without volume reduction 2 Volume reduction at 11 sites; disposal at 12 sites 3 Disposal at 6 sites, without volume reduction 4 Volume reduction at 7 sites; disposal at 6 sites 5 Volume reduction at 4 sites; disposal at 6 sites 6 Disposal at 2 sites (the Hanford Site and SRS), without volume reduction 7 Disposal at 2 sites (NTS and SRS), without volume reduction
Centralized (5 Alternatives)	One site (either the Hanford Site or NTS) disposes of all LLW projected over the next 20 years; in three alternatives, treatment to reduce volumes is also assumed 1 Disposal at the Hanford Site, without volume reduction 2 Disposal at NTS, without volume reduction 3 Volume reduction at 7 sites; disposal at the Hanford Site 4 Volume reduction at 7 sites; disposal at NTS 5 Volume reduction and disposal at the Hanford Site

Table 3.6–3. Transuranic Waste—6 Alternatives

No Action	Continue storage in existing facilities
Decentralized	TRUW would be treated to meet WIPP current criteria. Sites with small amounts would transport to 10 largest sites until disposal at WIPP
Regionalized (3 Alternatives)	1 Contact-handled TRUW would be treated at 5 sites and remote-handled TRUW would be treated at 2 sites, to intermediate level (to reduce gas generation), and transported to WIPP for disposal 2 Same as Regionalized 1, but waste would be treated to more stringent levels to meet land disposal restrictions (LDRs) 3 Contact-handled TRUW would be treated at 3 sites, and remote-handled TRUW at 2 sites to meet LDRs, then transported to WIPP for disposal
Centralized	Contact-handled TRUW would be transported to WIPP for treatment to meet LDRs and disposal; remote-handled TRUW would be transported to ORR and the Hanford Site for treatment to LDRs and then to WIPP for disposal

Table 3.6–4. High-Level Waste—5 Alternatives

No Action	HLW canisters would be stored at the Hanford Site, SRS, and WVDP until acceptance at geologic repository; HLW at INEL would be stored as calcine or liquids
Decentralized	HLW canisters of solidified waste would be stored at the 4 sites producing canisters until acceptance at geologic repository
Regionalized (2 Alternatives)	1 Canisters from WVDP would be transported to SRS; canisters would be stored at the Hanford Site, SRS, and INEL until acceptance at geologic repository 2 Canisters from WVDP would be transported to the Hanford Site; canisters would be stored at the Hanford Site, SRS, and INEL until acceptance at geologic repository
Centralized	Canisters would be transported from WVDP, INEL, and SRS to the Hanford Site; canisters would be stored at the Hanford Site until acceptance at geologic repository

Note: Each of the five alternatives is analyzed under two timing assumptions: (1) acceptance at the candidate repository begins in 2015; and (2) acceptance is delayed past 2015.

Table 3.6–5. Hazardous Waste—4 Alternatives

No Action	Nonwastewater HW would continue to be transported to commercial facilities; two DOE sites would thermally treat organic materials
Decentralized	Similar to the No Action Alternative, except organic materials would be thermally treated at three DOE sites
Regionalized (2 Alternatives)	1 50% of nonwastewater HW would be treated at five DOE sites (the Hanford Site, INEL, LANL, ORR, and SRS); 50% would be treated at commercial facilities 2 90% of nonwastewater HW would be treated at two DOE sites (INEL and ORR); 10% would be treated at commercial facilities
Centralized	None

3.7 Preferred Alternatives

The DOE selected its preferred alternatives after considering the analyses presented in the WM PEIS, the decision criteria presented in Section 1.7 of Volume I, and all of the comments submitted on the Draft WM PEIS. Table 3.7–1 summarizes the preferred alternatives for all of the major sites analyzed in the WM PEIS, and Tables 3.7–2 through 3.7–6 identify the waste management activities that each of the major sites would conduct under the preferred alternative. The preferred alternatives for each waste type are as follows.

Treatment of LLMW. A number of the Department's sites (generally sites with small amounts of LLMW) would send their LLMW to other sites for treatment. The sites that would receive these wastes and treat them under the DOE's preferred alternative are Hanford, INEL, ORR, and SRS. ANL-E, FEMP, LLNL, LANL, Pantex, PORTS, RFETS, and SNL-NM would treat LLMW onsite.

DOE's preferred alternative is a combination of parts of the Decentralized Alternative and several Regionalized Alternatives as shown in Table 3.7–1. The potential environmental impacts of all alternatives for treatment of LLMW evaluated in the WM PEIS are small. DOE's preferred alternative is generally consistent with the Site Treatment Plans prepared under the FFCAct; these plans include the use of commercial facilities to treat some LLMW. DOE realizes that the compliance orders issued by State and Federal regulators on the basis of these Site Treatment Plans establish the requirements for treatment of DOE's LLMW.

Table 3.7-1. Summary of Preferred Alternatives

Waste Type	Decision	ANL	BNL	FEMP	Hanford	INEL	LLNL	LANL	NTS	ORR
LLMW	Treatment	D	R1[a]	D	R1	R4	D	D	R1[a]	R2
	Disposal[b]	R	R	R	R	R	R	R	R	R
LLW	Treatment	R3	R3	R3	R3	R3	R3	R3	R3	R3
	Disposal[b]	R	R	R	R	R	R	R	R	R
TRUW	Treatment	D			D	R3	D	D	D	R1
HLW	Storage				D	D				
HW	Treatment	N	-	-	N	N	N	N	-	N

Waste Type	Decision	PGDP	Pantex	PORTS	RFETS	SNL-NM	SRS	WVDP	WIPP
LLMW	Treatment	R2	D	D	D	D	R1	R1[a]	
	Disposal[b]	R	R	R	R	R	R	R	
LLW	Treatment	R3	R3	R3	R3	R3	R3	R3	
	Disposal[b]	R	R	R	R	R	R	R	
TRUW	Treatment	D	**		D	R1	R1	D	*
HLW	Storage						D	D	
HW	Treatment	–	N	–	–	N	N	–	

Notes: N = No Action; D = Decentralized; R1, R2, R3, R4 = Regionalized; - = site not analyzed as a major generating site; * = no impacts from treatment or storage. ** = the very small amount of TRUW at Pantex would be shipped to LANL for treatment and storage. A blank cell indicates that the waste type is not found at the site.

[a] Wastes from these sites (BNL, NTS, and WVDP) are shipped offsite to regional treatment centers.

[b] DOE prefers to further narrow its configuration of LLMW and LLW disposal sites to two to three sites. The selection of sites would be made following consultation with regulatory authorities, State and Tribal governments, and other interested stakeholders.

Table 3.7–2. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLMW

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
Ames	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
ANL-E	Treatment	Onsite		Some waste may be shipped to regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
BCL	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Bettis	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
BNL	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Charleston	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
ETEC	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
FEMP	Treatment	Onsite[d]		Some waste may be shipped to regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
GA	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
GJPO	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
Hanford	Treatment	Onsite	Regional treatment site[b]	
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
INEL	Treatment	Onsite	Regional treatment site[b]	Some INEL waste may be shipped to another regional treatment site[b]
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
KCP	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
KAPL	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LEHR	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LBL	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LLNL	Treatment	Onsite		Some waste may be shipped to regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
LANL	Treatment	Onsite		
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
Mare Island	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]

Table 3.7–2. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLMW—Continued

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
Mound	Treatment	Onsite[e]		Regional treatment site[b,e]
	Disposal	Offsite		Regional disposal site[c]
NTS	Treatment	Offsite		Regional treatment site[b]
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
Norfolk	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
ORR	Treatment	Onsite	Regional treatment site[b]	
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
PGDP	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Pantex	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
Pearl Harbor	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Pinellas	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
PORTS	Treatment	Onsite[f]		Regional treatment site[b,f]
	Disposal	Offsite		Regional disposal site[c]
Ports Nav	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
PPPL	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
Puget So	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
RMI	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
RFETS	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
SNL-NM	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[c]
SRS	Treatment	Onsite	Regional treatment site[b]	Some SRS waste may be shipped to another regional treatment site
	Disposal	Onsite/offsite	Potential regional disposal site	Regional disposal site[c]
UofMO	Treatment	Offsite		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]
WVDP	Treatment	Offsite[d]		Regional treatment site[b]
	Disposal	Offsite		Regional disposal site[c]

See footnotes on next page.

Table 3.7–2. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLMW—Continued

Note: A blank cell indicates that a site either does not receive LLMW from other sites or does not ship LLMW to other sites.
[a] A site is listed if it currently manages LLMW or is expected to manage it in the future.
[b] The regional treatment sites would be Hanford, INEL, ORR, or SRS, depending upon which site is shipping waste. The configuration analyzed in the WM PEIS for Hanford, INEL, ORR, and SRS is not exactly the same as those in the Site Treatment Plans; under the Site Treatment Plans:

- Hanford receives LLMW from BCL;
- INEL receives LLMW from Bettis, Charleston, ETEC, KAPL, LBL, LLNL, Mare Island, NTS, Norfolk, Pearl Harbor, PORTS, Puget So, SRS, and UofMO;
- ORR receives LLMW from ANL-E, BNL, FEMP, INEL, LBL, Mound, NTS, PGDP, PORTS, RMI, and WVDP; and
- SRS receives LLMW from Bettis, Charleston, KAPL, and Norfolk.

The evaluation of impacts at each of the major sites under the Preferred Alternative provides similar results as the configurations specified in the Site Treatment Plans. DOE realizes that the Site Treatment Plans, unless modified by the appropriate regulatory agency, establish the requirements for treatment of DOE's LLMW.
[c] The selection of two or three regional disposal sites will be made following further consultation with regulatory agencies, State and Tribal Governments, and other interested stakeholders.
[d] Site Treatment Plan indicates some waste may be treated onsite.
[e] Site Treatment Plan indicates some waste may be treated offsite at ORR.
[f] Site Treatment Plan indicates some waste may be treated offsite at INEL and ORR.

Table 3.7–3. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLW

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
Ames	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
ANL-E	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Bettis	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
BNL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Fermi	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
FEMP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Hanford	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
INEL	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
KCP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
KAPL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
LBL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]

Table 3.7–3. Waste Management Activities Under the Preferred Alternative for Treatment and Disposal of LLW—Continued

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to
LLNL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
LANL	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
Mound	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
NTS	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
ORR	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
PGDP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Pantex	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
Pinellas	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
PORTS	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
PPPL	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
RFETS	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
RMI	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
SNL-NM	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
SRS	Treatment	Onsite		
	Disposal	Onsite or offsite	Potential regional disposal site	Regional disposal site[b]
SLAC	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]
WVDP	Treatment	Onsite		
	Disposal	Offsite		Regional disposal site[b]

Note: A blank cell indicates that a site *either* does not receive LLW from other sites or does not ship LLW to other sites.
[a] A site is listed if it currently manages LLW or is expected to manage it in the future.
[b] The selection of two or three regional disposal sites will be made following further consultation with regulatory agencies, State and Tribal governments, and other interested stakeholders.

Table 3.7–4. Waste Management Activities Under the Preferred Alternative for Treatment and Storage of TRUW

Generating Site[a]	Activity	Location	Receives Waste	Ships Waste to[c]
ANL-E	Treatment	Onsite		
	Storage	Onsite		
ETEC	Treatment	Onsite		
	Storage	Onsite		
Hanford	Treatment	Onsite		
	Storage	Onsite		
INEL	Treatment	Onsite	RFETS	
	Storage	Onsite	RFETS	
LANL	Treatment	Onsite	Pantex, SNL-NM	
	Storage	Onsite	Pantex, SNL-NM	
LBL	Treatment	Onsite		
	Storage	Onsite		
LLNL	Treatment	Onsite		
	Storage	Onsite		
Mound	Treatment	Onsite		
	Storage	Onsite		
NTS	Treatment	Onsite		
	Storage	Onsite		
ORR[b]	Treatment	Onsite/offsite	SRS	CH-TRUW to SRS
	Storage	Onsite/offsite	SRS	CH-TRUW to SRS
Pantex	Treatment	Offsite		LANL
	Storage	Offsite		LANL
PGDP	Treatment	Onsite		
	Storage	Onsite		
RFETS	Treatment	Onsite/offsite		INEL
	Storage	Onsite/offsite		INEL
SNL-NM	Treatment	Offsite		LANL
	Storage	Offsite		LANL
SRS[b]	Treatment	Onsite/offsite	ORR	RH-TRUW to ORR
	Storage	Onsite/offsite	ORR	RH-TRUW to ORR
UofMO	Treatment	Onsite		
	Storage	Onsite		
WVDP	Treatment	Onsite		
	Storage	Onsite		

Notes: *CH-TRUW = contact-handled TRUW; RH-TRUW = remote-handled TRUW.* A blank cell indicates that a site either does not receive TRUW from other sites or does not ship TRUW to other sites.

[a] A site is listed if it currently manages TRUW or is expected to manage it in the future.

[b] Under the Preferred Alternative, ORR is a regional treatment center for RH-TRUW, and SRS is a regional treatment center for CH-TRUW.

[c] Storage of treated TRUW pending final disposition.

Table 3.7–5. Waste Management Activities Under the Preferred Alternative for Storage of Treated HLW

Generating Site[a]	Stores Waste at	Receives Waste	Ships Waste to[b]
Hanford	Hanford		
INEL	INEL		
SRS	SRS		
WVDP	WVDP		

Note: A blank cell indicates that a site either does not receive HLW from other sites or does not ship HLW to other sites.
[a] A site is listed if it currently manages HLW or is expected to manage it in the future.
[b] Storage pending ultimate disposition.

Table 3.7–6. Waste Management Activities Under the Preferred Alternative for Treatment of HW

Generating Site[a]	Treats Waste at	Receives Waste	Ships Waste to
ANL-E	Offsite commercial facility		Offsite commercial treatment facility
Fermi	Offsite commercial facility		Offsite commercial treatment facility
Hanford	Offsite commercial facility		Offsite commercial treatment facility
INEL	Organic HW onsite, other HW at offsite commercial facility		Offsite commercial treatment facility
KCP	Offsite commercial facility		Offsite commercial treatment facility
LANL	Offsite commercial facility		Offsite commercial treatment facility
LLNL	Offsite commercial facility		Offsite commercial treatment facility
ORR	Organic HW onsite, other HW at offsite commercial facility		Offsite commercial treatment facility
Pantex	Offsite commercial facility		Offsite commercial treatment facility
SNL-NM	Offsite commercial facility		Offsite commercial treatment facility
SRS	Offsite commercial facility		Offsite commercial treatment facility

Note: A blank cell indicates that a site either does not receive HW from other sites or does not ship HW to other sites.
[a] Sites analyzed in the WM PEIS are those 11 sites that generated more than 90% of DOE's HW in 1991.

Disposal of LLMW. The Department's preferred alternative at this time is to send its LLMW to regional disposal sites after it is treated. After consultations with stakeholders, the Department intends to select two or three sites from the following six: Hanford, INEL, LANL, NTS, ORR, and SRS.

The six sites named above are those at which DOE already has established LLW or LLMW disposal operations and, except for NTS and LANL, each has relatively large LLMW volumes for disposal. Because these six sites would have more than adequate capacity for the amounts of LLMW the Department will need to dispose of, there is no need for additional candidate sites. Fewer than the six sites would provide adequate capacity at a substantially lower overall cost. Relying on only one disposal site, however, would require the most transportation of the waste, and would be operationally inflexible if disposal activities were interrupted.

While all six current disposal sites remain candidates for future disposal operations and the potential health and environmental impacts of regionalized disposal are small, further consideration of various factors may affect the DOE's site preferences. For example, hydrological characteristics indicate that disposal at sites with high rainfall, such as ORR and SRS, would require mitigation costs that would not be needed at more arid sites. Preliminary cost analyses indicate that regional disposal at ORR, LANL, and INEL may not be as cost effective as disposal at SRS, NTS, and Hanford.

Because of these sometimes contravening factors and the permanence associated with disposal decisions, it is prudent to further evaluate costs and discuss all pertinent aspects of potential configurations with stakeholders before identifying two or three preferred sites for disposal. The Department will notify the public which specific sites it prefers for disposal of LLMW by publishing a notice in the *Federal Register* and by other means. DOE will not issue a Record of Decision selecting any regional disposal sites for LLMW sooner than 30 days after publication of its preferred sites in the *Federal Register*.

Treatment of LLW. Each site with LLW would treat its waste onsite. Each site would perform minimum treatment on its wastes to prepare them for disposal, although DOE would allow each of its sites the flexibility to perform additional treatment if it would decrease costs and requirements for transportation by significantly reducing the volume of LLW requiring disposal. The potential environmental impacts of all alternatives for treatment of LLW evaluated in the WM PEIS are small. The impacts of DOE's preferred alternative for LLW are identified in Regionalized Alternative 3 as

shown in Table 3.7–1, under which the potential impacts associated with minimum treatment of LLW at each site were analyzed, assuming regionalized disposal, as discussed below.

Disposal of LLW. The Department's preferred alternative at this time is to send its LLW to regional disposal sites after it is treated. After consultations with stakeholders, the Department intends to select two or three sites from the following six: Hanford, INEL, LANL, NTS, ORR, and SRS.

The six sites named above are those at which DOE already has established LLW disposal operations and, except for NTS, each has large waste volumes for disposal. Because these six sites would have more than adequate capacity for the amounts of LLW the Department will need to dispose of, there is no need to establish additional sites. Fewer than the six sites would provide adequate capacity at a substantially lower overall cost. Relying on only one disposal site, however, would require the most transportation of the waste, with correspondingly higher traffic accident fatalities, and would be operationally inflexible if disposal activities were interrupted.

While all six current disposal sites remain candidates for future disposal operations and the potential health and environmental impacts of regionalized disposal are small, further consideration of various factors may affect the DOE's site preferences. For example, hydrological characteristics indicate that disposal at sites with high rainfall, such as ORR and SRS, would require mitigation costs that would not be needed at more arid sites. However, a disposal configuration that included at least one eastern site and one western site would require less transportation and produce fewer fatalities from traffic accidents than an eastern-only or western-only configuration. Preliminary cost analyses indicate that regional disposal at ORR, LANL, and INEL may not be as cost effective as disposal at SRS, NTS, and Hanford.

Because of these sometimes contravening factors and the permanence associated with disposal decisions, it is prudent to further evaluate costs and discuss all pertinent aspects of potential configurations with stakeholders before identifying two or three preferred sites for disposal. The Department will notify the public which specific sites it prefers for disposal of LLW by publishing a notice in the *Federal Register* and by other means. DOE will not issue a Record of Decision selecting any regional disposal sites for LLW sooner than 30 days after publication of its preferred sites in the *Federal Register*.

Treatment and Storage of TRUW. Most of the DOE's sites with TRUW would treat and store it onsite. Five sites would ship TRUW to other sites for treatment under the preferred alternative: Pantex would ship its de minimis amount of TRUW to LANL for treatment; RFETS would ship some of its TRUW to INEL for treatment; ORR would send its CH-TRUW to SRS for treatment; SRS would send its RH-TRUW to ORR for treatment; and SNL-NM would send its TRUW to LANL for treatment. This preference assumes that WIPP will require treatment to the waste acceptance criteria the Department has proposed to EPA for this geologic repository. DOE's preference could change if WIPP requires a different level of treatment. The Department would store its TRUW where it is treated pending a decision on its disposal or other disposition.

DOE's preferred alternative is a combination of parts of the Decentralized Alternative and several of the Regionalized Alternatives as shown in Table 3.7–1. It provides for cost-effective management of TRUW, poses low potential risks to the public, and has relatively small environmental impacts. DOE's preference is consistent with the preferred alternative identified in the *Waste Isolation Pilot Plant Disposal Phase Draft Supplemental Environmental Impact Statement* (WIPP SEIS-II).

Storage of HLW. The Department's preferred alternative at this time is to store its HLW where the waste is treated pending a decision on its disposal or other disposition. Because it is impractical to ship liquid HLW for treatment, DOE had previously decided that each of the four sites with HLW (Hanford, INEL, SRS, and WVDP) will treat its own waste onsite.

The potential impacts of DOE's preferred alternative are presented under the Decentralized Alternative for HLW. This alternative minimizes the transportation of treated HLW, makes use of existing storage capacity at WVDP and SRS, and would cost less than regionalized or centralized storage. The potential environmental impacts of all alternatives for HLW evaluated in the WM PEIS are small.

Treatment of HW. DOE's preferred alternative for HW is the No Action Alternative, which means the Department would continue to use commercial facilities to treat most of its non-wastewater HW. The transportation and environmental impacts are low for all of the alternatives for HW evaluated in the WM PEIS; however, the No Action Alternative costs less than the Decentralized or Regionalized Alternatives for HW treatment.

3.8 Use of Commercial or Privatized Facilities

After Records of Decision are issued, particular sites may propose to use commercial or privatized facilities for waste management activities. Such proposals would be analyzed in sitewide or project-specific NEPA documents. This WM PEIS does not preclude the use of waste management facilities constructed and operated by private entities on DOE sites at DOE's direction.

3.9 Comparison of Alternatives

A comparison of the alternatives analyzed for each waste type can be found in Chapters 6 through 10.

3.10 Alternatives Not Evaluated in Detail in the WM PEIS

Only DOE sites were analyzed as potential locations for waste management facilities in this PEIS. Other Federal sites (e.g., Department of Defense sites) were not considered to be reasonable alternatives. DOE prefers to avoid introduction of radioactive waste at DOE and other Federal sites where none exists. However, the WM PEIS does consider (at a conceptual level) the use of commercial and privatized waste management facilities for all waste types, including facilities at sites that may be purchased or leased from other Federal agencies.

The WM PEIS analysis does not assume the use of commercial waste management facilities across the Department except for hazardous waste because commercial capabilities for other waste types are limited. There are no commercial facilities for HLW or TRUW treatment, storage, or disposal. Nothing in the WM PEIS precludes a site from considering privatization or the use of commercial waste management facilities, since sitewide or project-level NEPA reviews of proposals for waste management may include alternatives for use of commercial vendors.

DOE analyzed representative alternatives ranging from management of wastes at all of the sites (the Decentralized Alternatives) to management at one site (the Centralized Alternatives) as potential locations for waste management facilities. CEQ has indicated that, when there are a very large number of possible reasonable alternatives, "... only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared in the EIS" (CEQ, 1981). DOE believes that the

Regionalized Alternatives selected for analysis in this PEIS are representative of the numerous permutations between the Decentralized and Centralized Alternatives.

Chapter 3
Reference

Council on Environmental Quality (CEQ). 1981. "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations." *Federal Register* (March 23), p. 18026.

CHAPTER 4
Affected Environment

In this chapter, summary information is presented to characterize the pertinent environmental conditions at the U.S. Department of Energy (DOE) sites potentially affected by implementation of the various waste management alternatives (see Chapter 3). This chapter focuses on the 17 major DOE sites where most waste is located and where the waste management actions that have the potential to cause significant impacts will occur. The chapter describes the methodology and assumptions used to define and characterize each important aspect of the affected environment and summarizes the affected environment at the 17 major sites. The chapter includes short descriptions of other DOE sites with waste management activities considered part of the overall WM program. Detailed information on the affected environments at the DOE sites is provided in the Waste Management Programmatic Environmental Impact Statement (WM PEIS) Technical Report on Affected Environment (DOE, 1996).

4.1 Introduction

In accordance with the Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations (40 CFR 1508.14) on preparing an environmental impact statement, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." Characterization of the affected environment defines the baseline conditions against which the impacts of the various alternatives—including the No Action Alternative—are assessed. All data presented in this chapter are in summary form. Therefore, the length of the discussion is not intended to indicate the significance of the potential effects.

4.2 Approach to Defining the Affected Environment

In this PEIS DOE examines a range of broadly defined waste management alternatives potentially affecting many DOE sites located throughout the country. DOE focused the analysis of environmental impacts on the environment of and around individual sites that would have major roles in the DOE waste management program and defined the regions at each of these sites where different types of impacts were likely to occur.

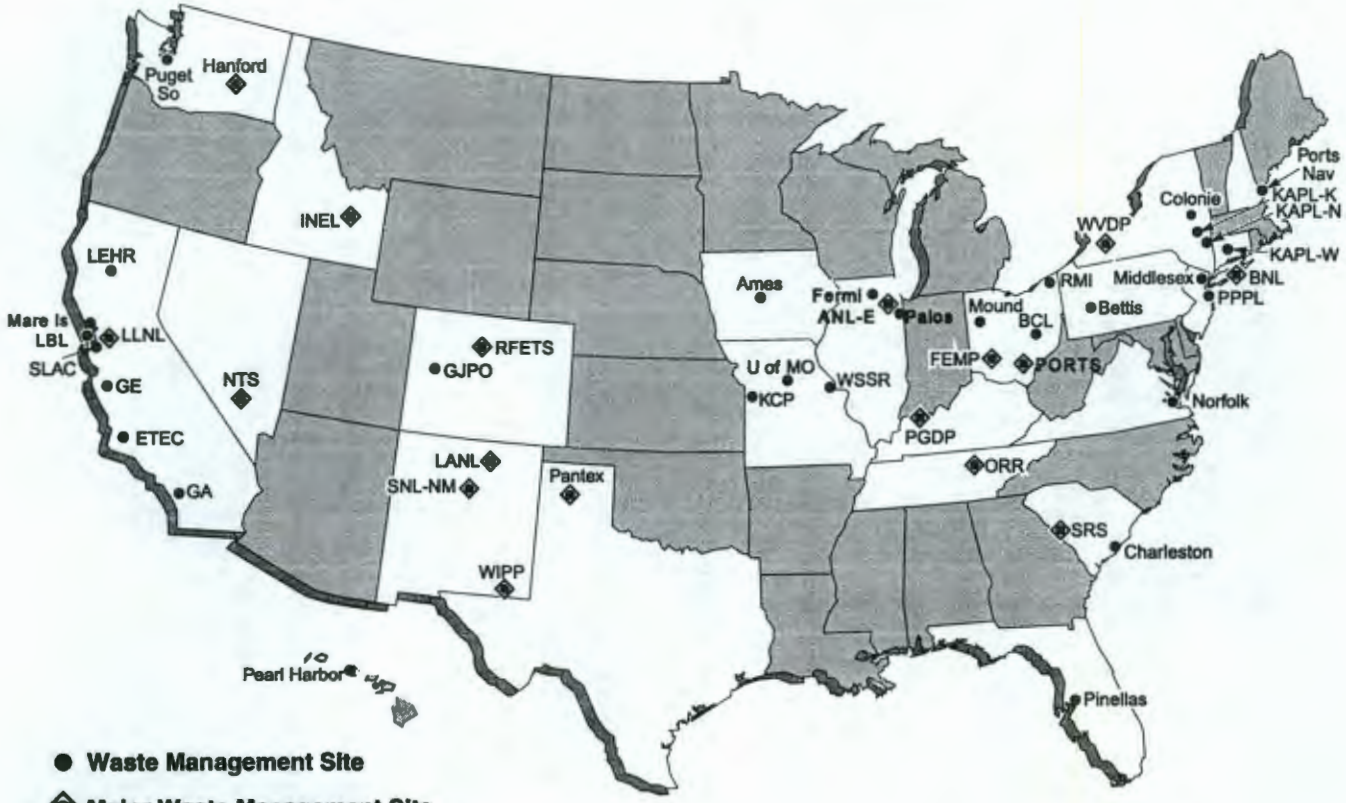
Shipping wastes for treatment or disposal between sites, as well as shipping HLW and TRUW to their respective repositories, as proposed under the alternatives may affect the environment along connecting road or rail corridors. However, specific waste shipping routes are not being selected in this PEIS, so the

ultimate shipping routes are not known at this time and could not be analyzed. As a basis for estimating the human health risks of transportation, DOE used representative road and railway routes. Human population densities along the representative routes were used to estimate population doses in the transportation risk assessment, but DOE did not otherwise attempt to characterize the affected environment along transportation routes.

4.2.1 Major Sites

To determine the scope of the environmental impacts analysis for the WM PEIS, DOE reviewed the quantities of waste expected to be generated or currently in inventory at all the sites where DOE has management or other contractual responsibility for wastes. DOE determined that 54 sites (Figure 4.2–1) generate or have in inventory substantial quantities of radioactive or hazardous waste. These 54 sites constitute the set of sites at which waste management activities would be conducted under the proposed action. For a list of the waste types managed at each site, see Table 1.6–1 in Chapter 1. The Waste Isolation Pilot Plant (WIPP), although not yet in operation, is counted as one of the 54 sites because DOE plans to use WIPP to provide permanent disposal for TRUW. For a list of estimated quantities of LLMW, LLW, TRUW, HLW, and HW to be managed at each site, see Table 1.6–2 in Chapter 1.

Of the 54 sites, 17 were designated as major sites (see Figure 4.2–1) for detailed impacts analysis in this WM PEIS because they meet one or more of the following criteria: (1) they are candidates to receive wastes generated offsite, (2) they are candidates to host disposal facilities, (3) they manage HLW, or (4) they were included to be consistent with the Federal Facility Compliance Act process. The major sites contain the bulk of the five waste types, have capability for future disposal of LLW or LLMW, or have existing or planned major waste management facilities. The potential environmental impacts that could arise from treating, storing, and disposing of wastes at these major sites are considered in detail in this WM PEIS. Actions at the remaining sites are not evaluated in detail. Although WM actions will occur at the other 37 sites, DOE does not expect significant impacts to occur from those actions nor would those actions otherwise affect the programmatic decisions to be made subsequent to the PEIS.



● Waste Management Site

◆ Major Waste Management Site

Note: ORR includes K-25, ORNL, ORISE, and Y-12
INEL includes NRF, and ANL-W
LLNL includes SNL-CA
SNL-NM includes ITRI

Figure 4.2–1. Waste Management Sites Considered in the WM PEIS

4.2.2 Regions of Influence

DOE evaluated the direct, indirect, and cumulative environmental impacts of the waste management alternatives within defined regions of influence (ROIs) or regions of impact at each of the 17 major sites and along waste transportation routes. ROIs at each site were specific to the type of effect evaluated and encompassed geographic areas within which DOE could reasonably expect to capture in its PEIS analysis any potentially significant impact of the WM program actions that might occur. For example, human health risks to the general public from exposure to waste management facility airborne contaminant emissions were assessed for an area either within a 50-mile radius of a generic WM facility assumed to be centrally located at each smaller DOE site or within a 50-mile radius of an existing WM location at each larger DOE site (i.e., Hanford, INEL, LANL, NTS, ORR, and SRS). The human health risks of shipping wastes between sites were evaluated for populations living along the road and railway corridors linking the DOE sites. Economic effects, such as job and income growth, in the regions surrounding each site were evaluated within a socioeconomic ROI that included the site host county, adjacent counties, and other nearby counties in which a substantial portion of each site's work force resides. The overall economic impact of DOE expenditures for all site activities and all waste shipments under each WM alternative was evaluated within the national economy. Brief descriptions of the impact-specific ROIs are given in Table 4.2–1.

At each of the 17 major sites, a baseline condition for each environmental resource area was determined from existing data and from information provided in previous environmental studies, relevant laws and regulations, and other government reports and databases (see Section 4.3). Table 4.2–2 summarizes certain data related to the ROI features at the 17 major sites used in the waste management impact analyses.

The health risk ROI populations differ from the socioeconomic ROI populations in Table 4.2–2 because they are based on different areas; the former are estimates of population within a 50-mile radius of each site's center and the latter are calculated by summing county populations for all counties in the socioeconomic ROI.

4.3 Affected Environment Resources Areas

The environmental features that may be affected by the waste management alternatives described in Chapter 3 include human health as it is related to the level of radionuclide and radiation exposure; air

Table 4.2–1. WM PEIS General Regions of Influence

Environmental Feature	WM PEIS Region of Influence (ROI)
Human health	Includes the site and nearby offsite areas (within 50 miles of the site and the transportation corridors between the sites) where worker and general population radiation, radionuclide, and hazardous chemical exposure is likely to occur
Air quality	Includes the site and nearby offsite areas within local air quality control regions and the transportation corridors between the sites that could be affected by airborne emissions generated from WM activities
Water resources	Includes onsite and adjacent surface water bodies and groundwater that could be affected by WM activities
Geology	Includes geologic resources within the DOE site and offsite areas where geology may influence or be influenced by WM activities
Soils	Includes soils within the DOE site and offsite areas where soils may be affected by WM activities
Ecological resources	Includes the site, adjacent resource areas, and the transportation corridors between the sites where ecological communities, including sensitive habitats and sensitive species, could be affected by WM activities
Socioeconomic conditions	Includes the counties that contain or are contiguous to the site or part of the site, and counties in the area where at least 90% of site employees reside
Environmental justice	Includes the regions of influence for all health, environmental, and socioeconomic impacts as defined in this table, although the WM PEIS environmental justice analysis focused primarily on human health risks within 50 miles of the sites
Land use	Includes the site and the area immediately adjacent to the site
Infrastructure	Includes power, water supply, sanitary wastewater treatment facilities, and road systems on the site, those offsite utilities that currently provide support to the site, and local offsite infrastructure
Transportation (national)	Includes the population and areas of the road and rail network that would be affected by shipping radiological and hazardous waste between the 54 sites
Transportation (local)	Includes the road and rail network connections to the site from the national road and rail networks
Cultural resources	Includes the area within and adjacent to the site boundary that may be affected by the proposed action

Table 4.2–2. Summary Data for Waste Management Sites

Site	Symbol	Acreage	MEI Dose[a] (mrem)	Population Dose[b] (person-rem)	Site Work Force[c]	Health Risk ROI Population[d]	Socioeconomic ROI Population[e]
1. Argonne National Laboratory-East	ANL-E	1,500	0.0085	17.0	4,455	7,939,785	6,568,800
2. Brookhaven National Laboratory	BNL	5,263	0.11	2.7	3,557	5,738,554	2,609,212
3. Fernald Environmental Management Project	FEMP	1,050	0.0021	1.30	1,939	2,764,589	1,313,000
4. Hanford Site	Hanford	358,309	0.0037	0.60	14,394	377,645	409,200
5. Idaho National Engineering Laboratory	INEL						
Idaho National Engineering Laboratory	INEL	569,588	0.0015	0.030	11,813	153,061	196,039
Argonne National Laboratory-West	ANL-W	f	f		f		f
Naval Reactor Facility	NRF	f	f		f		f
6. Lawrence Livermore National Laboratory	LLNL						
Lawrence Livermore National Laboratory	LLNL	8,172	0.690	1.70	8,713	6,324,234	2,934,064
Sandia National Laboratory (California)	SNL-CA	g	g		g		g
7. Los Alamos National Laboratory	LANL	27,520	7.90	1.40	6,199	159,152	151,408
8. Nevada Test Site	NTS	864,000	0.012	0.0290	7,086	14,266	759,240
9. Oak Ridge Reservation	ORR	35,000	1.400	43.0	21,544	881,652	482,481
K-25 Site	K-25	1,500	h		h		h
Oak Ridge Institute for Science and Education	ORISE	340	h		h		h
Oak Ridge National Laboratory	ORNL	2,900	h		h		h
Y-12 Plant	Y-12	811	h		h		h
10. Paducah Gaseous Diffusion Plant	PGDP	3,425	0.0045	0.017	1,740	500,502	151,526
11. Pantex Plant	Pantex	10,080	i		2,891	265,185	194,123

Table 4.2–2. Summary Data for Waste Management Sites—Continued

Site	Symbol	Acreage	MEI Dose[a] (mrem)	Population Dose[b] (person-rem)	Site Work Force[c]	Health Risk ROI Population[d]	Socioeconomic ROI Population[e]
12. Portsmouth Gaseous Diffusion Plant	PORTS	4,003	0.260	3.0	2,386	639,602	204,136
13. Rocky Flats Environmental Technology Site	RFETS	6,500	0.0002	0.140	7,365	2,171,877	1,790,600
14. Sandia National Laboratories	SNL-NM						
Sandia National Laboratories (New Mexico)	SNL-NM	2,820	0.0034	0.020	8,596	610,714	722,138
Inhalation Toxicology Research Institute	ITRI	135	j		218		726,200
15. Savannah River Site	SRS	198,000	0.140	6.40	17,492	620,618	460,028
16. Waste Isolation Pilot Plant	WIPP	10,245	—	—	932	99,889	217,661
17. West Valley Demonstration Project	WVDP	220	0.0003	0.011	1,100	1,698,391	1,052,766

[a] Dose to maximally exposed individual (MEI) from emissions of airborne radionuclides excluding radon-220, which is not subject to National Emission Standards for Hazardous Air Pollutants (NESHAP) limits (DOE, 1994a). Exposure at ANL-E including radon-220 = 0.24 mrem; exposure at FEMP including radon-220 = 51 mrem.
[b] Collective dose to health risk ROI population.
[c] The number shown represents only that portion of the site workforce residing in the socioeconomic region of influence.
[d] The population within 80 km (50 miles) of a site (ROI) which is considered at risk for health impacts.
[e] The population of the site host county, adjacent counties, and nearby counties which supply in aggregate 90% or more of the site workforce.
[f] Data included in INEL.
[g] Data included in LLNL.
[h] Data included in ORR.
[i] Exposure less than 0.0001 mrem/year.
[j] Data included in SNL-NM.

quality; water resources and water quality; geology and soils; ecological resources; socioeconomic conditions; land use; infrastructure; transportation; and cultural resources. The approach used for characterizing the affected environment for these resource areas at the 17 major sites is summarized below. The baseline year for the affected environment in this PEIS is the end of the 1992 calendar year. Some exceptions do exist for certain resource features, such as socioeconomic or population data, which are based on 1990 census data. These exceptions are based on the requirement to incorporate the best available data that are consistent for the 17 sites in the analysis. These exceptions are noted where applicable. In some instances there have been significant changes since 1992; for example, in "Site Work Force" data. Wherever more current data have been recommended by the site(s) concerned, an evaluation of the analytical affects of the difference(s) was made. If no substantive change in the impacts analysis would result, the data have not been changed. Additional information is contained in the WM PEIS Technical Report on Affected Environment (DOE, 1996).

4.3.1 Human Health

The release of radionuclides to the atmosphere from existing site actions and the potential exposure of the offsite public to these contaminants are the focus of the human health affected environment section. Data reported in this section include (1) the ROI population based on 1990 Census data, which consists of individuals living within a 50-mile (80-kilometer) radius of the sites; (2) the estimated existing condition collective radiological dose (in person-rem) for the ROI population; and (3) the estimated existing condition radiological dose (in rem) for a hypothetical maximally exposed individual (MEI) living within the offsite population. The MEI is an individual whose estimated dose is higher than that received by most members of the general population. The exposure estimates are presented in units of person-rem for population risk and rem for individual risk. The rem (roentgen equivalent man) is a measure of biological damage to living cells caused by radiation in any form. A millirem (mrem) is one-thousandth of a rem.

The airborne radiation dose estimates for the offsite populations and MEIs presented in this chapter were compiled from a DOE report entitled *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a). Note that these exposure estimates were developed using air dispersion models; they do not represent actual monitored or measured exposures. Additional exposure estimates, including monitored exposures and multimedia MEI exposure estimates presented in annual site environmental reports, are not included. However, this information is presented in the technical report on the affected environment (DOE, 1996). Only the airborne pathway exposure estimates are presented in this

chapter, because inhalation of airborne contaminants released from waste treatment facilities is assumed to be the most important exposure pathway for the greatest number of individuals in offsite populations. Note also that only the air pathway exposure estimates presented in Chapter 4 are used in the cumulative impact analyses in Chapter 11 to characterize existing site conditions. The health risk estimates presented in Chapters 6 through 10 represent the incremental risk from the proposed waste management actions that would be added to the existing baseline risks at the sites. The cumulative health risks estimated in Chapter 11 include risks from existing operations, the incremental risks from WM actions, and risks from other DOE actions proposed at the sites. Risks from past DOE operations are not included in the cumulative risk analysis because only a limited amount of data are available. Although dose reconstruction studies are being conducted at a number of DOE sites, study results are available only for three sites: Hanford (Shipler et al., 1996), NTS (Thompson and McArthur, 1996), and RFETS (Ripple et al., 1996).

All members of the public are exposed to a variety of radiation sources, both natural and manmade, called background radiation. The average background radiation level in the United States is estimated to be 360 mrem per year. The natural sources include radon (55% of the total radiation exposure), cosmic rays (8%), terrestrial (8%), and internal (11%). The manmade sources are x-rays (11%), nuclear medicine (4%), consumer products (3%), and other sources (less than 1%). Natural background radiation is the largest contributor to the average radiation dose to individuals and is the most variable component of background radiation. The total annual dose from background radiation can range from 100 mrem per year for people who live on sandy soil at sea level, to nearly 1,000 mrem per year for people who live in stone houses at high elevations (NCRP, 1987; NRC, 1994).

The U.S. Environmental Protection Agency (EPA) regulations (40 CFR 61, Subpart H) set the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for public exposure to airborne radioactive materials (other than radon), including emissions from DOE sites. The nonradon limit for airborne exposure is 10 mrem per year from all sources. DOE has established a 100 mrem dose for annual exposure to members of the general public from all sources and through all pathways as part of DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE, 1990). DOE radon emissions are regulated by 40 CFR 61, Subparts Q and T. To ensure that such limits are observed, filtration systems are installed. For example, high-efficiency particulate air (HEPA) systems are routinely used that are capable of trapping and retaining at least 99.97% of all nondispersed particulates of 0.3 μm in diameter or larger.

DOE issued a report summarizing the emission reports submitted by 38 DOE sites to EPA for calendar year (CY) 1992 (DOE, 1994a). The total atmospheric release of radioactivity from radionuclides from the 38 DOE sites subject to the EPA reporting requirement was approximately 250,000 curies during 1992 (248,000 curies, or 99% of the total emissions, were emitted from the 17 major waste management sites analyzed in the WM PEIS). This was a 44% reduction from the 1991 releases. Most sites demonstrated compliance with the 10 mrem per year "effective dose equivalent" (EDE) standard of 40 CFR 61, Subpart H, including contributions from radon emissions regulated separately under subparts Q and T. More than 70% of the sites reported doses to the MEI that were less than 1% of the standard. Los Alamos National Laboratory (LANL) reported the highest estimated dose, about 80% of the standard. Doses received by the MEI from the airborne pathway are included in Table 4.2–2.

4.3.2 Air Quality

In support of the air quality impact assessment, affected environment data were obtained to establish background pollutant concentrations, local meteorological conditions, and local air quality requirements. In addition to the air quality impact assessment, the data on local meteorology were used to support the emissions deposition modeling for health risk studies and studies to determine the toxicity to terrestrial wildlife from airborne releases.

The affected environment was characterized in terms of EPA primary and secondary ambient air quality standards for criteria air pollutants and other ambient standards established by each State. The criteria air pollutants are carbon monoxide, sulfur dioxide, particulate matter (particles with a diameter less than or equal to 10 micrometers), ozone, nitrogen dioxide, and lead. In addition to the national criteria pollutants, certain states have adopted State-regulated criteria pollutants, which are listed in the technical report on affected environment, for each of the DOE sites (DOE, 1996). In addition to the criteria air pollutants, National Emission Standards for Hazardous Air Pollutants (NESHAP) established by EPA were also considered. These hazardous pollutants include radionuclides and hazardous materials that may be associated with DOE operations. Applicability of EPA regulations for the prevention of significant deterioration (PSD) was also considered. The PSD regulations are established to maintain air quality in areas already in attainment of the National Ambient Air Quality Standards (NAAQS). Some DOE sites in PSD areas have obtained PSD permits.

The ROI for air quality includes the site, nearby offsite areas, and the transportation corridors between the sites that could be affected by airborne emissions generated from WM activities. For most air quality impacts, the ROI includes areas within a 50-mile (80-kilometer) radius of the site. Data on the existing air quality environment were obtained from monitoring stations located on the site, or as close to the site as possible. Sites within 62 miles (100 kilometers) of a national park, monument, seashore, wildlife refuge, or wilderness area were noted in order that a screening assessment of impacts to visibility in these Class I areas could be performed.

Another important aspect of the ROI is the attainment status of the EPA-designated air quality control region(s) in which the site is located. The EPA air quality control region does not necessarily correspond to the ROI and may be larger or smaller. The ROI itself may contain portions of more than one EPA region. To be conservative, if the site could affect the air quality in more than one air quality control region, the data from the region with the worst air quality were used.

Table 4.3–1 presents the criteria air pollutant attainment status within the EPA-defined air quality regions where the 17 major sites are located. In general, the region is in attainment for a particular criteria pollutant if monitored ambient levels are below the NAAQS for that pollutant. The region is a nonattainment area for a particular criteria air pollutant if monitored ambient levels are at or exceed the NAAQS for that pollutant. The fact that criteria air pollutant standards are exceeded in the region of many DOE sites is not presumed to be directly attributable to DOE activities, but represents a condition that exists in the region as a whole. As indicated in Table 4.3–1, pollutants of particular concern include carbon monoxide, ozone, and particulate matter. New projects, including DOE facilities, must conform with the attainment plans contained in the State Implementation Plans, which describe the procedures to attain and maintain compliance with EPA criteria air pollutant levels.

4.3.3 Water Resources

Surface and groundwater affected by or used in conjunction with site activities define the affected environment in terms of water resources. Water resource elements include surface water bodies and their watersheds, stormwater runoff, groundwater resources, aquifers, floodplains, and potable drinking water sources. EPA designated sole-source aquifers and Federal Wild and Scenic Rivers are identified when near a DOE site.

Table 4.3–1. Criteria Pollutant Attainment Status at the 17 Major Sites

Site	State	NAAQS Attainment Status[a]					
		CO	NO_2	O_3	Pb	PM_{10}	SO_2
ANL-E	IL	A	A	S-17	A	MOD	A
BNL	NY	A	A	S-17	A	A	A
FEMP	OH	A	A	MOD	A	A	A
Hanford	WA	A	A	A	A	A	A
INEL	ID	A	A	A	A	A	A
LANL	NM	A	A	A	A	A	A
LLNL	CA	A	A	A	A	A	A
NTS	NV	MOD-2	A	A	A	MOD	A
ORR	TN	A	A	A	A	A	A
PGDP	KY	A	A	MAR	A	A	A
PORTS	OH	A	A	A	A	A	A
Pantex	TX	A	A	A	A	A	A
RFETS	CO	MOD-2	A	TRANS	A	MOD	A
SNL-NM	NM	MOD-1	A	A	A	A	A
SRS	SC	A	A	A	A	A	A
WIPP	NM	A	A	A	A	A	A
WVDP	NY	A	A	A	A	A	A

Notes: CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; PM_{10} = particulate matter ≤10 micrometers; SO_2 = sulfur dioxide; A = attainment; nonattainment codes: S-17 = severe-17; MOD-2 = moderate-2; MOD-1 = moderate-1; MOD = moderate; MAR = marginal; TRANS = transitional.

[a] Attainment status based on 1992 data except for LLNL, which were updated with 1995 data.

In support of the water resources impact assessment, data were obtained to establish baseline water usage, including use of municipal water, surface water and groundwater, as appropriate. Major stream flows were identified where they were used as a water source or received effluent discharge from the site. The site National Pollutant Discharge Elimination System (NPDES) permits, where applicable, are briefly described and the status of compliance with permit limits is summarized. Significant known surface water, sediment, and groundwater contamination are also described.

Contamination of surface water, stream sediment, and groundwater has occurred to varying degrees at most of the DOE sites; however, contamination is usually limited to onsite areas. Most contamination is related

to past practices that have been discontinued. The type of contamination varies by site, depending on the activities that occurred. The following is a partial summary of the known water resource contamination:

Known surface water contaminants include:

- Cesium at NTS and ORR
- Plutonium at LANL, NTS, and ORR
- Strontium at the Hanford Site, LANL, ORR, and WVDP
- Tritium at the Hanford Site, NTS, ORR, and SRS
- Uranium at FEMP. the Hanford Site, and ORR

Known sediment contaminants include:

- Cesium at the Hanford Site, ORR, and SRS
- Mercury at ORR
- Plutonium at LANL and SRS
- Uranium at ORR, Paducah, FEMP, and Portsmouth

Known groundwater contaminants include:

- Cesium at the Hanford Site and SRS
- Plutonium at the Hanford Site, NTS, and RFETS
- Strontium at BNL, the Hanford Site, INEL, ORR, and SRS
- Technetium at the Hanford Site, ORR, and Paducah
- Tritium at BNL, the Hanford Site, INEL, LBL, LLNL, ORR, and SRS
- Uranium at FEMP, RFETS, and SRS
- Solvents at BNL, the Hanford Site, INEL, LBL, LLNL, ORR, Paducah, Portsmouth, RFETS, and SRS

4.3.4 Geology and Soils

Geology and soils are not likely to be affected by the WM actions. However, geologic and soil characteristics will factor into siting decisions when specific facility locations are selected. Elements of geology include topography, geologic formations, geologic structures, volcanic hazards, seismicity, and mineral deposits. Soil characteristics include type, permeability, porosity, susceptibility to subsidence, and

erodibility. The geology and soils baseline assessment included identification of (1) the seismic risk, (2) soil characteristics, and (3) soil contamination that could affect health risk.

Most of the DOE sites are in stable geologic areas. The greatest seismic risks at the 17 major sites are believed to be at LLNL and Paducah. No DOE site is in an area of known substantial volcanic hazards. Subsidence (soil instability) is generally not a problem at the DOE sites, although slope failures may occur in association with seismic events.

For most DOE sites, the site's topography is such that sufficient buildable area exists without limiting construction and operation of new facilities. Most DOE sites have soils that are adequate for normal bearing loads encountered with limited height facilities; these soils are not prone to liquefaction or excessive erosion. In general, no unique deposits of minerals have been identified or are expected to be found at any DOE site; sand and gravel deposits occur at some sites. The Acquired Lands Act of 1947 prohibits mineral exploration and development at DOE sites, and most lands under DOE control have been closed to mineral exploration.

Varying degrees of soil contamination occur at many DOE sites. Most soil contamination is related to accidental spills or past practices that have been discontinued, and contamination is usually confined to onsite areas. The type of contamination varies by site and depends on the activities that occurred and the materials handled. Contaminants include radionuclides, organic compounds, and metals. Examples of known soil contamination include:

- Cesium contamination at the Hanford Site and ORR
- Plutonium contamination at the Hanford Site, NTS, INEL, and RFETS
- Strontium contamination at the Hanford Site
- Uranium contamination at FEMP, NTS, Paducah, the Pantex Plant, and Portsmouth
- Solvent (organic) contamination at LBL, LLNL, the Pantex Plant, and SRS

4.3.5 Ecological Resources

Ecological resources include terrestrial communities (including recreational wildlife and significant forestry), aquatic communities (including recreational fishing), wetlands, threatened and endangered species, and biodiversity. Many sites, particularly the larger sites, such as the Hanford Site and SRS, support diverse communities of plants and animals. Some sites, such as RFETS, support habitats that are

biologically more diverse than the surrounding landscape because they have remained protected from grazing, farming, and development. Construction site clearing, excavation, and access road building for new waste treatment, storage, and disposal facilities may disturb or remove portions of the natural habitats at the sites, depending on where the new facilities are located. In support of the ecological resources impact assessment, affected environment data were obtained from site environmental reports to determine the presence of Federal and State threatened and endangered (sensitive) species on the sites. Table 4.3–2 provides a summary of the threatened and endangered species that have been identified at the major DOE waste management sites. Additional information is presented in the affected environment technical report (DOE, 1996).

4.3.6 SOCIOECONOMIC CONDITIONS

Socioeconomic elements include population size, demographics (age, sex, and race), site employee residence patterns, current employment, unemployment, and income and earnings by industry. The variables used as baseline data to calculate impacts include employment, per capita income, and population for 1990. Per capita income is multiplied by population to calculate total personal income. Employment and personal income are used as baseline variables from which percent changes due to waste management activities are calculated. Regional industry multipliers (the change in the economy in response to a change in expenditure) were determined for the socioeconomic ROIs of the major sites. In support of the socioeconomic impact analysis, data were also obtained to establish employee residence patterns and housing and demographic characteristics. The housing data considered are occupancy and vacancy rates, and number of housing units. Baseline socioeconomic data were obtained from the U.S. Department of Commerce (DOC), Bureau of the Economics Analysis (BEA), and the Bureau of the Census (DOC, 1991, 1992a-c).

As noted in Table 4.2–1, the ROI for socioeconomics consists of the site host county, all contiguous counties, and those nearby counties where, in aggregate, at least 90% of the site workforce currently resides. In addition, baseline data were collected for the nation as a whole. The nationwide data were developed to provide a baseline for the comparison of employment, income, and industrial output by alternative nationally.

Table 4.3–2. Federal and State Threatened and Endangered Species at the 17 Major Sites

Site	Federal and State Threatened and Endangered Species[a]
ANL-E	Species potentially occurring—1 Federal Endangered (mammal), 1 Federal Threatened (insect), 3 State Endangered (1 bird, 1 mammal, 1 plant), 2 State Threatened (1 reptile, 1 plant)
BNL	Species occurring onsite—1 Federal Endangered (bird), 1 Federal Threatened (bird), 2 State Endangered (1 bird, 1 amphibian), 4 State Threatened (birds)
FEMP	Species occurring or potentially occurring—2 Federal Endangered (1 mammal, 1 plant), 3 State Threatened (1 bird, 1 crustacean, 1 plant), 7 State Endangered (1 amphibian, 3 birds, 1 mammal, 2 plants)
Hanford[b]	Species occurring—1 Federal Endangered (bird), 2 Federal Threatened (2 birds), 7 State Endangered (4 birds, 2 plants, 1 mammal), 4 State Threatened (2 birds, 2 plants)
INEL	Species occurring—1 Federal Endangered (bird), 1 Federal Threatened (bird), 2 State Endangered (2 birds)
LLNL[c]	Species potentially occurring—5 Federal Endangered (2 invertebrates, 1 mammal, 1 bird, 1 plant), 1 Federal Threatened (1 invertebrate), 2 State Endangered (1 bird, 1 plant), 3 State Threatened (1 reptile, 1 mammal, 1 bird)
LANL	Species occurring—1 Federal Endangered (bird), 1 Federal Threatened (bird), 4 State Endangered (1 plant, 2 birds, 1 amphibian)
NTS	Species occurring—1 Federal Endangered (bird), 1 Federal Threatened (reptile), 2 State Endangered (1 bird, 1 plant-critically endangered)
ORR	Species occurring—1 Federal Threatened (bird), 4 State Endangered (3 birds, 1 plant), 7 State Threatened (5 birds, 2 plants)
PGDP	Species occurring or potentially occurring in the vicinity—7 Federal Endangered (1 bird, 5 mollusks, 1 mammal), 2 Federal Threatened (1 bird, 1 mammal), 9 State Endangered (3 birds, 1 fish, 1 mammal, 4 mollusks), 3 State Threatened (2 plants, 1 reptile)
Pantex	Species occurring or potentially occurring in the vicinity—3 Federal Endangered (3 birds), 2 Federal Threatened (2 birds), 5 State Endangered (4 birds, 1 reptile), 3 State Threatened (2 birds, 1 reptile)
PORTS	Species occurring or potentially occurring in the vicinity—1 Federal Endangered (mammal), 4 State Endangered (1 mammal, 2 mollusks, 1 plant), 5 State Threatened (1 fish, 4 mollusks)
RFETS	Species potentially occurring—1 Federal Endangered (bird), 1 Federal Threatened (bird), 2 State Endangered (2 birds)
SNL-NM	Species potentially occurring—1 Federal Endangered (bird), 8 State Endangered (5 birds, 3 plants)
SRS	Species potentially occurring—6 Federal Endangered (4 birds, 1 fish, 1 plant), 2 Federal Threatened (1 reptile, 1 bird), 7 State Endangered (5 birds, 1 fish, 1 mammal), 1 State Threatened (bird)
WIPP	Species potentially occurring—1 Federal Endangered (1 bird), 1 Federal Threatened (1 bird), 4 State Endangered (4 birds), 1 State Threatened (reptile)
WVDP	Species potentially occurring—1 Federal Endangered (mammal), 4 State Endangered (1 bird, 1 mammal, 1 plant, 1 reptile), 4 State Threatened (2 birds, 1 plant, 1 reptile)

[a] This list covers species that are known to occur or may occur on the site or in the vicinity. Listings of common and scientific names are provided in the WM PEIS Technical Report on Affected Environment (DOE, 1996).
[b] Hanford policy is to treat 11 candidate species as if they were endangered (see site description).
[c] Includes Federal and State listed species from Site 300.

The site work force estimates and ROI population size data presented in Table 4.2–2 are used only in evaluating socioeconomic and site transportation infrastructure impacts. The health risk analyses use separate estimates of population sizes for the offsite population (based on a 50-mile radius for aerial dispersion of facility release), noninvolved worker population, and waste management worker receptor groups (see Sections 5.4.1 of Volume I and D.2.2 of Volume III).

4.3.7 ENVIRONMENTAL JUSTICE

Executive Order 12898, titled *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs Federal agencies to incorporate environmental justice as part of their missions. As such, Federal agencies are specifically directed to identify and address as appropriate disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. The approach used to address the potential for these impacts in the WM PEIS first identified minority and low-income populations residing within 50 miles of the DOE sites, and then determined where and under what circumstances waste management impacts might be disproportionately high and adverse.

For each of the 17 major waste management sites, demographic maps were generated through a geographic information system that used 1990 census data available from the U.S. Bureau of the Census. These maps, which appear in Appendix C, are based on an analysis of 1990 United States Bureau of the Census Tiger Line files, which contain political boundaries and geographical features, and Summary Tape Files 1 and 3, which contain demographic information (DOC, 1992d,e). Data were resolved to the census tract level. A census tract is an area defined for the purpose of monitoring census data that is usually composed of between 2,500 and 8,000 persons. Figures C.4–1 through C.4–34 in Appendix C illustrate census tract distributions for minority and low-income populations residing within 50 miles of the 17 DOE sites being considered for the management of the five waste types.

Federally recognized Native American tribal lands within 50 miles of each site were also identified and mapped and are included in Appendix C, where applicable, with the minority distribution maps C.4–1 through C.4–17. Although not identified in the site summary section of this chapter (Section 4.4), nonfederally recognized Native American groups may also be present near DOE sites. DOE would consult with concerned Native American groups before taking actions under the WM PEIS at sites that have tribal

involvement. Specifically, DOE will consult with tribal governments to assure that tribal rights, including treaty rights, are considered prior to making any site-specific decisions.

A ***minority population*** consists of persons classified by the U.S. Bureau of the Census as Negro/Black/African-American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, or other nonwhite, based on self-classification by the people according to the race with which they most closely identify. In order to avoid double-counting minority Hispanic persons (Hispanics can be of any race), only white Hispanics were included in the tabulation of racially based minorities. Nonwhite Hispanics had already been counted under their respective minority racial classification (e.g., Black, American Indian). For purposes of this analysis, a minority population consists of any census tract within the 50-mile zone of impact with a minority population proportion greater than the national average of 24.4%. A ***low-income population*** refers to U.S. Census Bureau data definitions of individuals living below the poverty line. The poverty line is defined by a statistical threshold that considers family size and income (see Appendix C). For purposes of this analysis, a low-income population consists of any census tract within the 50-mile zone of impact with a low-income population proportion greater than the national average of 13.1%.

Table 4.3-3 summarizes minority and low-income population data for the 50-mile zone of impact at each site. The percentage of population that is minority and low-income was calculated from actual counts that include, but are not limited to, the census tracts depicted in Appendix C. As the table indicates, 7 of the 17 sites have census tracts containing minority population proportions in their respective 50-mile zone of impact that exceed the national average of 24.4%. Of the 7 sites, 6 had minority proportions larger than 5% above the national average. However, 4 of these sites are in states (California and New Mexico) with minority population proportions well above the national average. For low-income populations, 8 of the 17 sites have census tracts containing low-income population proportions that exceed the national average of 13.1%. Of the 8 sites, 4 had low-income proportions larger than 5% above the national average. The site fact sheet sections on environmental justice in this chapter refer to Appendix C for the maps of minority and low-income populations that surround the sites. Appendix C also provides the data definitions and methods used to develop the maps.

Table 4.3–3. Demographic Data Related to Environmental Justice

Site	Population in the 50-Mile Impact Zone (millions)	Percent Minorities	Federally Recognized Native American Groups	Percent Below Poverty Level
ANL-E	8.03	33.5	None	11.4
BNL	5.26	21.4	None	5.4
FEMP	2.64	13.2	None	11.8
Hanford	0.35	25.8	Yes	18.8
INEL	0.11	10.2	Yes	12.5
LLNL	6.31	40.9	None	9.5
LANL	0.27	48.1	Yes	13
NTS	0.01	12.8	Yes	12.6
ORR	0.88	6.1	None	16.2
PGDP	0.50	9.1	None	19.1
Pantex	0.27	19.8	None	15.2
PORTS	0.61	3.2	None	20.8
RFETS	1.98	19.7	Yes	9.8
SNL-NM	0.61	45.1	Yes	14.8
SRS	0.59	37.8	Yes	18
WIPP	0.10	30.9	Yes	21.6
WVDP	1.54	11.6	Yes	12.2

4.3.8 LAND USE

In support of the land use impact assessment, information on total site acreage, land utilized for existing structures, land suitable for waste management operations (excluding land set aside for sensitive species, wetlands, floodplains, or land with other limitations or designated uses), land designated for future waste management operations, and site development plans were obtained. The land use baseline for each site was defined by using U.S. Geological Survey maps, and DOE environmental reports and development plans.

Table 4.3–4 presents the total acreage at each site and the estimated acreage available for the 17 major sites. Site acreage data were compiled from *DOE Real Property: A Yearly Statistical Handbook Fiscal Year 1993*, (DOE, 1994b). The "Available Acres for Waste Management Facilities" (column 3) were obtained from site development reports when available. For those sites without a designated waste management area, this value was computed by subtracting the land currently used and the land unavailable from the total acreage.

Table 4.3–4. Land Available for Facilities at the 17 Major Waste Management Sites

Site	Total Acreage	Available Acres for Waste Management Facilities
ANL-E	1,500	1,190[a]
BNL	5,263	2,900
FEMP	1,050	275
Hanford	358,309	6,000
INEL	569,588	22,330
LLNL	8,172	7,849
LANL	27,520	16,187
NTS	864,000	640,000
ORR	35,000	5,629
PGDP	3,425	2,675[a]
Pantex	10,080	7,713
PORTS	4,003	3,203
RFETS	6,500	5,753
SNL-NM	2,820	206
SRS	198,000	145,400
WIPP	10,245	10,210
WVDP	220	165

[a] Data shown were available at the time of computations. The Chicago Operations Office has since reported that fewer acres are available for waste management facilities and that much of the operations will be performed in existing facilities which will be converted to the required technologies. Subsequent information also indicates that fewer acres would be available for waste management facilities at PGDP.

Established buffer zones, untenable terrain (e.g., wetlands, canyons), and land committed to planned projects are examples of land unavailable. These exceptions are noted in further detail on a site-specific basis in Section 4.4. Specific site selection for facilities proposed by this PEIS would be addressed by project-level EISs prepared for the sites concerned.

4.3.9 INFRASTRUCTURE

Infrastructure elements include the site's potable water supply, wastewater treatment system, electrical power systems, and transportation network. In support of the infrastructure impact analysis, data were

obtained to establish baseline capacities for the site potable and process water supply, process and sanitary wastewater treatment, and electrical power. The site hazardous and toxic waste treatment and disposal systems (nonradiological) are considered as part of the hazardous waste alternatives analyses and are not discussed here.

In general, water and wastewater treatment systems are located on site. Potable water is supplied from deep wells or from surface water systems, which frequently require some type of chemical treatment. A few sites dispose sewage in a municipal system. However, most DOE sites have their own disposal facilities. Many of the onsite landfills for the DOE sites have closed, and the sites have contracts with public or private landfills. In many cases, offsite electrical power companies are connected to onsite substations. For example, the Hanford Site is supplied by the Bonneville Power Administration. Some sites have limited onsite electrical power generation capability; however, the equipment is usually used only for backup or in emergency situations.

Table 4.3–5 lists the water, wastewater, and power infrastructure features at the 17 major sites that have potential limitations on increased usage related to implementing the waste management alternatives. The transportation infrastructure at each site is briefly described in Section 4.4.

4.3.10 TRANSPORTATION

4.3.10.1 National Transportation

Transportation elements include the number of rail and truck shipments to and from DOE sites and the local transportation network in the vicinity of the individual sites. In support of the impact analysis, data on DOE's rail and truck shipment traffic were obtained.

In addition, the national transportation environment was established in terms of the applicable government regulations and DOE policy related to transporting radiological and other hazardous material, general risk criteria, and the methodology for determining national transportation routes. The current DOE traffic volumes and associated accidents, packaging of materials, and emergency response preparedness are also presented.

Table 4.3–5. Infrastructure Use and Capacities[a]

Site	Water		Wastewater		Power	
	Total Capacity (mgd)	Total Current Use (mgd)	Total Capacity (mgd)	Total Current Use (mgd)	Total Capacity (MW)	Peak Load (MW)
ANL-E	1.8	0.645	1.8	1.08	*	23
BNL	6	4.5	2.3	1.0	47	35
FEMP	1.6	0.4	2.27	2.18	33	30
Hanford	79.06	9.51	0.2	0.158	352	59
INEL	30.96	5.242	1.0	0.254	55	42
LLNL	2.52	0.717	1.68	0.4	100	61
LANL	10	4.1	1	*	120	68
NTS	2.78	1.36	0.338	0.14	45	30
ORR	40.2	18.3	0.92	0.64	660	116
PGDP	30	15	1.75	0.4	3,040	1,564
Pantex	1.5	0.5	0.545	0.275	1,523	13
PORTS	37	14	1.2	0.35	1,929	1,537
RFETS	1.0	0.272	0.5	0.15	35	18
SNL-NM	4.03	1.0	*	0.548	50	35
SRS	5.0	1.6	0.75	0.5	*	130
WIPP	0.54	0.075	0.0185	0.012	9.4	4.6
WVDP	0.11	0.07	0.07	0.07	6.5	2.9

Notes: mgd = million gallons per day; MW = megawatts; * = value unknown.
[a] Data for baseline infrastructure represent onsite use only. Wastewater use and capacity are based on sanitary waste. No process wastes are involved.

Shipping radiological and other hazardous material from DOE sites to interstate highways or a rail terminus is described for each site in the WM PEIS Technical Report on Affected Environment (DOE, 1996). Air and barge transport are not considered in this PEIS.

The selection of a regional or centralized waste management alternative will potentially result in the transport of large quantities of radioactive waste on the nation's highways. In conducting transportation campaigns, DOE will adhere to applicable Federal regulations to ensure that the waste is transported safely and that the potential for impacts to the public and environment is minimized. These regulations cover the packaging, handling, and transporting of radioactive and hazardous material. DOE has adopted these regulations as part of DOE Order 1450.1C.

All transportation routes used for shipping radiological and other hazardous material have been derived from the HIGHWAY program model (ORNL, 1993a) and the INTERLINE model (ORNL, 1993b), which consider population densities along the routes. These models choose transportation routes between shipping-receiving combinations in accordance with U.S. Department of Transportation (DOT) routing constraints for transporting radiological and other hazardous materials, with maximum use of interstate highways and rail lines and minimum travel time and distance. Population density distributions were calculated along the routes used in this PEIS to compute health risk consequences. Results of transportation analyses are contained in the chapter for each waste type, Chapter 11, and Appendix E.

Transportation mode and routing decisions will be made on a site-specific basis during the transportation planning process. Sites can use the transportation analyses in this WM PEIS to make site-specific transportation decisions or, if necessary, conduct additional transportation analyses. DOE proactively works with states, regional entities, and carriers during large shipping campaigns to ensure that safe routing alternatives and safe havens are utilized.

Data for DOE radiological and hazardous materials shipments were obtained from the DOE Shipment Mobility/Accountability Collection (SMAC) information system (Morris, 1994, 1995). These data represent most, but not all, of the DOE transportation activities related to the shipment of radioactive waste material.

On the national level, about 100 million packages classified as hazardous materials (flammables, explosives, poisons, and radioactive material) are shipped each year (NRC, 1977). A more recent radioactive materials transport study stated that, excluding DOE shipments, approximately 2 million shipments of radioactive materials consisting of 2.79 million packages are made each year (SNL, 1985).

For FY 1993, radioactive and other hazardous material shipments accounted for 4.5% (27,698) of all DOE shipments and 32.6% of the tonnage. Of these shipments, 33.3% (9,231) contained radioactive material, and 13.3% (3,695) contained a combination of radioactive and other hazardous material.

For more than 40 years, radioactive materials have been shipped in the United States with no known adverse health effects due to accidental releases. Information about accidents involving radioactive materials has been collected over a 23-year period through September 1993 (SNL, 1993). During that period, 349 air, highway, and rail transportation accidents occurred. Of these accidents, 307 were highway, 20 were rail-related, and the remaining 22 were air-related. Packages used for shipping quantities or types of radioactive

materials that could have serious consequences if released are designed to withstand accident conditions. Accidents involving these packages have resulted in no release of radioactive materials. The Nuclear Regulatory Commission (NRC) has concluded that at least half of the radiation exposure resulting from shipments of radiological materials would be received by transportation workers, but the doses would be below allowable limits (NRC, 1977). The NRC also concluded that exposure from accidents was about 10 times less significant than the normal operational exposure (as determined by a statistical prediction of the number of latent cancer fatalities).

Because health and safety consequences may possibly result from an accident involving radioactive or other hazardous material, DOE will allocated resources and has established training on emergency response under the overall Federal Emergency Response Program to mitigate the effects of such an accident. Under this program, DOE was directed by Congress in Section 180 of the Nuclear Waste Policy Act (42 USC 10101-10270) to provide assistance and funds to States training public safety officials of local governments. The Federal Emergency Management Agency (FEMA) coordinates peacetime radiological accident response (as directed in the FEMA regulation 44 CFR 351).

The ROI for transportation is the ROI for the national transportation environment which is the population and areas associated with the road and rail network that would be affected by shipping radiological and hazardous material between the 54 sites that could be affected by implementing the waste management alternatives discussed in Chapter 3.

Tables 4.3–6 and 4.3–7 provide the number of current rail and truck shipments to and from the major DOE sites on the basis of the 1993 Shipment Mobility/Accountability Collection (SMAC) and the Waste Manifest System FY 1993 (Morris, 1994, 1995). This database includes all radioactive material shipments, not just waste shipments. The sites report the data for incoming and outgoing shipments of all hazardous material. Hazardous materials containing a radioactive component are listed as "radioactive" and provided in both the "Incoming" and "Outgoing" columns. The remaining hazardous materials not containing a radioactive component are shown in the "Other Hazardous" columns.

Table 4.3–6. DOE Truck Shipments of Hazardous Materials to or From Major Waste Generating and Storage Sites During Fiscal Year 1993

Site	Incoming				Outgoing			
	Radioactive[a]		Other Hazardous[b]		Radioactive[a]		Other Hazardous[b]	
	Shipments[c]	Wt (lb)[d]	Shipments[c]	Wt (lb)[d]	Shipments[c]	Wt (lb)[d]	Shipments[c]	Wt (lb)[d]
ANL-E	15	244,013	0	0	93	1,089,798	2	646
BNL	3	1,860	0	0	5	95,560	0	0
ETEC	1	150	0	0	25	981,643	0	0
FEMP	1	5,787	3	20,000	445	16,454,993	3	96,068
Hanford	113	3,063,760	0	0	18	358,682	2	4,830
INEL	22	317,828	2	646	36	881,145	4	1,167
KAPL-K	24	388,347	0	0	25	452,810	1	14
LBL	1	4,820	0	0	12	250,166	0	0
LLNL	9	6,872	8	7,544	5	8,875	9	12,309
LANL	18	20,491	8	43,759	9	8,059	2	43
Middlesex	0	0	0	0	0	0	0	0
NTS	449	16,518,680	2	886	5	15,303	5	32,153
ORR	197	387,269	49	1,216,790	843	23,140,823	44	548,573
PGDP	895	22,621,065	16	284,341	101	3,610,839	9	93,728
Pantex	72	971,011	9	1,627	163	353,142	8	8,248
PORTS	107	3,831,089	24	199,232	153	1,130,976	31	979,820
RFETS	4	5,418	2	641	17	144,100	1	70
SNL-NM	5	25,470	2	4,794	1	1,035	3	2,164
SRS	39	676,679	0	0	19	112,660	1	5
WIPP[e]	0	0	0	0	0	0	0	0
WVDP	0	0	0	0	0	0	0	0
Total	1,975	49,090,609	125	1,780,260	1,975	49,090,609	125	1,779,838

[a] Includes all types of radioactive materials, as well as any radioactive waste.
[b] "Other hazardous" refers to all hazardous materials except those that are radioactive.
[c] Reflects shipments to and from DOE sites.
[d] Weight includes shipping containers.
[e] Site not reporting to SMAC in fiscal year 1993.

Source: Based on DOE waste shipments as reported to the Shipment Mobility/Accountability Collection (SMAC) (Morris, 1994, 1995).

Table 4.3–7. DOE Rail Shipments to or From Major Waste Generating and Storage Sites During Fiscal Year 1993

Site	Incoming				Outgoing			
	Radioactive[a]		Other Hazardous[b]		Radioactive[a]		Other Hazardous[b]	
	Shipments[c]	Wt (lbs)[d]	Shipments[c]	Wt (lbs)[d]	Shipments[c]	Wt (lbs)[d]	Shipments[c]	Wt (lbs)[d]
ANL-E	0	0	0	0	0	0	0	0
BNL	0	0	0	0	0	0	0	0
ETEC	0	0	0	0	0	0	0	0
FEMP	0	0	0	0	0	0	0	0
Hanford	0	0	0	0	0	0	0	0
INEL	0	0	0	0	0	0	0	0
KAPL-K	0	0	0	0	0	0	0	0
LBL	0	0	0	0	0	0	0	0
LLNL	0	0	0	0	0	0	0	0
LANL	0	0	0	0	0	0	0	0
Middlesex	0	0	0	0	0	0	0	0
NTS	0	0	0	0	0	0	0	0
ORR	0	0	0	0	8	995,658	13	2,307,000
PGDP	106	8,566,763	7	1,217,100	117	18,992,927	0	0
Pantex	0	0	0	0	0	0	0	0
PORTS	117	18,992,927	6	1,089,900	98	7,571,105	0	0
RFETS	0	0	0	0	0	0	0	0
SNL-NM	0	0	0	0	0	0	0	0
SRS	0	0	0	0	0	0	0	0
WIPP[e]	0	0	0	0	0	0	0	0
WVDP	0	0	0	0	0	0	0	0
Total	223	27,559,690	13	2,307,000	215	27,559,690	13	2,307,000

[a] Includes all types of radioactive materials and radioactive waste.
[b] "Other hazardous" refers to all hazardous materials except those that are radioactive.
[c] Reflects shipments to and from DOE sites.
[d] Weight includes shipping containers.
[e] Site not reporting to SMAC in FY 93.

Source: Based on DOE waste shipments as reported to the Shipment Mobility/Accountability Collection (SMAC) (Morris, 1994, 1995).

4.3.10.2 Local Transportation

All major sites analyzed in the WM PEIS have local road and, in some cases, rail connections to the site. Details of these road and rail connections are described in the WM PEIS Technical Report on Affected Environment (DOE, 1996) and summarized in Section 4.4 for each site.

4.3.11 CULTURAL RESOURCES

Cultural resources include archaeological remains, historically significant architecture, traditional cultural properties, and a variety of resources significant to contemporary Native American cultures. Paleontogical resources, although not cultural in origin, are also included because of their recognized value and similar need for protection. Information regarding known cultural resources at the 17 major DOE sites is presented in Table 4.3–8. Information on the extent to which each site has been surveyed is also provided. No assumption with respect to the presence or absence of additional resources is made for areas not surveyed. Additional cultural resource surveys would be required for this purpose. For additional information regarding Native American cultural resources, see Sections 1.4.1 and 5.4.10.

Archaeological remains include both prehistoric and historic sites and both buried and standing remains, including artifacts, architecture, and botanical and zoological remains associated with Old-World-derived and Native American cultures.

In the United States, historic resources date to the period after European contact. Archaeological and architectural properties of sufficient significance and integrity are eligible for inclusion in the National Register of Historic Places (NRHP). Impacts to eligible sites located on Federal land must be considered, whether or not they are listed on the NRHP.

Cultural resources important to Native American groups include burials, artifacts, structures, areas of religious importance, and traditional natural resources including plants, animals, and land forms such as mountains or bodies of water. Impacts to these resources located on Federal land must also be considered.

The cultural resource baseline was based on DOE environmental reports. Inquiries were also sent to the State Historic Preservation Officers (SHPOs) with jurisdiction over the 17 major sites. Many of these sites

Table 4.3–8. Status of Known Sites With Regard to the National Register of Historic Places

Site	Acreage in FY 1995 FAAQ	Acres Inventoried[a]	Percent Inventoried	Historic and Archeological Sites				
				NRHP	NRHP Eligible	NRHP Ineligible	Awaiting Determination	Not NRHP Evaluated
ANL-E	1,700	1,700	100	0	3	20	23	ND
BNL	5,325	0	0	0	3	0	0	0
FEMP	1,150	700	61	0	3	39	ND	ND
Hanford	358,400	21,358	6	49	84	15	0	883
INEL	568,820	26,237	5	1	1	2	0	1,708
LLNL[b]	7,640	ND	ND	0	0	0	0	28
LANL	27,869	15,327	55	0	280	95	777	253
NTS	864,812	53,395	6	1	150	652	1,160	x
ORR	34,700	5,882	17	0	15	31	0	0
PGDP	3,423	1,361	40	0	0	3	1	2
Pantex	15,936	7,100	45	0	0	0	23	64
PORTS	3,714	0	0	0	0	0	0	0
RFETS	6,550	6,550	100	0	0	64	0	0
SNL-NM	2,830	2,830	100	0	0	0	0	0
SRS	298,000	51,818	17	0	55	116	208	827
WIPP	10,240	3,416	33	0	0	ND	33	ND
WVDP[c]	X	X	X	X	X	X	X	X

Notes: FAAQ = Federal Archaeological Activities Questionnaire; ND = no data provided by the facility in the FY 1995 FAAQ; X = no response provided by the facility in the FY 1995 FAAQ.

[a] Acres inventoried sufficiently to identify all readily apparent archaeological properties.

[b] Most recent data available are from FY 1992.

[c] While the West Valley Demonstration Project has not responded to the Federal Archaeological Activities Questionnaire, an archaeological survey covering 360 acres was conducted in 1990. As a result of this survey, nine archaeological sites were discovered, none of which has been listed in the National Register (NRHP), and a model predicting the likelihood of sites over the remainder of the site has been developed (DOE, 1996).

Source: Information provided by DOE's Federal Preservation Officer, Office of Environmental Policy and Assistance (based on the FY 1995 Archaeological Activities Questionnaire) (FAAQ).

have not been completely surveyed for cultural resources. These surveys would be required for any new construction associated with waste treatment, storage, and disposal facilities.

4.3.12 Safeguards and Security

DOE has a Safeguards and Security (S&S) Program to protect DOE interests from theft or diversion of special nuclear material; sabotage, espionage, loss or theft of classified matter or government property; and other hostile acts that may cause unacceptable adverse impacts on national security or on the health and safety of employees, the public, or the environment. Because radioactive and hazardous waste mishandled with malicious intent could cause adverse safety and health impacts, the Safeguards and Security Program applies to waste management, in addition to other material that presents greater safeguards and security risks. DOE's planning and preparedness for operational emergencies recognizes hostile attack, terrorism, sabotage, and malevolent acts as events that should be considered as possible initiators of operational emergencies. Operational emergency plans address coordination with Federal, state, tribal, and local organizations to locate and recover materials, especially those with national security implications. Of the types of waste considered in this PEIS, transuranic waste probably has the greatest safeguards and security implications because it contains plutonium, a special nuclear material.

4.4 Affected Environment at the Major Sites

This section contains a summary of the most pertinent facts characterizing the affected environment and defining the ROI for each of the 17 major sites. Each site is first described in terms of its location, mission, and brief history. This is followed by resource area-specific information. While useful at the programmatic level, this information will be supplemented by detailed analyses in sitewide or project-level NEPA reviews. Tables 3.6–1 through 3.6–5 provide a summary of which sites are considered under each alternative for each waste type.

4.4.1 Argonne National Laboratory-East—Chicago, Illinois

Argonne National Laboratory-East (ANL-E), a 1,500-acre site located 22 miles southwest of downtown Chicago in northeast Illinois, is an outgrowth of the Metallurgical Laboratory established in 1942 as part

of the Manhattan Project. The mission of this 4,670-employee research and development laboratory is to conduct programs in basic energy and related sciences. ANL-E is an important engineering center for the study of nuclear and nonnuclear energy sources. ANL-E is shown in Figure 4.4–1.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 7,939,785 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0085 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a). If radon is included, the dose is 0.24 mrem.
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 16.8 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- ANL-E and the counties surrounding it are classified by EPA as severe nonattainment areas for the criteria pollutant ozone. Lyons Township in southeast Chicago is listed as a moderate nonattainment area for particulate matter less than 10 micrometers in diameter (PM_{10}). The areas are in attainment for the other criteria air pollutants.
- Major sources of air pollution at the site include a steam plant, oil-fired boilers, gasoline and methanol dispensing facilities, two alkali metal reaction booths, a small vapor degreaser, a number of bulk chemical tanks, a dust collection system, a medical equipment sterilization unit, fire training activities, a combustion and power generation research facility, laboratory ventilation systems for hot cell facilities, and ventilation systems for active and inactive reactors and particulate accelerators.
- Prevailing winds are from the south and southwest with a significant northeast component. The frequency of calm winds is 3%. Average monthly temperatures of 27.9 to 68.5 degrees Fahrenheit (°F) were recorded in 1992. Precipitation for the year was 31.5 inches.

Water Resources

- Major surface water features include Lake Michigan (24 miles east), the Des Plaines River (1.25 miles southeast), and the onsite Sawmill Creek. The Freund Brook drains most of the site.
- No federally designated Wild and Scenic Rivers exist in the ROI.
- Sanitary and laboratory wastewaters are combined, treated, and discharged to Sawmill Creek, which drains into the Des Plaines River.

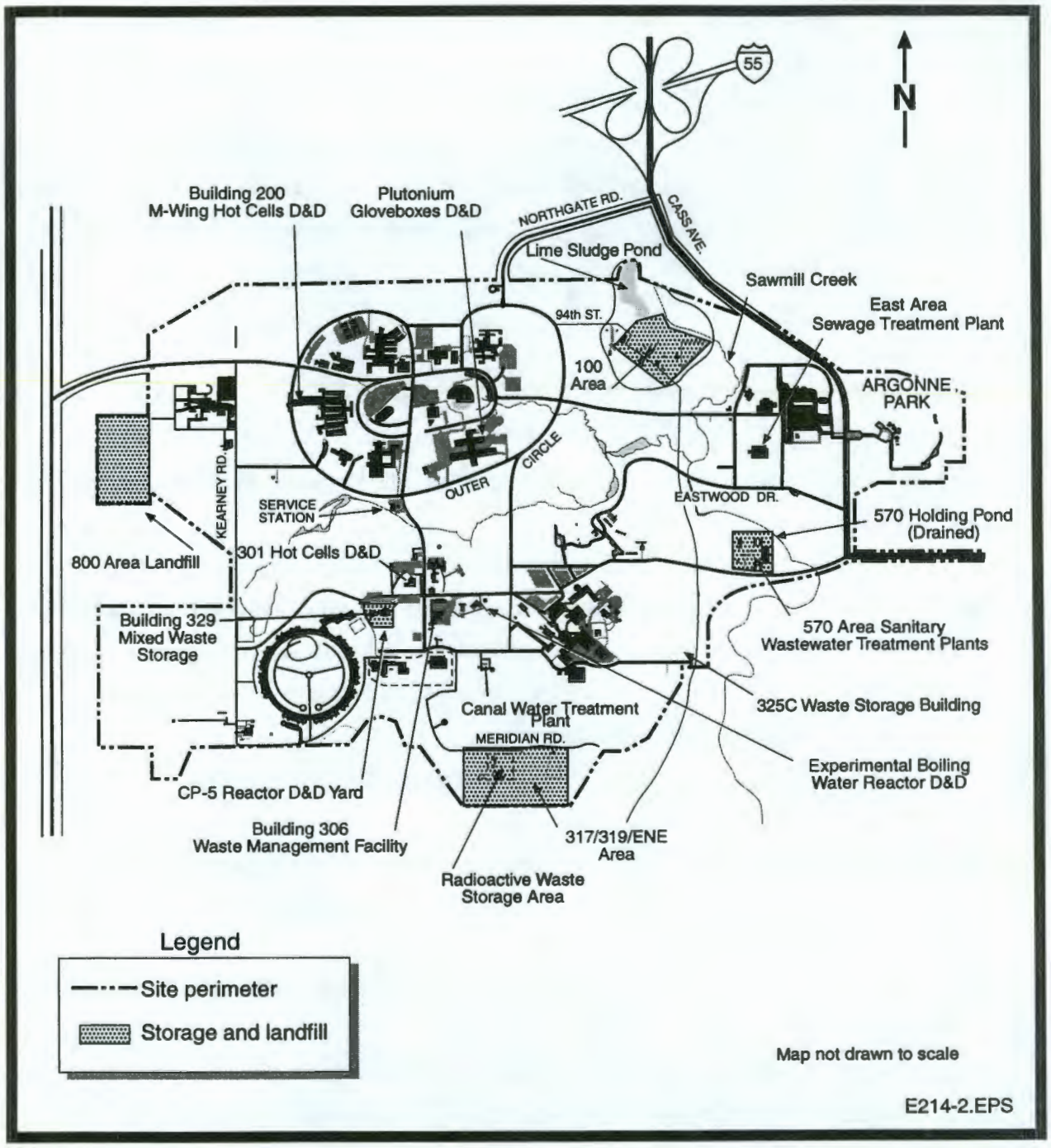


Figure 4.4–1. Argonne National Laboratory-East

- In 1993, all radionuclides measured in Sawmill Creek were a small fraction of the DOE-derived concentration guides.
- Water for the site is supplied by groundwater from the Niagara Aquifer.
- Major groundwater units include, from deep to shallow, the Galesville Sandstone, the Maquoketa Shale aquitard, and the Niagara and Alexandria Dolomite. No sole source aquifers exist beneath the site.
- Five commonly monitored groundwater contaminants exceeded comparison criteria in 1990.
- Site facilities are outside of the 500-year floodplain.

Geology and Soils

- The topography of the site is gently rolling, with an average elevation of about 725 feet above sea level.
- Major rock units include, from oldest to youngest, the Galesville Sandstone, the Maquoketa Shale, and the Niagara and Alexandria Dolomite.
- Glacial till is approximately 30 to 100 feet thick and overlies nearly horizontal sedimentary rocks.
- Most soils at the site are moderately well-drained silt loams with slopes ranging from 2% to 10%.
- Geologic hazards include little or no risk from earthquakes or volcanos. A few minor earthquakes have occurred in the northern Illinois area; these are believed to be caused by isostatic adjustments of the Earth's crust in response to glacial unloading.

Ecological Resources

- Vegetation communities are a mixture of open field, deciduous forest, pine plantation, and tall-grass prairie. Much of the natural vegetation in the ANL-E area has been altered by clearing and tillage. The 2,040-acre Waterfall Glen Forest Preserve surrounds ANL-E.
- Wetlands total 3.56 acres and consist of cattail marsh and wooded swamp. Adjacent wetlands are present in Waterfall Glen Forest Preserve.
- Federally listed threatened or endangered species are not known to reside on the ANL-E site. The Black Crowned Night Heron (*Nycticorax nycticonax*) is a State-listed endangered species residing onsite. The Federally endangered Indiana Bat (*Myotis sodalis*) and the Federally threatened Hine's Emerald Dragonfly (*Somatochlova hineana*) reside in the area and may possibly reside on the ANL-E site. Two State-endangered species, River Otter (*Lutra canadensis*) and White Lady's Slipper (*Cypridedium candidum*), and two State-threatened species, Kirtland's Snake (*Clonophis kwitlandi*) and Sedge (*Carex crawei*) reside in the area and may possibly reside on the ANL-E site.

Socioeconomic Conditions

- The ROI for ANL-E comprises Du Page, Cook, Kane, and Will Counties. Approximately 95% of the site's employees reside in these counties.
- Total site employment in 1990 was 4,455. Total ROI employment by place of work in 1990 was 3,883,841.
- The ROI unemployment rate in 1991 was 6.7%.
- The ROI per capita income in 1990 was $22,169.
- The total population in the ROI in 1990 was 6,568,800. Population demographics: Native Americans—0.2%; urban—97.4%.
- Housing: owner-occupied—59.4%; renter-occupied—40.6%.
- Sensitive populations: children (under 15 years old)—21.7%; women of child-bearing age (ages 15 to 44)—24.2%, adults over 65—11.6%.

Environmental Justice

- Minorities—Figure C.4–1.
- Below poverty level—Figure C.4–24.
- Presence of Federally recognized Native American Tribes: none.

Land Use

- The site covers an area of 1,500 acres, of which about 30% is developed; approximately 1,190 acres are available for development.
- The Waterfall Glen Forest Preserve, adjacent to the site, is used for skiing, hiking, and equestrian sports.
- The area immediately outside the preserve is predominantly single-family residential.

Infrastructure

- Four onsite wells provide an average of 0.645 million gallons of water per day.
- An onsite facility receives an average of 1.08 million gallons of sewage per day.
- Commonwealth Edison Company supplies power to the site; the current site load is 23 megawatts.
- Interstate I-55 provides direct access to the site from Chicago and Joliet. Interstates I-88, I-355, I-80, and I-294 are other major roads providing access to ANL-E. Local roads include Illinois Route 83, U.S. Route 45/20, and U.S. Route 34. The Santa Fe, Burlington Northern, Conrail Corporation, Union Pacific, Illinois Central, and CSX are among the major rail lines that ANL-E has access to.

Cultural Resources

- Native American groups lived in the region surrounding ANL-E from approximately 10,000 years ago until the beginning of Euro-American settlement during the early 19th century.
- Within ANL-E, 46 archaeological sites have been recorded. Of these, 23 await determination of eligibility for the National Register of Historic Places.
- Three archaeological sites within ANL-E are eligible for the National Register.

4.4.2 Brookhaven National Laboratory—Upton, New York

Brookhaven National Laboratory (BNL) is located in Upton, New York, 60 miles east of New York City, in the center of Suffolk County. The contract for the 5,263-acre site was approved by the Manhattan District of the Army Corps of Engineers in 1947, and BNL was established on the former Upton Army camp. The mission for this 3,557-employee site is to conceive, design, construct, and operate large, complex-research facilities for fundamental scientific studies and to conduct basic and applied research in the physical, biomedical, and environmental sciences and selected energy technologies. BNL is shown in Figure 4.4–2.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 5,738,554 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.11 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 2.7 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Suffolk County, in which BNL is located, is classified by EPA as a nonattainment area for the criteria pollutant ozone. The county is in attainment for the other five criteria air pollutants.
- Primary sources of air emissions at the site include furnaces, vehicle refueling stations, and surface coating and surface preparation operations.

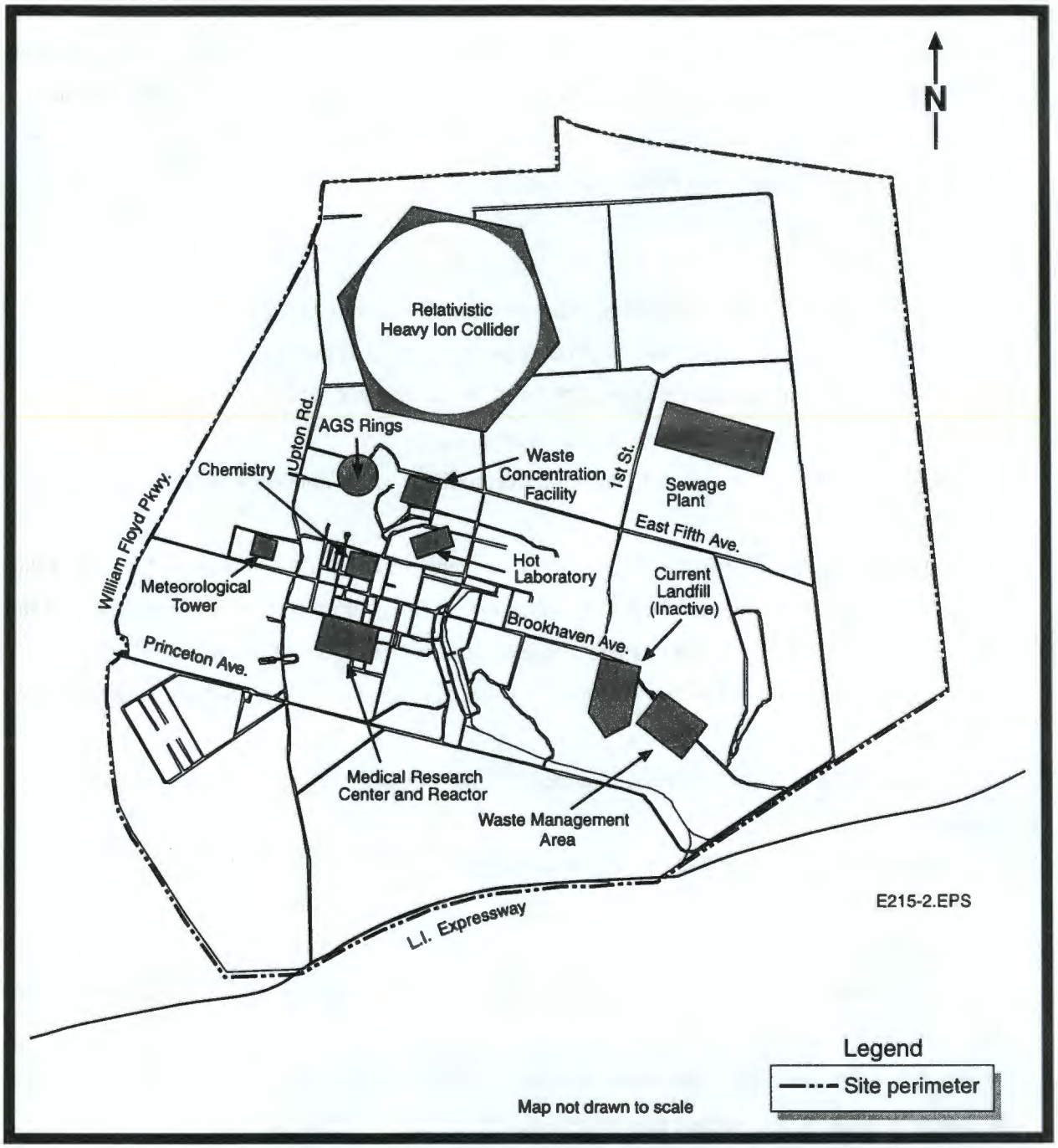


Figure 4.4–2. Brookhaven National Laboratory

- Prevailing winds in 1991 were from the south and southwest with a frequency of 12%. Dominant windspeed ranged from 8 to 11 miles per hour (mph) and occurred almost 34% of the time during 1991. The frequency of calm winds was 14%. Average monthly temperatures of 21.2 to 83.8 °F were recorded in 1991. Precipitation for the year was 45.3 inches.

Water Resources

- Major surface water features include the onsite Peconic River and its intermittent tributary.
- No federally designated Wild and Scenic Rivers exist in the ROI. A portion of the Peconic River that flows through the site has been designated "scenic" by the State of New York.
- Onsite streams and the Peconic River receive treated wastewater.
- Discharge monitoring in 1991 showed that all concentrations were within applicable standards, except for trichloroethylene.
- The Upper Glacial Aquifer and the Magothy Aquifer supply water for the site through 12 onsite wells.
- The major groundwater units are the lower aquifer system (Magothy and Raritan Formations) and the Pleistocene Upper Glacial Aquifer. These aquifers are considered sole source aquifers.
- Groundwater monitoring in 1991 showed that 8 parameters exceeded New York State Drinking Water Standards.
- Some groundwater contamination has migrated off site at concentrations that exceed drinking water standards.
- A portion of the BNL site is in the 100-year floodplain.

Geology and Soils

- The topography of the site is generally gently rolling, with elevations ranging from 43.6 to 120 feet above sea level.
- Major geologic units include, from oldest to youngest, the basement rocks, the Raritan Formation, the Magothy Formation, and surface glacial deposits.
- Glacial deposits include the Gardiners Clay, overlain by 170 feet of sand.
- Soils on the site consist of deep, well-drained to excessively drained, coarse-textured soils.
- Geologic hazards include little or no risk from earthquakes or volcanos.

Ecological Resources

- Vegetation at BNL includes pine plantation, moderately mature pitch pine/oak forest, predominantly deciduous forest, early successional shrub/sapling community, pine barren, shrub/sapling wetland, and

lawn area. Approximately 75% of BNL is primarily woodland. Old-growth hardwood trees that are unusual in the region are located next to BNL. Unique habitats include coastal plain ponds and a coastal plain stream.

- Wetlands include palustrine forested, herbaceous, and lacustrine wetlands.
- Based on a survey of 15 ecological communities identified on or adjacent to BNL, the peregrine falcon is the only Federal and State-listed endangered species reported to occur onsite at BNL. The bald eagle, Federally listed as threatened, is also reported at BNL. State-listed species include 4 threatened (osprey, red-shouldered hawk, northern harrier, and common tern), 1 endangered (eastern tiger salamander), and 12 species of special concern. A wetland on BNL is a breeding area for the eastern tiger salamander. No Federal or State-listed endangered, threatened, or special concern plants are found on site at BNL. However, one Federal endangered plant, the sandplain gerardia, has been reported in the Brookhaven area (though not on or adjacent to the site), and five flowering plants and eight fern species found at BNL are protected under State law.

Socioeconomic Conditions

- The ROI for BNL comprises Suffolk and Nassau Counties. Ninety percent of the site's employees reside in these counties.
- Total site employment in 1990 was 3,557. Total ROI employment by place of work in 1990 was 1,419,040.
- The ROI unemployment rate in 1991 was 6%.
- The ROI per capita income in 1990 was $27,919.
- The total population in the ROI in 1990 was 2,609,212. Population demographics: Native Americans—0.2%; urban—97.9%.
- Housing: owner-occupied—80.28%; renter-occupied—19.72%.
- Sensitive populations: children (under 15 years old)—19.9%; women of child-bearing age (ages 15 to 44)—23.2%; adults over 65—12.4%.

Environmental Justice

- Minorities—Figure C.4–8.
- Below poverty level—Figure C.4–25.
- Presence of Federally recognized Native American Tribes: none.

Land Use

- The site covers an area of 5,263 acres, of which 1,655 acres are developed. The site contains six designated, regulated wetlands and areas where the water table is close to the surface, that comprise an aggregate area of approximately 700 acres. Thus, approximately 2,900 acres are available for development.
- Land use surrounding the site is predominantly undeveloped private and public forest land but is experiencing intensified pressure for residential development. BNL is located in the Central Pine Barrens and within the Peconic Estuary system.

Infrastructure

- An onsite water treatment plant supplied by groundwater provides an average of 4.5 million gallons of water per day.
- An onsite plant receives an average of 1 million gallons of sewage per day, with the effluent discharged to the headwaters of the Peconic River.
- The Long Island Lighting Company supplies power to BNL; the current site load is 35 megawatts.
- Interstate I-495 provides direct access between BNL and New York City. The region surrounding BNL is served by the Long Island Railroad.

Cultural Resources

- BNL contains no recorded archaeological sites, standing structures, or traditional cultural properties. However, the site has not been the subject of a comprehensive cultural resource investigation.
- Three areas that have been identified as eligible for inclusion on the National Register of Historic Places.

4.4.3 FERNALD ENVIRONMENTAL MANAGEMENT PROJECT—FERNALD, OHIO

The Fernald Environmental Management Project (FEMP), formerly Feed Materials Production Center, is just north of Fernald, Ohio, a small farming community in southwest Ohio (about 17 miles northwest of downtown Cincinnati). In operation since 1952, the primary mission of the 1,050-acre FEMP was to produce purified uranium metal and uranium compounds for use at other DOE defense facilities. A small amount of thorium processing has also been conducted at FEMP. FEMP is shown in Figure 4.4–3.

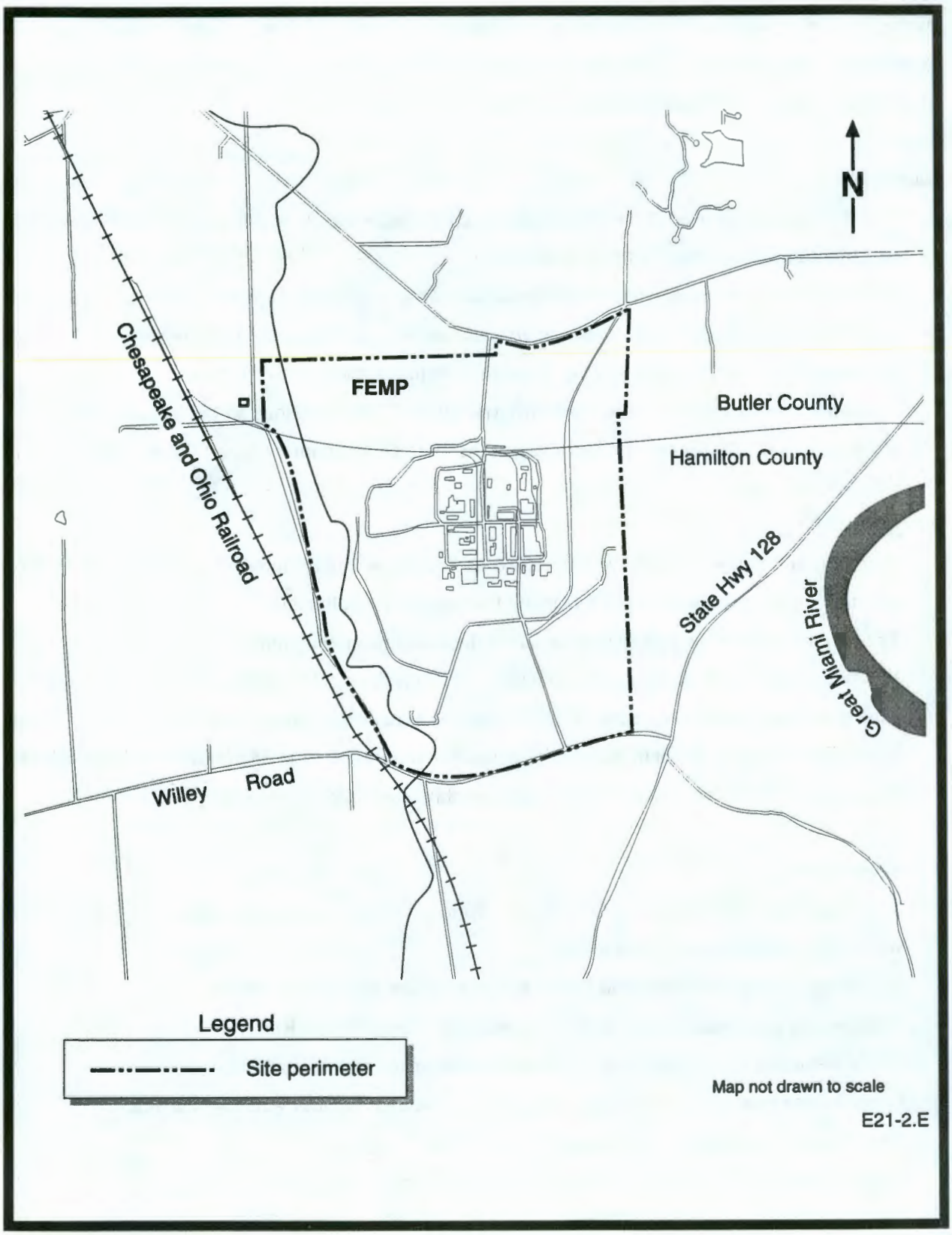


Figure 4.4–3. Fernald Environmental Management Project

By the late 1980s, production was suspended, and the site's mission was changed from uranium production to environmental restoration of the site. The 1,939 FEMP employees are now engaged in cleanup of the site and support of the waste management and base services activities.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 2,764,589 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0021 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a). If radon is included, the dose is 51 mrem.
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 1.30 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Hamilton and Butler Counties are classified as "moderate nonattainment" areas for ozone; these counties are in attainment for the remaining five criteria air pollutants.
- The major source of air pollution at the site is the boiler plant emissions.
- Prevailing winds are from the south southwest 12% of the time; calm winds occur 4% of the time. The annual average windspeed recorded at the Greater Cincinnati Airport was 9 mph with 1-minute sustained winds up to 46 mph. Average monthly temperatures of 32 to 88 °F were recorded in 1992. Precipitation for the year was 38 inches; the monthly maximum was 7 inches in July.

Water Resources

- Major surface water features include Paddy's Run, which drains the site to the Great Miami River, which then drains into the Ohio River.
- No federally designated Wild and Scenic Rivers exist downstream of the site.
- Wastewaters are discharged to onsite streams and the Great Miami River.
- Two parameters in the surface water exceeded comparison criteria in 1992.
- Groundwater from the Great Miami Buried Valley Aquifer supplies water for the site.
- The Great Miami Buried Valley Aquifer is a sole source aquifer.
- Eleven contaminants in the groundwater exceeded comparison criteria in 1992.
- The site is located above the 100-year floodplain of the Great Miami River.

Geology and Soils

- The site lies on a terrace remnant above the Great Miami River Valley. Glacial features dominate the landscape.
- Bedrock consists of sedimentary shales and limestone approximately 60 to 200 feet below the ground surface. The bedrock forms the floor and valley walls of the New Haven Trough.
- No major geologic faults have been mapped.
- The dominant soils at the site are silty loams of glacial origin. These soils are poorly drained, occur on relatively flat surfaces, have low permeability, and experience seasonal saturation.
- Geological hazards include little or no risk from subsidence, earthquakes, or volcanic eruptions.

Ecological Resources

- Vegetation consists of nonnative grasslands, pine plantations, deciduous woodlands, and riparian woodlands.
- Ecologically important habitat includes mature woodlands, pine for managed wildlife species, such as white-tailed deer and eastern cottontail rabbit, and riparian woodlands. Cattle grazing and brush clearing have resulted in habitat fragmentation and reduction in wildlife corridors.
- A total of 35.9 acres of freshwater wetlands (palustrine forested, drainage ditches/swales, and isolated persistent emergent and scrub/shrub wetlands) were delineated at FEMP.
- No Federally listed threatened or endangered plant or animal species are known at FEMP. However, potential habitat exists for the Indiana bat (Federal and State endangered). Running buffalo clover, a Federally listed endangered plant species, occurs near FEMP. Seven state-listed endangered species (including the Indiana bat) and three state-listed threatened species occur or potentially occur at FEMP.

Environmental Justice

- Minorities—Figure C.4–9.
- Below poverty level—Figure C.4–26.
- Presence of Federally recognized Native American Tribes: none.

Socioeconomic Conditions

- The ROI for FEMP comprises Hamilton, Butler, and Warren Counties in Ohio and Dearborn County in Indiana. Ninety percent of the site's employees reside in these counties.
- Total site employment in 1990 was 1,939. Total ROI employment by place of work in 1990 was 804,376.

- The ROI unemployment rate in 1991 was 6%.
- The ROI per capita income in 1990 was $19,275.
- The total population in the ROI in 1990 was 1,313,000. Population demographics: Native Americans—0.1%; urban—89.1%.
- Housing: owner-occupied—62.4%; renter-occupied—37.6%.
- Sensitive populations: children (under 15 years old)—23.8%; women of child-bearing age (ages 15 to 44)—23.9%; adults over 65—12.2%.

Land Use

- The site covers an area of 1,050 acres, of which 275 acres are developed; of the area that is undeveloped, 195 acres are considered environmentally sensitive. Land available for development is approximately 275 acres.
- Land use surrounding the site is predominantly agricultural.

Infrastructure

- An onsite well system provides an average of 0.4 million gallons of water per day. Connection to a public system is planned.
- An onsite wastewater treatment plant treats an average of 2.18 million gallons of sewage per day and discharges treated effluent into the Little Miami River.
- The Cincinnati Gas and Electric Company supplies power to the site; average loads are 33 megawatts.
- Transportation in the region consists of roads and interstates, such as nearby State Route 126. U.S. Route 27 provides access to Interstates 275 and 74. Rail access is by the Baltimore and Ohio Railroad, 3 miles to the west.

Cultural Resources

- Native American occupation of the FEMP area began about 14,000 years ago. European settlement began during the late 18th century.
- The site has 42 recorded archaeological sites, standing structures, or traditional cultural properties. Sixty-one percent of this site has been subject to a comprehensive cultural resources survey.
- Three areas are eligible for inclusion on the National Register of Historic Places.

4.4.4 HANFORD—RICHLAND, WASHINGTON

The Hanford Site occupies approximately 560 square miles of semi-arid desert land in southeastern Washington State, approximately 119 miles southwest of Spokane and 150 miles southeast of Seattle, and employs approximately 14,394 people. The Federal Government acquired the Hanford Site in 1943, and for almost 50 years, Hanford's facilities were dedicated to plutonium production and to the storage and disposal of the resulting waste products. Since the 1960s, however, programs at the Hanford Site have diversified to include research and development for advanced reactors, renewable energy technologies, waste disposal technologies, and cleanup of site contamination. The Hanford Site is shown in Figure 4.4–4.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 377,645 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0037 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 0.60 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Benton and Franklin Counties are classified as attainment areas for all six of the National Ambient Air Quality Standards criteria air pollutants. The southernmost portions of Benton, Franklin, and Walla Walla Counties (which do not include the Hanford Site) are suspected to be in nonattainment for particulate matter under 10 micrometers in diameter (PM_{10}), although they are not classified as nonattainment areas.
- Major sources of air pollution at the site are the 9 primary boiler units, the 300-Area incinerator, and fugitive emissions from the 200-East and 200-West coal piles.
- Prevailing winds are from the northwest during all months of the year, with monthly average speeds of 6 to 7 mph in the winter and 9 to 10 mph in the summer. Temperatures range from 36°F in early January to 95°F in late July. Annual average precipitation is 6.3 inches.

Water Resources

- Major surface water features include the onsite Columbia River and the nearby Yakima River. The Columbia River, which forms some of the site's eastern boundary, is regulated by a network of dams.

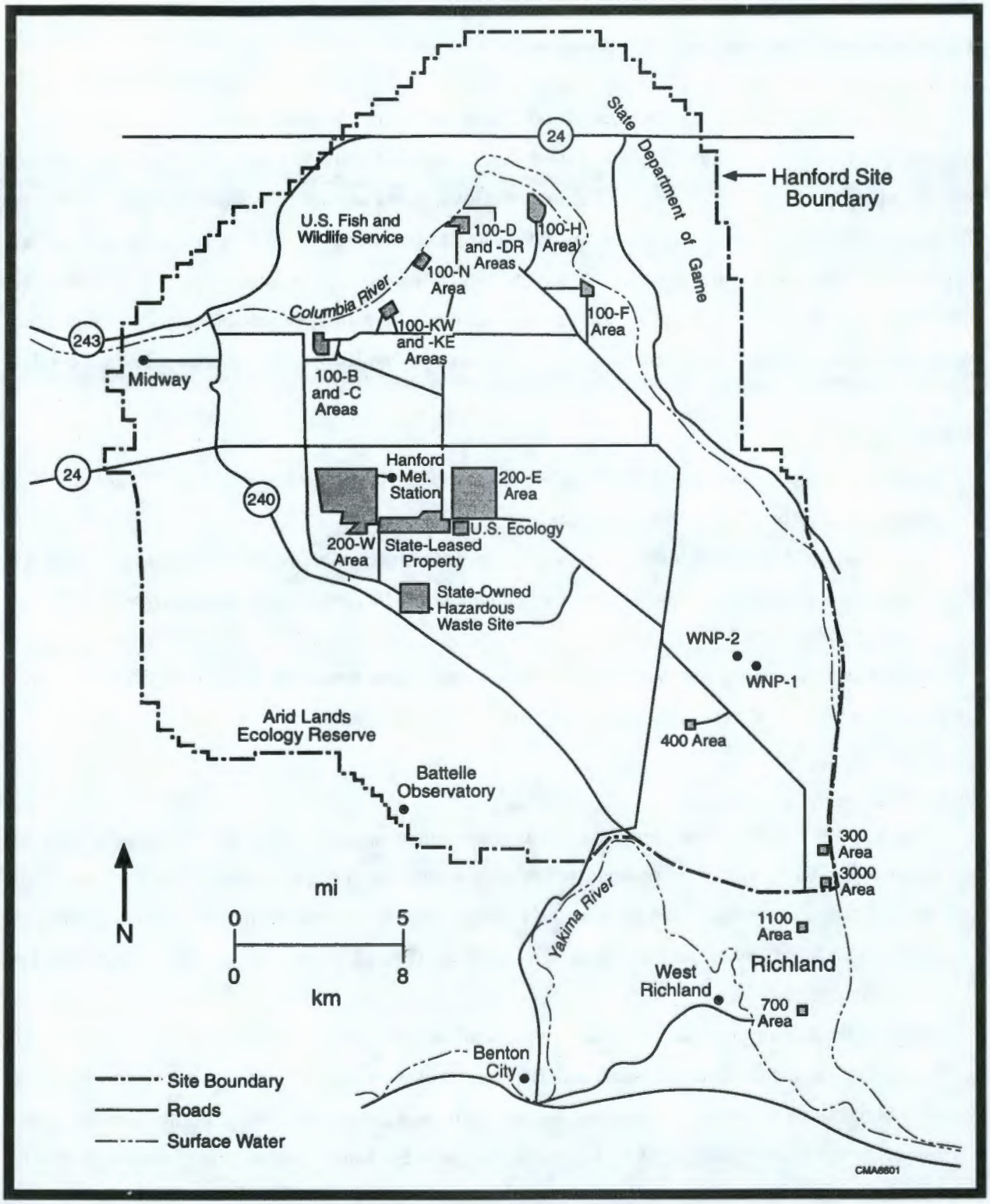


Figure 4.4–4. Hanford Site

- No federally designated Wild and Scenic Rivers exist in the ROI, although the Hanford Reach of the Columbia River has been recommended for inclusion in the Wild and Scenic Rivers System in the Record of Decision for the *Final Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* (DOI, 1994).
- The probable maximum flood would inundate parts of the 100-Area located adjacent to the Columbia River.
- The Columbia River and onsite wells supply water for the site.
- Treated wastewater is discharged to onsite drainfields and the Columbia River.
- Results from surface water monitoring in 1992 show five parameters exceeded comparison criteria.
- Unconfined aquifers contained within glaciofluvial sands and gravels and within the Ringold Formation and deeper confined aquifers within the Columbia River Basalts are the major groundwater units. No aquifers are considered sole source aquifers.
- Groundwater monitoring in 1992 showed that 14 parameters exceeded comparison criteria. Preliminary investigations have identified four major groundwater contaminant plumes, which have been found to enter the Columbia River in at least three locations.
- Lands susceptible to the 500-year flood on the Columbia River would be restricted to those areas of the site adjacent to the river. The 100-year flood on the Yakima River could extend into the southern section of the site.

Geology and Soils

- The site is on the intermontane Columbia Plateau, with the topography dominated by basalt plateaus, ridges, and buttes.
- Surface sediments consist of as much as 1,640 feet of unconsolidated sands, silts, gravels, and clays.
- Major rock units include—from oldest to youngest—flood basalts; the Ringold Formation consisting of unconsolidated fluvial sediments; the glacial Hanford Formation; and ash layers from Crater Lake, Oregon, Glacier Peak, Washington, and Mount St. Helens, Washington.
- Anticlines form surface highs in the region and are broken by faults on their crests. Steeply dipping shear zones are abundant in the region and extend to the northwest.
- Surficial soils vary from sand to silty and sandy loam but are predominantly deep, well-drained sandy loams. The Hanford formation near the Columbia River consists of coarse-grained soils composed mostly of the soil column above the basalt.

- The seismicity of the Columbia Plateau is relatively low. Shallow, low-intensity earthquakes occur throughout the Hanford Site area, although quakes of greater magnitude have occurred in the plateau region.

Ecological Resources

- The Hanford Site contains the largest tract of undisturbed native sagebrush steppe remaining in the State of Washington and is 6 linear miles from the second largest tract in the state, the Yakima Training Center. The National Biological Service has listed native shrub and grassland steppes in Washington and Oregon as an endangered ecosystem (Noss, 1995). This habitat also has been identified as a priority habitat by the State of Washington. There are 24 major plant communities (DOE, 1995). Big sagebrush and bitterbrush are important desert shrubs, and some plants have medicinal and dye value. Important terrestrial habitats include riparian areas, native shrub and grasslands, canyons, upland habitats, basalt outcroppings and cliffs, and trees that serve as nesting platforms for birds.
- Wetlands occur on the Hanford Site, with the largest wetland being the riparian zone bordering the Columbia River.
- The peregrine falcon (Federal and State endangered), the bald eagle (Federal and State threatened), and the Aleutian Canada Goose (Federal threatened, State endangered) are found on the Hanford Site. The peregrine falcon is a casual migrant to the Hanford Site and does not nest there. The bald eagle winters along the Hanford Reach. State-listed species include seven State endangered and four State threatened species. Eleven Federal candidate species (three are State threatened; two are State endangered; one is a State species of special concern; and two are State candidate species) have been observed. It is Hanford Site policy to treat candidate species in the same manner as listed species. An additional seven State candidate species have been found on the Hanford Site, as well as nineteen State plant species of concern. The Hanford Reach is the only significant mainstream spawning habitat remaining for Fall Chinook salmon. The Hanford Reach is the only significant remaining section of the inland Columbia River where White sturgeon are able to spawn. Three plant and seven insect species new to science have been discovered on the Hanford Site since 1994, indicating a very high-quality ecosystem.

Socioeconomic Conditions

- The ROI for the Hanford Site comprises Adams, Benton, Franklin, Grant, and Yakima Counties. Ninety-nine percent of the site's employees reside in these counties.

- Total site employment in 1990 was 14,394. Total ROI employment by place of work in 1990 was 214,298.
- The ROI unemployment rate in 1991 was 10.9%.
- The ROI per capita income in 1990 was $15,927.
- The total population in the ROI in 1990 was 409,200. Population demographics: Native Americans—2.5%; urban—50.1%.
- Housing: owner-occupied—63.1%; renter-occupied—36.9%.
- Sensitive populations: children (under 15 years old)—26.2%; women of child-bearing age (ages 15 to 44)—21.7%; adults over 65—11.8%.

Environmental Justice

- Minorities—Figure C.4–10a.
- Below poverty level—Figure C.4–27.
- Presence of Federally recognized Native American Tribes: Yakima Nation, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, Confederated Tribes of the Warm Springs Indian Reservation.

  Tribal lands—Figure C.4–10b.

Land Use

- The site occupies approximately 560 square miles (358,300 acres) of arid desert land, of which 21,498 acres (6%) are developed. Of the undeveloped area, 77,000 acres have been set aside as an arid land ecology reserve, and an additional 89,000 acres (Wahluke Slope) are managed by the U.S. Fish and Wildlife Service and the Washington Department of Fish and Wildlife as a National Wildlife Refuge and Wildlife Area. Land area recommended for future waste management activities is 6,000 acres.
- The predominant land uses in the ROI are agriculture, the Yakima Indian Reservation, the Yakima Training Center (Department of Defense), and the Hanford Site.

Infrastructure

- Onsite wells and the Columbia River provide an average of 9.51 million gallons of water per day.
- Onsite treatment facilities (such as septic tanks, subsurface soil absorption systems, and a sanitary treatment plant) treat an average of 0.158 million gallons of sewage per day.
- The Bonneville Power Administration supplies power; average loads are 59.36 megawatts.

- Transportation in the region consists of local access roads, such as State Routes 240 and 24 and Interstates 82 and 90. Rail lines, including the onsite U.S. Government railroad, also serve the region.

Cultural Resources

- Native American settlement of the region began approximately 10,000 years ago. Europeans occupied the region during the 19th century.
- The Hanford Site contains numerous recorded archaeological and may contain additional traditional cultural properties important to Native American groups.
- The Hanford Site contains several industrial and architectural properties, including the Hanford B Reactor, that are listed on the National Register of Historic Places.

4.4.5 IDAHO NATIONAL ENGINEERING LABORATORY—IDAHO FALLS, IDAHO

The Idaho National Engineering Laboratory (INEL) occupies 890 square miles (569,600 acres) of desert in the southeastern portion of Idaho, approximately 42 miles west of Idaho Falls. INEL was established in 1949 as a site where DOE could safely build, test, and operate various types of nuclear facilities. Currently, the focus of INEL is environmental restoration, waste management, and technology development. INEL is shown in Figure 4.4–5.

Included within the boundaries of INEL are two sites, Naval Reactors Facility (NRF) and Argonne National Laboratory-West (ANL-W), that are included in the analysis of the LLMW alternatives. The NRF site occupies 4,400 acres in the central portion of the INEL site, but only 84 acres are developed. The NRF is engaged in research and development for design and operation of naval nuclear propulsion plants as part of the joint DOE and Department of Navy Naval Nuclear Propulsion Program.

ANL-W is located on a 1,900-acre site on the southeastern portion of INEL. The primary mission of ANL-W is research and development in support of the Nation's fast reactor program. Approximately 850 persons are employed at ANL-W.

These two sites share the same environmental features with the INEL site and thus the summary descriptions presented below also apply to NRF and ANL-W.

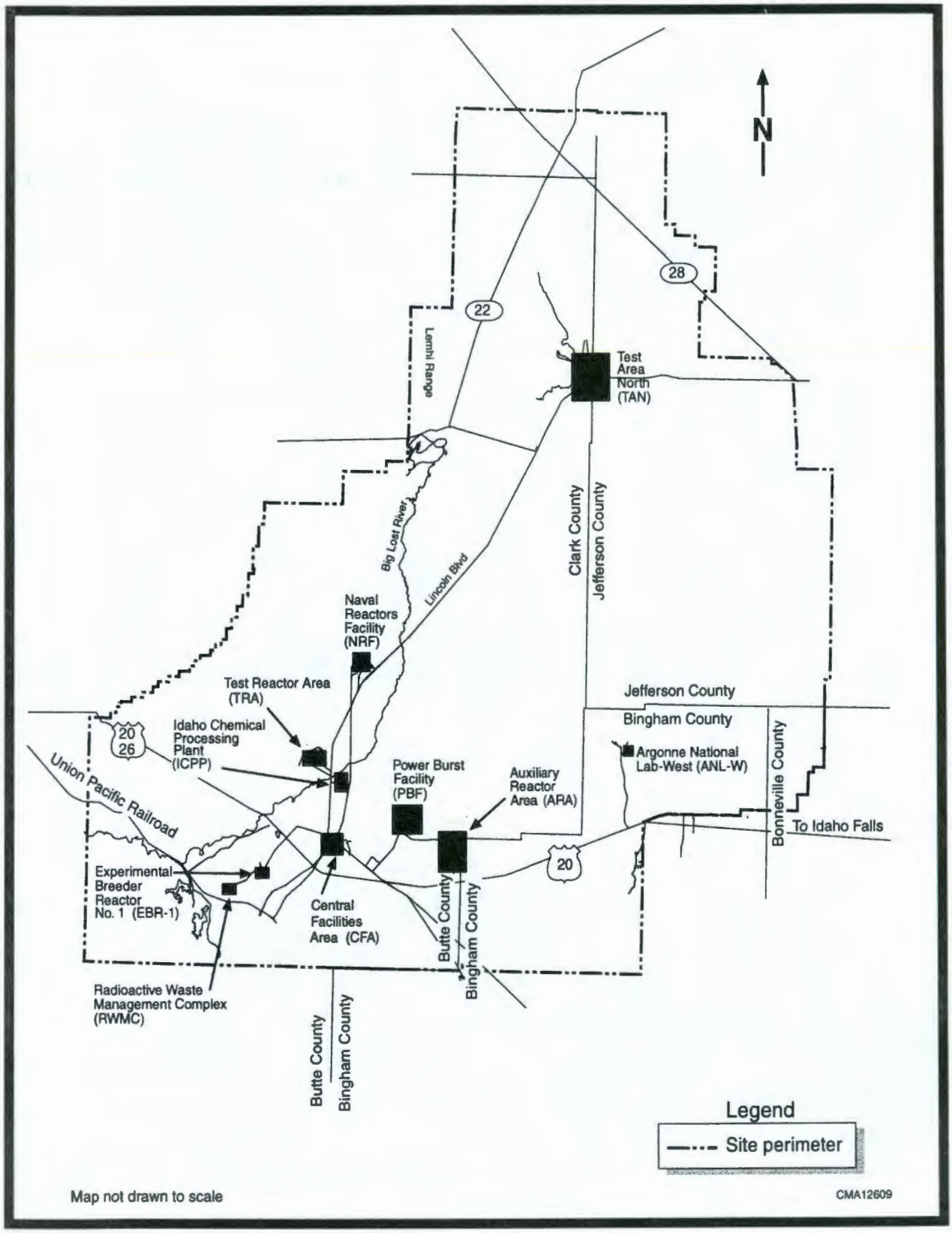


Figure 4.4–5. Idaho National Engineering Laboratory

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 153,061 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0015 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 0.030 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- The counties of Butte, Jefferson, Bonneville, and Bingham are classified as attainment areas for all six of the National Ambient Air Quality Standards criteria air pollutants.
- Major sources of air pollution at the site are the DOE programs, including irradiation services, calcination of liquid radioactive waste solutions, light-water-cooled reactor testing research, operation of research reactors, environmental restoration at the site, and storage and surveillance of solid transuranic waste.
- The prevailing wind directions are from the south to southwest and from northwest to northeast, with annual average speeds of 7 mph. Windspeeds are lowest during the winter months, averaging 5 mph, and highest during the spring months, averaging 8 mph. Annual temperatures average 42°F, ranging from -49 to 103°F.

Water Resources

- Major surface water features include the Big Lost River, the Little Lost River, and Birch Creek, all of which flow toward the INEL site, although only the Big Lost River actually flows onto the site in years of high precipitation. Because of infiltration, evaporation, and uptake by plants, none of the rivers flow off site.
- No Federally designated Wild and Scenic Rivers exist in the ROI.
- If Mackay Dam fails, the Idaho Chemical Processing Plant, the Naval Reactors Facility, and Test Area North would be flooded.
- Wastewater is discharged to onsite drainfields or evaporation/percolation ponds.
- Because creeks and rivers at INEL are ephemeral, surface water sampling can only be performed infrequently, after heavy precipitation events.
- Water is supplied by wells in the Snake River Plain Aquifer.

- The major groundwater unit is the Snake River Plain Aquifer, consisting of 1,000 to 2,000 feet of basaltic rocks and interbedded sedimentary sequences. It is considered a sole source aquifer.
- Groundwater monitoring for radioactive and nonradioactive parameters in 1992 showed levels above comparison criteria for four contaminants at onsite wells. No contaminants were found to exceed established EPA levels in offsite wells.
- Only one contaminant exceeded its comparison criterion in onsite wells in 1994.

Geology and Soils

- The topography is flat to gently rolling with frequent lava outcrops and an average elevation of 4,900 feet above sea level.
- The site is located in the Eastern Snake River Plain with the Lemhi, Lost River, and Bitterroot Mountain ranges bordering the site on the north and northwest.
- Underlying rock includes basaltic lava flows interbedded with sediments to a depth of several thousand feet.
- Soils beneath the southern part of the site are gravelly to rocky and generally shallow; the northern part is covered by lake and wind deposits, and most soils are composed of unconsolidated clay, silt, and sand.
- Geologic hazards include possible earthquakes with moderate to major probability of seismic damage. Historically, few earthquakes have occurred on the Eastern Snake River Plain, although two major earthquakes (Richter magnitude 7.5 and 7.3) have occurred within 100 miles of the site during the last 35 years. The most recent volcanism occurred about 2,100 years ago, 15 miles southeast of the site.

Ecological Resources

- Saltbrush deserts, juniper woodlands, native grasslands, big and low sagebrush, and riparian communities are found on INEL. Big sagebrush is dominant, covering approximately 80% of INEL. Nonnative cheatgrass is a serious threat to the integrity of the sagebrush shrub-steppe community. Unusual lava-tube cave systems are found throughout INEL and in nearby areas.
- Potential wetlands total approximately 2,000 acres and include waste ponds, river diversion spreading areas and hundreds of small playas.
- The bald eagle (Federal threatened, State endangered) and American peregrine falcon (Federal and state endangered) are found on INEL, but they do not reside year-round on INEL. No known critical habitat is found at INEL, and no known listed Federal or State threatened or endangered plant species are found at the site. However, one plant is listed by the State as imperiled, and eight Federal candidate

species (two are State species of special concern) and five State species of special concern are found on INEL.

Socioeconomic Conditions

- The ROI for INEL comprises Bannock, Bingham, Bonneville, Butte, Clark, and Jefferson Counties. At least 95% of the site's employees reside in these counties.
- Total site employment in 1990 was 11,813. Total ROI employment by place of work in 1990 was 99,692.
- The ROI unemployment rate was 5.3% in 1991.
- The ROI per capita income in 1990 was $14,622.
- The total population in the ROI in 1990 was 196,039. Population demographics: Native Americans—2.5%; urban—56.3%.
- Housing: owner-occupied—72.1%; renter-occupied—27.9%.
- Sensitive populations: children (under 15 years old)—30%; women of child-bearing age (ages 15 to 44)—21.6%; adults over 65—9.7%.

Environmental Justice

- Minorities—Figure C.4-11a.
- Below poverty level—Figure C.4-28.
- Presence of Federally recognized Native American Tribes: Fort Hall Shoshone-Bannock Tribes. Tribal lands—Figure C.4-11b.

Land Use

- The site occupies approximately 890 square miles (569,600 acres) of desert, of which 11,391 acres (2%) are developed, and the remainder is undeveloped; of the 550,000 acres that are undeveloped, approximately 330,000 acres are currently used for controlled grazing by cattle and sheep. The available area for future site development is approximately 22,330 acres.
- Land use surrounding the site is predominantly vacant and undeveloped, primarily devoted to grazing by sheep and cattle.

Infrastructure

- Onsite wells and storage tanks provide an average of 5.242 million gallons of water per day.

- Onsite treatment facilities (such as septic tanks, drainfields, or wastewater treatment plants) treat an average of 0.254 million gallons of sewage per day.
- The Idaho Power Company supplies power; the current load is 41.8 megawatts.
- Transportation in the region consists of local access roads such as U.S. Routes 20 and 26. Interstate 15 passes to the east of the site and intersects Interstate 84 to the south. Rail lines, including an onsite spur connecting to the Union Pacific Railroad, also serve the region.

Cultural Resources

- With only 5% of the facility surveyed, INEL contains at least 1,700 archaeological properties. The extent of INEL's architectural resources and traditional cultural properties has not been identified.
- INEL contains one National Historic Landmark—the Experimental Breeder Reactor #1. One archaeological site has been listed, and the Experimental Breeder Reactor #1 has also been designated for listing on the National Register of Historic Places.

4.4.6 LAWRENCE LIVERMORE NATIONAL LABORATORY—LIVERMORE, CALIFORNIA

The Lawrence Livermore National Laboratory (LLNL) includes the Livermore Site, and LLNL Site 300. The WM PEIS also analyzed the Sandia National Laboratories (California) (SNL-CA) as part of LLNL. The LLNL Livermore Site occupies 1.3 square miles, is located 40 miles east of San Francisco and 3 miles east of Livermore in Alameda County, and employs 8,964 people. LLNL Site 300 covers 10.8 square miles, is located 15 miles southeast of Livermore, and employs 200 people. The SNL-CA is located on 413 acres next to and south of the LLNL Livermore Site. LLNL is shown in Figure 4.4–6.

In 1952, the Atomic Energy Commission (AEC) established the University of California Radiation Laboratory-Livermore Site (LLNL's predecessor) as a laboratory dedicated to nuclear weapons research. The University of California has managed and operated LLNL for DOE and its predecessor agencies. In 1953, to support the LLNL Livermore activities, the AEC purchased the first 4,000 acres of Site 300 for high-explosive testing. In 1956, SNL established the Livermore facility to provide a closer relationship with the LLNL design work. Today, the major programs at LLNL include defense and related programs, laser fusion, laser isotope separation, biomedical and environmental research, and environmental restoration and waste management.

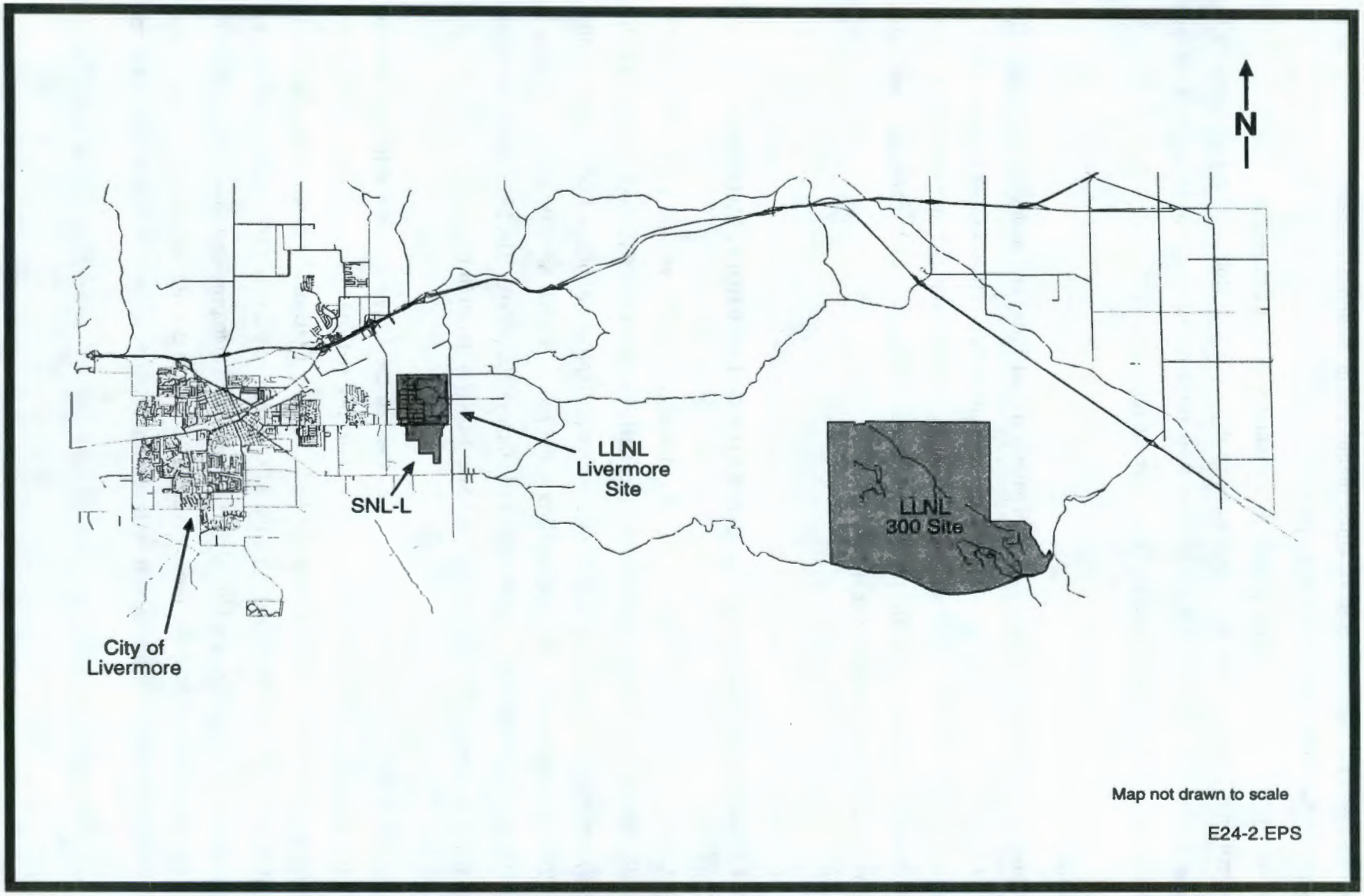


Figure 4.4–6. Lawrence Livermore National Laboratory

Owing to the proximity of SNL-CA to LLNL, the summary descriptions of environmental features presented below largely reflect the situations at SNL-CA.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 6,324,234 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) from point sources was 0.690 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a). The radiation dose from all sources for CY 1992 was 0.079 rem.
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 1.70 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Alameda County, which is located in the Bay Area Air Quality Management District, is currently classified as an attainment area for all six criteria air pollutants.
- Major sources of criteria pollutant emissions from the site are 96 boilers, 51 solvent cleaners, printing operations, paint booths, and oil shale experimental equipment. Tritium has been discharged from the tritium facility and miscellaneous diffuse sources.
- Prevailing winds at the San Francisco Airport in 1992 were from the west and northwest approximately 49% of the time, with the highest annual occurrence of windspeed of 4.6 to 11.5 mph 28% of the time. The average annual temperature is 59°F, ranging from a low monthly average of 46°F in January to a high monthly average of 71°F in July.

Water Resources

- Major surface water features at the Livermore Site include intermittent streams (such as Arroyo Mocho, Arroyo Seco, and Arroyo Las Positas), Patterson Reservoir (0.8 mile northeast of the Livermore Site), and Alameda Creek. Corral Hollow Creek is the only major surface water feature near Site 300 that receives drainage from local tributaries.
- No federally designated Wild and Scenic Rivers exist in the ROI.

- The Hetch Hetchy Aqueduct system supplies water for the Livermore Site. Groundwater is the main water supply for Site 300.
- No site facilities at either the Livermore Site or Site 300 lie within 100-year floodplains of Alameda Creek and Corral Hollow Creek, although portions of the Livermore Site adjacent to Greenville Road and portions of Site 300 near Corral Hollow Road are within the floodplains of the Arroyo Las Positas and Corral Hollow Creek, respectively.
- The majority of the wastewater generated from the Livermore Site discharges to the City of Livermore Water Reclamation Plant. Small amounts of low-threat wastewater are discharged into the stormwater drainage system under permits from the State and according to the CERCLA Record of Decision. Wastewater from Site 300 is released under permits, waivers, and agreements with the State of California.
- Major groundwater units at the Livermore Site include alluvial sediments and overlying lacustrine Livermore Formation sediments. Two water-bearing zones exist beneath Site 300 in the sandstones and conglomerates of the Neroly Formation. No aquifers are considered sole-source aquifers.
- Routine groundwater and surface water monitoring are conducted at both the Livermore Site and Site 300. Results of this monitoring are reported annually in the LLNL Environmental Report. Routine groundwater monitoring in 1992 showed that four parameters exceeded comparison criteria at the Livermore Site, and four parameters exceeded comparison criteria at Site 300.

Geology and Soils

- The LLNL Livermore Site is on relatively flat foothills with low relief and elevations ranging from 571 to 676 feet above National Geodetic Vertical Datum. Site 300 is in the Altamont Hills and includes steep ridges and canyons. Elevations range from 500 to 1,722 feet.
- The sediments beneath the Livermore Valley consist largely of the Livermore Formation. This includes gravel, sand, silt, and clay. Older formations are exposed at Site 300, which include the Panoche Formation, the Cierbo Formation sandstones, and the Neroly Formation.
- The soils at the Livermore Site are moderately developed soils and include loams, silty clay loams, gravelly loams, and clay loams. At Site 300, the soils are young with little or no development of the horizons that make up mature soils.
- Major faults in the area are the San Andreas, Hayward, Calaveras, and Greenville faults. Local faults have the greatest potential for damaging earthquakes.
- Local faults are the main seismic hazard with potential for damaging earthquakes.

- Potential for volcanic activity is small. Potential for slope instability at the Livermore site is also small. However, at Site 300, the potential for slope instability is considered moderate to high.

Ecological Resources

- At the Livermore Site, developed areas consist of ornamental vegetation and lawns; the undeveloped security zone is dominated by nonnative grasses. Wooded riparian habitat occurs along an arroyo.
- At Site 300, vegetation consists of the dominant introduced grassland (5,650 acres), native grassland, coastal sage scrub, oak woodland, and vegetation associated with seeps and springs. Site 300 includes a large stand of native perennial grassland now rare in California. Unique habitats include rocky outcrops and cliffs, two vernal pools, and forb communities along gullies.
- At the LLNL Livermore Site, wetlands occur along an arroyo and total 0.36 acres.
- At Site 300, wetlands total approximately 6.76 acres.
- At the LLNL Livermore Site, no threatened or endangered plant or animal species, or critical habitat has been found. Potential exists for the bald eagle (Federal threatened, State endangered), the San Joaquin kit fox (Federal endangered, State threatened), and the California red-legged frog (Federal proposed endangered) to be found, as well as one additional Federal proposed endangered species, three Federal candidate species, 32 State species of special concern, and two State threatened species. Several Federal and State endangered plants are also identified within the region.
- The large-flowered fiddleneck (Federal and State endangered), which is considered one of the most endangered plant species in California and possibly the nation, is found at Site 300. The peregrine falcon (Federal and State endangered), the San Joaquin kit fox (Federal endangered, State threatened), the longhorn fairy shrimp (Federal endangered), the conservancy fairy shrimp (Federal endangered), and the valley elderberry longhorn beetle (Federal threatened, State species of special concern) have been identified. Four State endangered, three State threatened, and 33 State species of special concern may occur at Site 300.

Socioeconomic Conditions

- The ROI for LLNL includes Alameda, Contra Costa, San Joaquin, and Stanislaus Counties. At least 97% of the Site's employees reside in these counties.
- Total site employment in 1994 was 8,713. Total ROI employment by place of work in 1990 was 1,512,433.
- The ROI unemployment rate was 9.3% in 1991.
- The ROI per capita income in 1990 was $21,099.

- The total population in the ROI in 1990 was 2,934,064. Population demographics: Native Americans—0.8%; urban—95.2%.
- Housing: owner-occupied—58.8%; renter-occupied—41.2%.
- Sensitive populations: children (under 15 years old)—22.2%; women of child-bearing age (ages 15 to 44)—24.2%; adults over 65—10.8%.

Environmental Justice

- Minorities—Figure C.4–12.
- Below poverty level—Figure C.4–29.
- Presence of Federally recognized Native American Tribes: none.

Land Use

- LLNL includes the Livermore Site, which occupies 1.3 square miles (832 acres); LLNL Site 300, which is located 15 miles from the Livermore Sites and covers 10.8 square miles (6,927 acres); and SNL-CA, which is located on 413 acres next to the Livermore Site.
- LLNL, including the three sites, occupies a total area of 8,172 acres of which 323 acres are developed and 7,849 acres are undeveloped.
- Land use surrounding the Livermore Site and SNL-CA is predominantly agricultural, residential, and light industrial.
- Land use surrounding the LLNL Site 300 is predominantly agricultural, primarily for grazing cattle and sheep; however, the City of Tracy has plans for its development within approximately 1 to 1½ miles of Site 300's eastern boundary in its 1993 Urban Management Plan.

Infrastructure

- San Francisco's Hetch Hetchy water system provides an average of 0.717 million gallons of water per day.
- The city of Livermore's wastewater treatment system receives an average of 0.4 million gallons of sewage per day.
- The Pacific Gas and Electric Company and the Western Area Power Administration supply power; the current site load is 61 megawatts. The Pacific Gas and Electric Company also supplies natural gas.
- Transportation in the region consists of local access roads (such as South Vasco and Greenville Roads) and interstates (such as Interstates 580, 5, and 680). The Southern Pacific Railroad and the Western Pacific Railroad are the primary providers of rail service to the LLNL region.

Cultural Resources

- Native American occupation of the LLNL region began around 10,000 years ago, although no sites have been identified on the Livermore Site.
- LLNL Site 300 contains a variety of recorded archaeological properties, many of which have not been evaluated for the National Register of Historic Places. No traditional cultural properties or architectural resources have been recorded.

4.4.7 Los Alamos National Laboratory—Los Alamos, New Mexico

Los Alamos National Laboratory (LANL) occupies 43 square miles (27,520 acres) in north central New Mexico and is approximately 25 miles north of Santa Fe on Pajarito Plateau, a series of mesas separated by deep canyons. Since its inception in 1943, LANL's primary mission has been nuclear weapons research and development and related projects. LANL is shown in Figure 4.4–7.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 159,152 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 7.90 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 1.40 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- The area encompassed by, and the counties surrounding, LANL are classified by EPA as attainment areas for all six of the National Ambient Air Quality Standards criteria air pollutants.
- Major sources of criteria air pollutants are steam plants and power plants, operations associated with beryllium, an asphalt plant, burning of wastes at the area TA-16 burnground, experimental detonation of conventional explosives, and the lead-pouring facility.

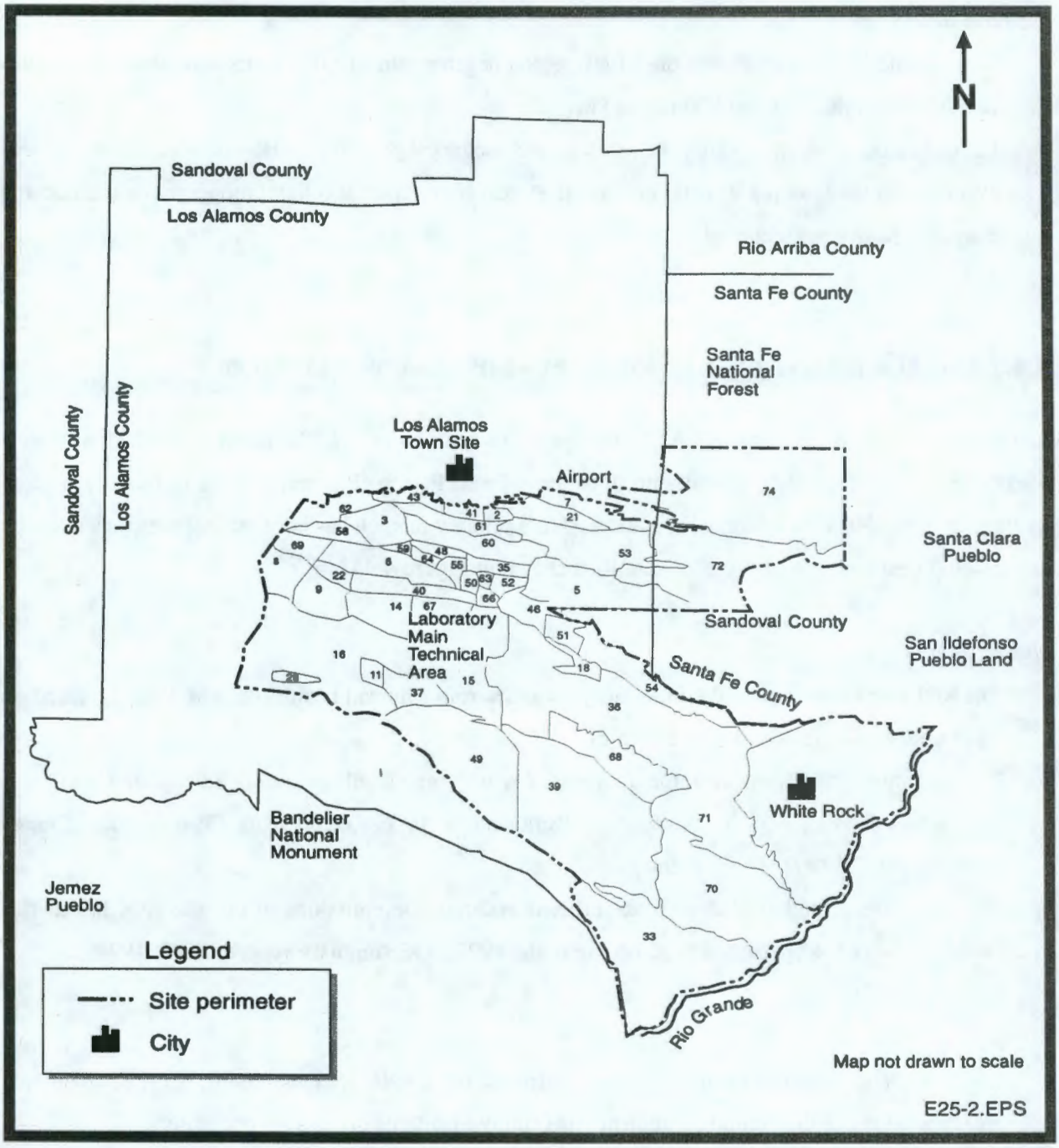


Figure 4.4–7. Los Alamos National Laboratory

- Prevailing winds at Albuquerque Airport for the 5-year period 1988-1992 were from the north approximately 10% of the time, with the highest annual occurrence of windspeed of 5 to 7 mph 38% of the time. The average annual temperature is 48°F, ranging from an average summertime daily maximum of 68°F to an average minimum in January of 29°F.

Water Resources

- Major surface water features include the Rio Grande (adjacent to the southeastern boundary of the site), 14 onsite intermittent tributaries, Rio de los Frijoles (parallels the southwestern boundary of the site), and the Los Alamos and Guaje Reservoirs.
- The East Fork of the Jemez River (located 5 miles west of LANL in a different drainage basin) is a federally designated Wild and Scenic River.
- Treated wastewater is discharged to onsite canyons. This water infiltrates into the ground and rarely reaches offsite areas.
- Surface water sampling in 1991 showed that 18 parameters exceeded their comparison criteria.
- Groundwater wells in the main aquifer supply water.
- Groundwater occurs within shallow alluvium, perched water, and in the main aquifer. The main aquifer is the only aquifer capable of supporting a municipal water supply and is hydrologically disconnected from the alluvial and perched waters. No aquifers are considered sole source aquifers.
- Groundwater monitoring in 1991 showed 13 parameters above comparison criteria.
- The technical areas located within the canyons would be within the 500-year floodplain of tributaries to the Rio Grande.

Geology and Soils

- The site is on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep east-to-west oriented canyons cut by intermittent streams. Mesa tops range in elevation from about 7,800 to 6,200 feet.
- Major rock units include, from oldest to youngest, the Tesuque Formation sediments, the Chino Mesa Formation basalts, the Puye Formation conglomerates, the Tschicoma Formation volcanics, and the Bandelier Tuff (from a major volcanic eruption in the Jemez Mountains).
- Alluvium derived from erosion of the surrounding rocks fills many of the canyons, with thicknesses ranging from 3 to 100 feet.
- Soil types vary in texture from clay and clay loam to gravel. Rock is exposed on greater than 50% of the site area.

- Geologic concerns include potential downslope movements in association with regional seismic activity. The potential for subsidence is minimal, as is the potential for renewed volcanic activity.
- The strongest earthquake in the last 100 years within a 50-mile radius was estimated to have a magnitude of 5.5 to 6 on the Richter Scale. Studies have determined the presence of three active faults in the area.

Ecological Resources

- Major vegetative communities include juniper-grassland, piñon pine-juniper, ponderosa pine, mixed conifer, spruce-fir, and subalpine grassland. Old-growth forest may be present. LANL has minimized the clearing of vegetation, and canyons are relatively undisturbed. Specialized habitats include steep-walled cliffs and associated rockpiles and narrow mesas separated by deep canyons.
- Wetlands are restricted to several canyons and are primarily temporary or seasonal. Riparian habitat is receiving legal protection in some areas of the region.
- The bald eagle (Federal threatened, State endangered) and peregrine falcon (Federal and State endangered), one candidate species, one Federal notice of review species (State listed), and one State endangered species are found on LANL. Seventeen Federal- or State-listed species potentially are found nearby.

Socioeconomic Conditions

- The ROI for LANL comprises Los Alamos, Santa Fe, and Rio Arriba Counties. Ninety-four percent of the site's employees reside in these counties.
- Total site employment in 1994 was 6,199. Total ROI employment by place of work in 1994 was 83,496.
- The ROI unemployment rate in 1991 was 7.3%.
- The ROI per capita income in 1990 was $16,559.
- The total population in the ROI in 1990 was 151,408. Population demographics: Native Americans—5.4%; urban—64.2%.
- Housing: owner-occupied—71.1%; renter-occupied—28.9%.
- Sensitive populations: children (under 15 years old)—23.1%; women of child-bearing age (ages 15 to 44)—23.4%; adults over 65—9.9%.

Environmental Justice

- Minorities—Figure C.4–13a.

- Below poverty level—Figure C.4–30.
- Presence of Federally recognized Native American Tribes: Cochiti, Jemez, Nambe, Pojoaque, Santa Clara, San Ildefonso, San Juan, Picuris and Tesuque Pueblos.
  Tribal lands—Figure C.4–13b.

Land Use

- The site occupies approximately 43 square miles (27,520 acres), of which 11,333 acres are developed and 16,187 are undeveloped; of the land that is undeveloped, nearly all is available for future site development.
- LANL was designated a National Environmental Research Park in 1976.
- Land use surrounding the site is predominantly undeveloped with large tracts held by the Bureau of Land Management and the National Park Service.

Infrastructure

- Three DOE-operated well fields and surface water from the Jemez Mountains provide an average of 4.1 million gallons of water per day.
- An onsite wastewater treatment plant and collection system receives sewage.
- A Los Alamos County/DOE power pool and a 20-megawatt onsite gas fired generation plant supply power. In 1993, site usage was 68 megawatts.
- Transportation in the region consists of local access roads (such as U.S. Route 502) and other major roads (such as U.S. Routes 84 and 285 and Interstates 25 and 40). No major railroads provide rail service to the LANL region.

Cultural Resources

- Native American occupation of the LANL area began about 12,000 years ago.
- Over 975 prehistoric sites and 50 historic resources have been recorded. Approximately 75% of LANL has been inventoried for cultural resources.
- About 95% of the prehistoric and historic sites are considered eligible or potentially eligible for inclusion in the National Register of Historic Places.

4.4.8 NEVADA TEST SITE—LAS VEGAS, NEVADA

The Nevada Test Site (NTS) occupies 1,350 square miles (864,000 acres) of desert valley and Great Basin mountain terrain in southern Nevada, 65 miles northwest of Las Vegas. The NTS has been the primary location for testing the Nation's nuclear explosive devices since 1951. NTS is shown in Figure 4.4–8.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 14,266 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.012 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 0.0290 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Nye and Lincoln Counties are classified by EPA as attainment areas for all six National Ambient Air Quality Standards criteria air pollutants. Clark County is designated as a nonattainment area for the criteria air pollutants carbon monoxide and particulate matter of less than 10 micrometers in diameter (PM_{10}).
- Sources of radiological air emissions on the site are post-test drilling, mining, and sampling operations for underground nuclear tests and, possibly, evaporation of containment pond water. Other air pollutant emissions are from construction activities, surface disturbances, fugitive dust from unpaved roads, fuel burning equipment, open burning, fuels storage facilities, and asbestos removal activities.
- Prevailing winds at the McCarren International Airport in 1992 were from the southwest with a 12% occurrence. The highest annual occurrence of windspeed was between 4.6 and 11.5 mph, with an occurrence of 34%. Data from NTS towers indicate that prevailing winds are from the southwest during the summer and from the north to northwest during the winter. Temperatures range from an average daily minimum of 28°F in January to an average daily maximum of 96°F in July.

Water Resources

- The only permanent onsite water bodies are ponds associated with wastewater disposal and springs. No continuously flowing streams occur on the site.

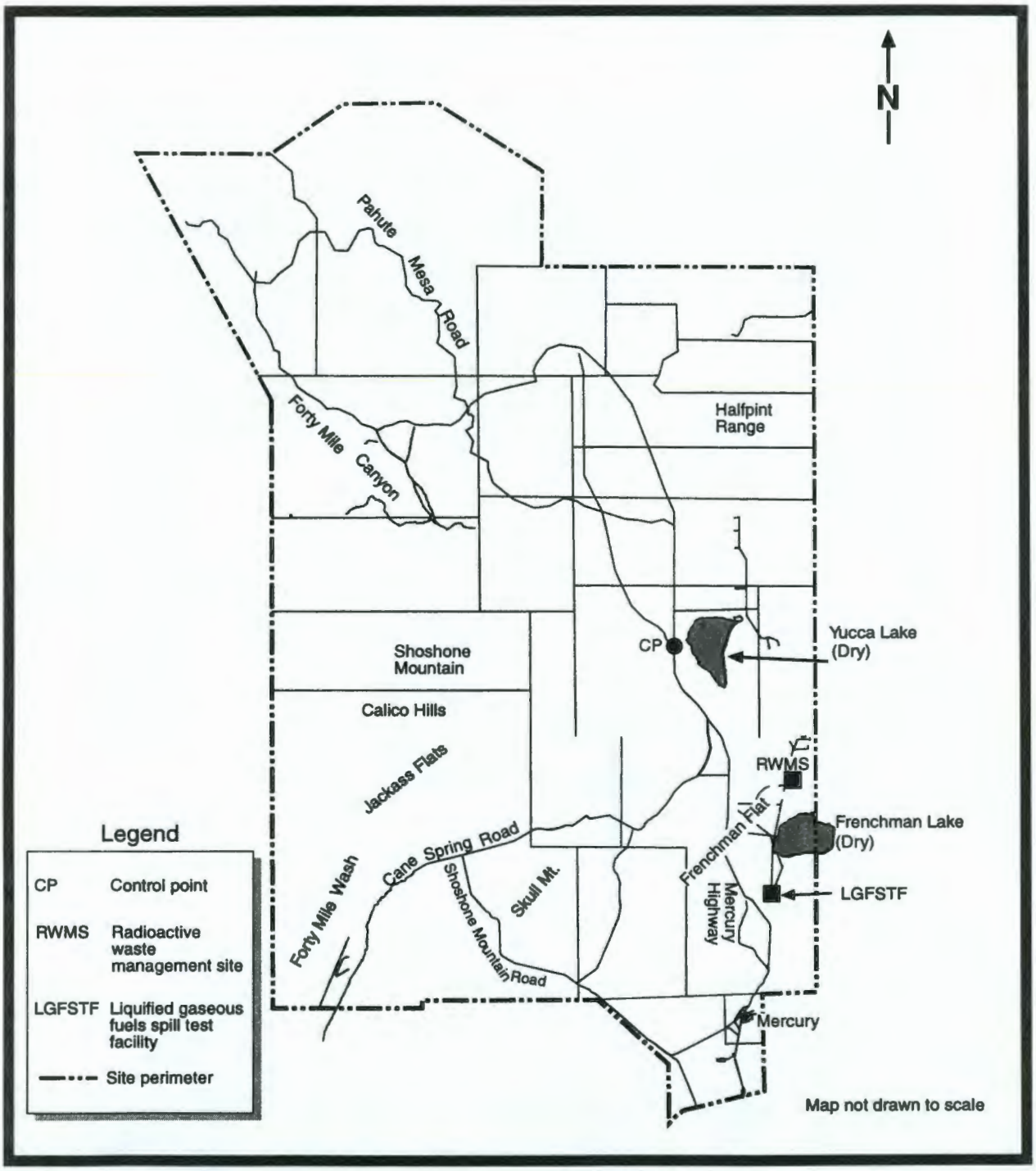


Figure 4.4–8. Nevada Test Site

- No federally designated Wild and Scenic Rivers exist on the site.
- During extreme precipitation, flash flooding may occur.
- Groundwater wells supply water.
- Onsite evaporation ponds receive waste discharge.
- Surface water sampling in 1991 showed nine parameters above comparison criteria.
- Major groundwater units include the lower carbonate aquifer, volcanic aquifer, and the valley fill aquifer. No aquifers are considered sole source aquifers.
- Groundwater monitoring in 1991 indicated that eight contaminant comparison criteria were exceeded at onsite wells.
- The site is not located within any floodplain as there are no continuously flowing surface water streams occurring on the site.

Geology and Soils

- The site is located in the Basin and Range physiographic province, with mountain ranges running from north to south separated by broad, flat-floored, and gently sloped valleys and elevations ranging from 3,000 to 6,900 feet.
- Major rock units include, from oldest to youngest, the Paleozoic carbonates and clastics, Tertiary tuffs and lavas, and Tertiary and Quaternary alluvium.
- Faults in the ROI include the Cane Springs and Yucca Faults.
- Severe earthquakes on faults in southern California (for example, the San Andreas Fault) should not result in damaging ground motion at the site. The Yucca Fault is the only capable fault on the NTS.
- Lava flows and associated cinder cones are within 30 miles of the site. The probability that a volcanic eruption would occur in the ROI in the near future is low.
- The potential for subsidence is low for a large portion of the site.

Ecological Resources

- Desert shrubs typical of the Mojave or Great Basin Deserts or transition desert between these two areas cover most of NTS. Shrubs and small trees are the dominant vegetation and vary, depending on elevation. Dominant associations include creosote bush, hopsage/desert thorn, sagebrush, and pinon pine and juniper with sagebrush. Crater environments and volcanic highlands are unique habitats.
- Springs and ponds have associated riparian areas, but no officially designated wetlands.
- The Federal and State endangered American peregrine falcon and Federal threatened and State protected desert tortoise are found on NTS. Nineteen candidate species are found on NTS (seven are State protected, one is State critically endangered, and one is protected as a game species); most

nonrodent species of mammals at NTS are on Nevada's protected species list. Twenty-one species of plants at NTS are State-listed. No plant species are federally endangered. Federal endangered aquatic species are located nearby at Ash Meadows (including the Devil's Hole pupfish, Warm Springs pupfish, Pahrump killifish, Ash Meadows speckled dace, and Ash Meadows Amargosa pupfish).

Socioeconomic Conditions

- The ROI for NTS comprises Nye and Clark Counties. One hundred percent of the site's employees reside in these counties.
- Total site employment in 1994 was 7,086. Total ROI employment in 1990 was 454,030.
- The ROI unemployment rate in 1991 was 5.4%.
- The ROI per capita income for 1991 was $18,543.
- The total population in the ROI in 1994 was 759,240. Population demographics: Native Americans—0.9%; urban—96%.
- Housing: owner-occupied—52.3%; renter-occupied—47.7%.
- Sensitive populations: children (under 15 years old)—21%; women of child-bearing age (ages 15 to 44)—23.2%; adults over 65—10.5%.

Environmental Justice

- Minorities—Figure C.4-14.
- Below poverty level—Figure C.4-31.
- Presence of Federally recognized Native American Tribes: Although none is located in the ROI, several have expressed an interest in DOE's waste management strategy. Interested tribal organizations include the Benton Paiute Reservation, Timbasha Shoshone Reservation, Bishop Paiute Reservation, Big Pine Point Shoshone Reservation, Fort Independence Reservation, Lone Pine Paiute Reservation, Yomba Reservation, Duckwater Reservation, Pahrump Paiute Tribe, Las Vegas Paiute Indian Colony, Chemehucvi Reservation, Colorado River Reservation, Paiute Indian Tribe of Utah, and Kaibab Paiute Reservation.

Land Use

- The site occupies approximately 1,350 square miles (864,000 acres) of desert valley and Great Basin mountain terrain, of which 25% is currently unused or provides buffer zones. Facility expansion is possible within all of the area in use.
- Land surrounding the site is predominantly federally owned.

Infrastructure

- Fourteen wells throughout the site supply an average of 1.36 million gallons of water per day.
- Onsite sewage treatment plants and septic tanks receive an average of 0.140 million gallons of sewage per day.
- The Nevada Power Company supplies power; the current site load is 30 megawatts.
- Transportation in the region consists of local access roads (such as Lathrop Wells Road, Jackass Flats Road, and Mercury Highway) and major routes (such as U.S. 95, U.S. 93, and Interstate 15). The Union Pacific Railroad is the primary provider of rail service to the NTS region.

Cultural Resources

- Human habitation of the NTS area dates from as early as 12,000 years ago. European contact began approximately 145 years ago.
- Numerous archaeological sites have been identified within the NTS facility. A long-range study will result in an 11% archaeological sample of NTS.

4.4.9 Oak Ridge Reservation—Oak Ridge, Tennessee

The Oak Ridge Reservation (ORR) occupies 35,000 acres in the valley and ridge province of eastern Tennessee. The ORR property was primarily used for agriculture before it was acquired by the Federal Government in 1942 for the wartime Manhattan Project. The ORR contains three major facilities: Oak Ridge National Laboratory (ORNL), the Y-12 Plant, and the K-25 Site. Also located on the ORR Site is the Oak Ridge Institute of Science and Education (ORISE), with an area of 340 acres. ORR is shown in Figure 4.4–9.

ORNL's mission is to conduct applied research and development in support of DOE programs in fusion, fission, conservation, and other energy technologies. The Y-12 Plant was established to separate uranium isotopes, and for many years served as a fabrication facility for nuclear weapons. The current Y-12 Plant mission is to perform defense-related assignments such as dismantling nuclear weapon components, providing special production support to various DOE programs, and serving as the nation's storehouse for special nuclear materials. The K-25 Site originally enriched uranium but was shut down permanently in 1987. Today, the K-25 Site's focus has shifted to supporting investigations related to waste management and environmental restoration issues and houses the Centers for Environmental Restoration and for Waste Management. The K-25 Site's evolving mission will include applied technology, data systems research and

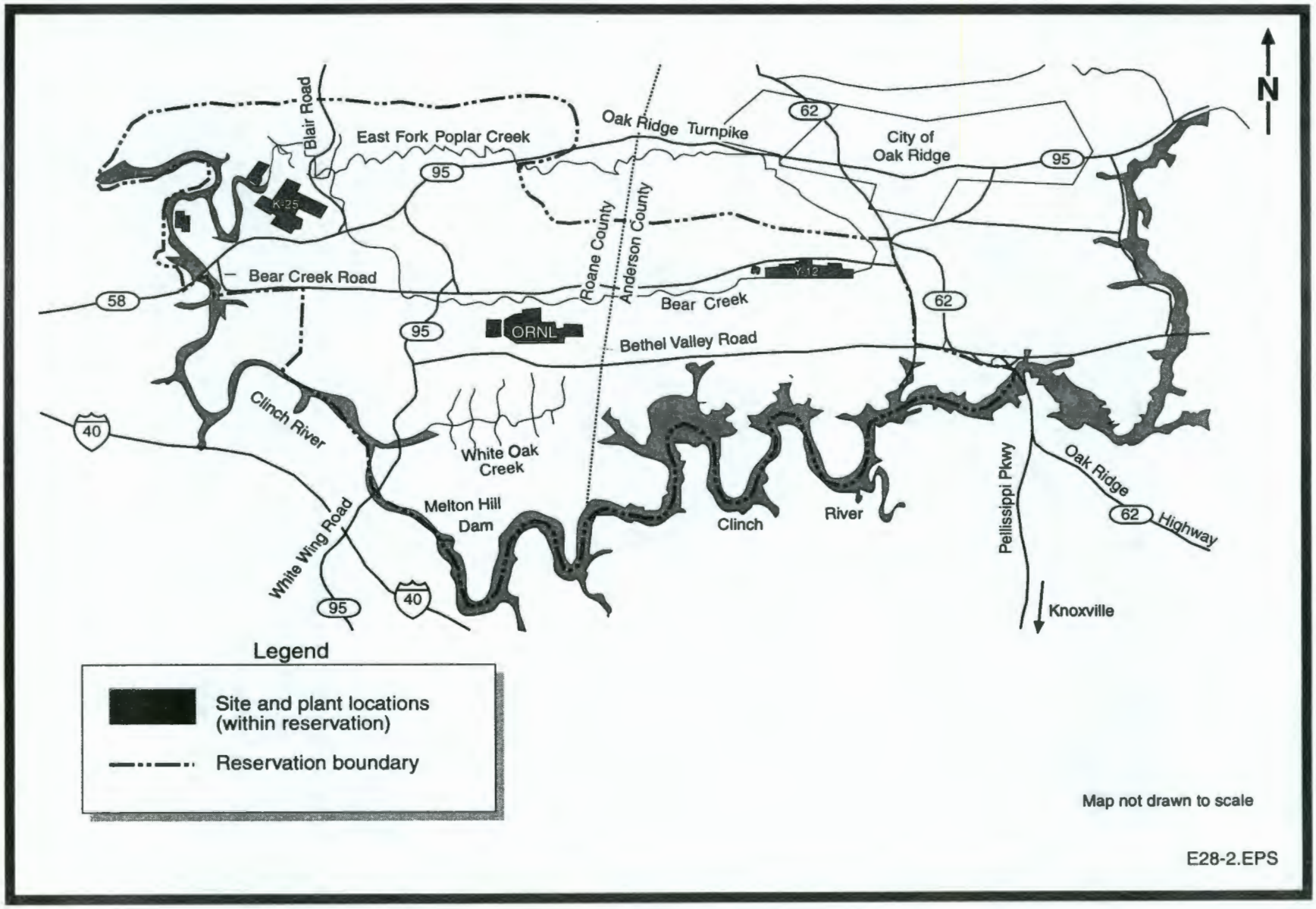


Figure 4.4–9. Oak Ridge Reservation

development, and engineering. ORISE works with DOE and others to provide capabilities in science and engineering education, particularly medical sciences, and environmental and energy systems.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 881,652 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 1.40 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 43 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- The Eastern Tennessee-Southwestern Virginia Interstate Air Quality Control Region is classified by EPA as an attainment area with respect to all six National Ambient Air Quality Standards criteria air pollutants.
- Major sources of criteria pollutant emissions from the site are steam plant emissions. The primary source of radionuclide emissions is the Toxic Substances Control Act Incinerator.
- Prevailing winds at ORR in 1992 were generally up-valley from the southwest and west-southwest or down-valley from the northeast and east-northeast; the highest occurrence of windspeed was between 1 and 4 mph with an annual occurrence of 58%. The average annual temperature is 57.3°F, ranging from an average daily minimum of 36.3°F in January to an average daily maximum of 87.2°F in July.

Water Resources

- Major surface water features include the Clinch River and its onsite tributaries—Bear Creek, East Fork Poplar Creek, White Oak Creek, Melton Branch, Poplar Creek, and Mitchell Branch.
- No federally designated Wild and Scenic Rivers exist in the ROI.
- The Clinch River supplies water.
- Onsite streams and the Clinch River receive treated wastewater.
- Surface water sampling in 1992 showed concentrations of 26 parameters that exceeded comparison criteria.
- The major groundwater unit is the Knox Aquifer, composed of the Knox Group and the Maynardville Limestone. No aquifers are considered sole source aquifers.

- Groundwater monitoring for radioactive and nonradioactive parameters in 1992 indicated that 17 contaminants exceeded comparison criteria.
- Most of the ORR site is outside the 500-year floodplain of Clinch River except for areas adjacent to the confluences of White Oak Creek and Raccoon Creek with Clinch River.

Geology and Soils

- The topography consists of alternating valleys and ridges that strike northeast to southwest.
- Major rock units include, from oldest to youngest, the Rome Formation (sandstones and shales), the Conasauga Group (limestones and shales), the Knox Group (cherty limestones and dolomites), and the Chickamauga Group (limestones with interbedded shales).
- Unconsolidated residual material is 16 to 98 feet thick.
- The formation of karst solution pits and sinkholes has occurred in the carbonate bedrock. Changes to local groundwater levels or to surface water drainage patterns could create localized subsidence.
- The typical residual soil in the area is a reddish-brown clay. Alluvium also occurs in floodplains along streambeds. Valley soils are a mixture of clays, silts, and weathered shale fragments.
- The structure of the Valley and Ridge province is characterized by major subparallel thrust faults. None of these faults is considered capable.
- Seismic activity in the southern Appalachian Mountains that has affected the site area has been recorded 45 times since 1800. The probability of future seismic damage is moderate.

Ecological Resources

- Natural plant communities or pine plantations cover most of ORR. Vegetation consists of pine and pine-hardwood; hemlock, white pine and hardwood; cedar, cedar pine, and cedar-hardwood; bottomland hardwood; upland hardwood; northern hardwood; and nonforest. Upland hardwoods dominate. Upland hardwood, cedar barrens, and old fields are ecologically significant resources. Unique habitats include river bluffs and slopes and spring-fed limestone quarries.
- Approximately 20% of ORR consists of wetlands; half are bottomland forested and half are pothole wetlands.
- The Federal threatened and State endangered bald eagle has been located on ORR. Eight candidate species (two are State endangered, three are State threatened, and two are State in need of management), two State endangered species, and four State threatened species are found on ORR. Federal- and State-listed species are also present near ORR.

Socioeconomic Conditions

- The ROI for ORR comprises Anderson, Knox, Loudon, and Roane Counties. Ninety percent of the site's employees reside in these counties.
- Total site employment in 1990 was 21,544. Total ROI employment by place of work in 1990 was 287,974.
- The ROI unemployment rate in 1991 was 5.9%.
- The ROI per capita income in 1990 was $16,821.
- The total population in the ROI in 1990 was 482,481. Population demographics: Native Americans—0.25%; urban—67.9%.
- Housing: owner-occupied—68.3%; renter-occupied—31.7%.
- Sensitive populations: children (under 15 years old)—18.9%; women of child-bearing age (ages 15 to 44)—24.2%; adults over 65—13.3%.

Environmental Justice

- Minorities—Figure C.4–15.
- Below poverty level—Figure C.4–32.
- Presence of Federally recognized Native American Tribes: none.

Land Use

- The site occupies approximately 35,000 acres of which 11,500 acres are developed and 23,500 acres are undeveloped; of the land that is undeveloped, approximately 5,629 acres are available for future site development.
- With the exception of the city of Oak Ridge to the north, land surrounding the site is predominantly rural, consisting of undeveloped forest land, agriculture, and low-density residential.

Infrastructure

- The Clinch River provides an average of 18.3 million gallons of water per day.
- The ORR wastewater facility serving K-25 and ORNL receives an average of 0.64 million gallons of sewage per day. Wastewater from the Y-12 facility is processed by the city of Oak Ridge.
- The Tennessee Valley Authority (TVA) supplies power; the current site load is 116 megawatts. Coal and natural gas are also used.
- Transportation in the region consists of local access roads (such as State Routes 1700 and 62) and major roads (such as Interstates 75, 40, and 81). The Southern Railway and the L&N Railway are the

primary providers of rail service to the ORR region, which includes a L&N rail line that runs adjacent to the site boundary.

Cultural Resources

- Native American occupation of the Oak Ridge area began about 12,000 years ago. European settlement began during the 18th century.
- More than 65 prehistoric sites and more than 240 historic resources (remains and standing structures) have been recorded at ORR. About 90% of the site has received at least reconnaissance-level studies; less than 5% has been intensely surveyed.
- About 10 prehistoric sites and 20 historic sites are potentially eligible for the National Register of Historic Places. The ORR Graphite Reactor has been designated as a National Historic Landmark.

4.4.10 Paducah Gaseous Diffusion Plant—Paducah, Kentucky

Paducah Gaseous Diffusion Plant (PGDP) occupies 3,425 acres in western Kentucky 10 miles west of Paducah, and employs 1,868 people. Paducah has been an active uranium enrichment facility since 1952. Enriched uranium is produced for the commercial sector as fuel for nuclear power reactors in the United States and overseas. Paducah is shown in Figure 4.4–10.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 500,502 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0045 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 0.017 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- McCracken County is currently classified by EPA as a marginal nonattainment area for ozone. The area is in attainment for the other five criteria pollutants.

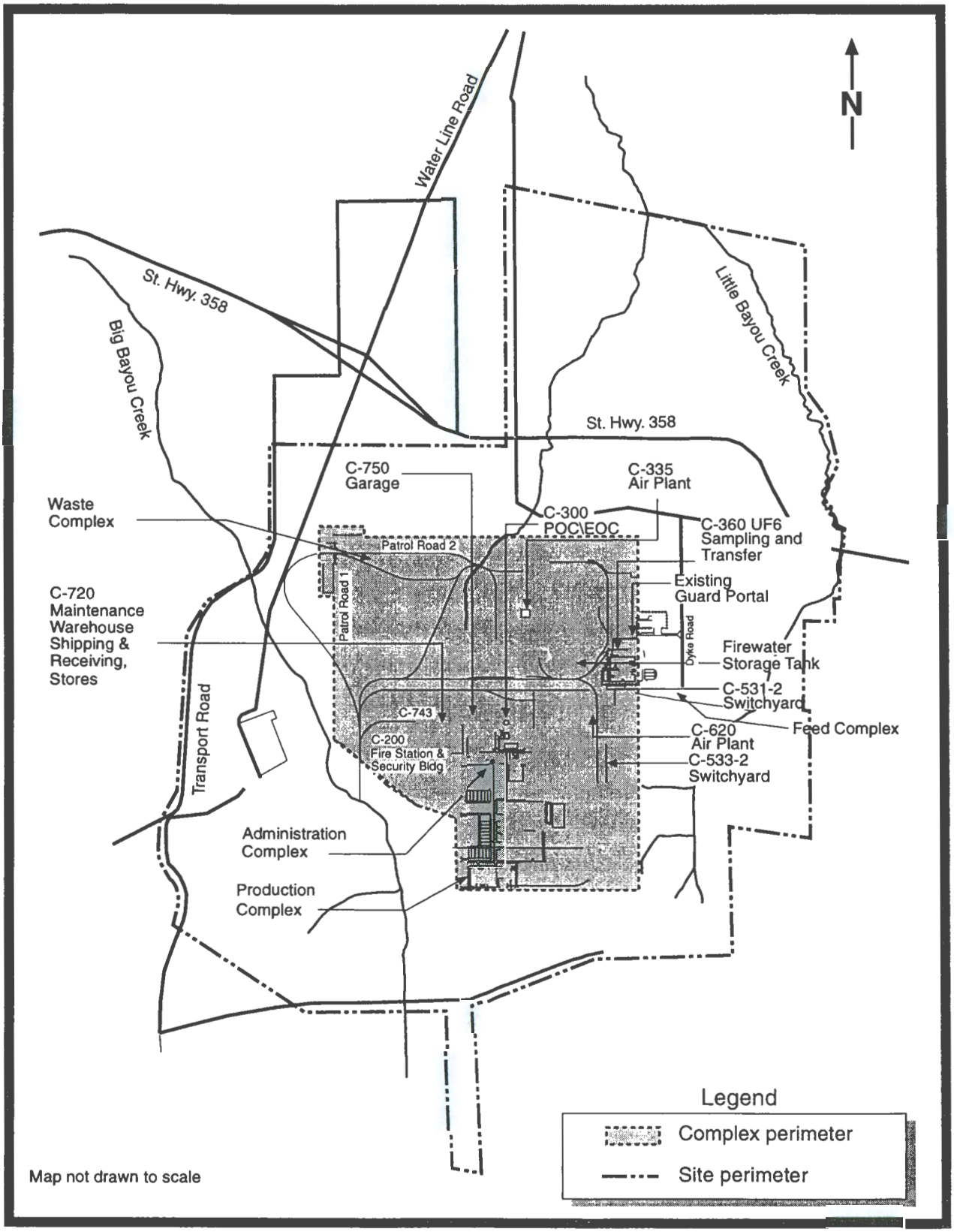


Figure 4.4–10. Paducah Gaseous Diffusion Plant

- The major sources of criteria air pollutant emissions are coal-, oil-, and gas-fired boilers. Sources of radionuclide emissions in 1992 were the cascade purge vent/stack at the C-310 purge and product building, decontamination activities at the C-400 cleaning building, and emissions from laboratory hoods in the C-710 building. Two vapor degreasers in the C-400 cleaning building are also sources of toxic air emissions.
- Prevailing winds at the Paducah Airport in 1992 were from the south 16% of the time on a yearly basis. The highest occurrence of windspeed was between 8 to 11 mph with an annual occurrence of 31%. January is the coldest month, with a daily average temperature of 35°F, while July is the warmest month with an average temperature of 79°F.

Water Resources

- Major surface water features include the Ohio River (less than 2 miles from Paducah), Metropolis Lake (1.5 miles northeast), and two small tributaries of the Ohio River (Big Bayou Creek and Little Bayou Creek) that provide surface drainage to the site.
- No federally designated Wild and Scenic Rivers exist in the ROI.
- The site would not be affected by the probable 500-year maximum flood.
- The Ohio River supplies water to Paducah.
- Onsite streams and the Ohio River receive treated wastewater.
- Results from surface water monitoring in 1992 indicated concentrations elevated above comparison criteria for two contaminants.
- Major groundwater units include, from bottom to top, the McNairy Flow System (interbedded sand, silt, and clay), the terrace gravels, the Regional Gravel Aquifer (the primary aquifer in the area, composed of sand and gravel units), and the Upper Continental Recharge System (clayey silt with interbedded sand and gravel). No aquifers are considered sole source aquifers.
- Groundwater monitoring for radioactive and nonradioactive parameters in 1992 showed the presence of 15 contaminants exceeding comparison criteria. Two major plumes of groundwater contamination extend into offsite areas.
- The site is outside the 500-year floodplain of the Ohio River.

Geology and Soils

- The topography slopes slightly from more than 450 feet in the southern part of the site to 300 feet near the Ohio River.
- Surface sediments consist of valley fill deposits, which underlie most of the site, extending northward to the Ohio River.

- Major rock units include, from oldest to youngest, basement rocks; Tuscaloosa Formation basal gravels; the McNairy Formation consisting of interbedded sand, silt, and clay; the Porters Creek Clay; continental deposits of gravel and clay-sand units; and a 10-to-30-foot layer of loess (wind-blown sediment).
- Soils beneath the site are nearly level, somewhat poorly-drained, medium-textured soils that occur on uplands.
- Geologic hazards include potential for earthquakes. The site is near two active seismic zones: the New Madrid Fault Zone and the Wabash Valley Fault Zone. The potential for damage from volcanic activity is small.

Ecological Resources

- Nonforested areas consisting of mowed grass and developed areas cover most of Paducah; forested areas are small and dominated by mature hardwood upland and riparian forests.
- Onsite wetlands consist of forested wetlands (mature riparian hardwood forest). A wetland in the West Kentucky Wildlife Management area (the buffer area surrounding the production facilities) has been designated an area of ecological concern.
- Federally listed endangered and State-listed endangered species that have been identified or could be identified in the vicinity of Paducah include the interior least tern and four species of pearly mussel. The Indiana bat, a Federally and State-listed endangered species, also has been identified or could be identified in the vicinity of Paducah. An additional species of pearly mussel is Federally listed as endangered only. The bald eagle (Federally threatened, State endangered), evening bat (Federal threatened, State species of special concern), eight candidate species (one is a State-endangered fish, one is a State-threatened reptile, and one is a State species of special concern), one State-endangered bird species, two State-threatened plant species, and seven State species of special concern are found or could be found near Paducah. No Federally listed plant species potentially occur in the vicinity of Paducah.

Socioeconomic Conditions

- The ROI for Paducah comprises McCracken, Ballard, Carlisle, Graves, and Marshall Counties in Kentucky, and Massac County in Illinois. Ninety-three percent of the site's employees reside in these counties.
- Total site employment in 1990 was 1,740. Total ROI employment by place of work in 1990 was 79,756.

- The ROI unemployment rate in 1991 was 9.7%.
- The ROI per capita income in 1990 was $15,536.
- The total population in the ROI in 1990 was 151,526. Population demographics: Native Americans—0.2%; urban—44.1%.
- Housing: owner-occupied—55.6%; renter-occupied—44.4%.
- Sensitive populations: children (under 15 years old)—20.2%; women of child-bearing age (ages 15 to 44)—17.6%; adults over 65—16.8%.

Environmental Justice

- Minorities—Figure C.4-16.
- Below poverty level—Figure C.4-33.
- Presence of Federally recognized Native American Tribes: none.

Land Use

- The site occupies approximately 3,425 acres, of which 750 acres are developed and 2,675 acres are undeveloped.
- Land use surrounding the site is predominantly undeveloped natural areas.

Infrastructure

- The Ohio River supplies an average of 15 million gallons of water per day; the water is treated onsite by chemical and physical processes.
- An onsite treatment plant receives an average of 0.2 to 0.4 million gallons of sewage per day. Treated sewage is discharged off site.
- Electric Energy Inc. supplies power; the current site load is 1,564 megawatts. The site also uses approximately 82 tons of coal per day.
- Transportation in the region consists of local access roads (such as State Routes 1154 and 358) and major roads (such as Interstate 24 and U.S. Highways 45, 60, and 63). The Burlington Northern Railroad, Paducah Railroad, Louisville Railroad, and the onsite U.S. Government Railroad are the primary providers of rail service to the Paducah region.

Cultural Resources

- The site has 3 recorded archaeological or historic sites, and others have been identified in areas near Paducah. This region has not been subject to any systematic cultural resources surveys.

4.4.11 PANTEX PLANT—AMARILLO, TEXAS

The Pantex Plant is approximately 17 miles northeast of downtown Amarillo, Texas, on the Llano Estacado (Staked Plains) and consists of 10,080 acres of DOE-owned land and 5,856 acres of land leased from Texas Tech University. The Pantex Plant was first used in 1942 by the Army Ordnance Corps for loading conventional ammunition shells and bombs. It was chosen in 1951 by the Atomic Energy Commission for expansion of its nuclear weapons assembly facilities. The mission of the Pantex Plant includes disassembly, assembly, quality evaluation, and maintenance of the Nation's nuclear weapons stockpile. The workforce at the Pantex Plant currently consists of 77 DOE employees and 2,930 prime contractor employees. The Pantex Plant is shown in Figure 4.4–11.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 265,185 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was less than 0.0001 mrem per year according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was negligible according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Potter and Armstrong Counties are classified by EPA as attainment areas for all six of the criteria air pollutants.
- The major source of emissions from the Pantex Plant is the boiler house for the steam plant. Sources of volatile organic compound emissions include building 16-4 (paint spray booth), building 12-19 (HE formulation), and building 11-36 (HE synthesis).
- Prevailing winds at the Amarillo International Airport in 1992 were from the south 13.5% of the time on a yearly basis; the highest occurrence of windspeed was between 12.5 to 18.4 miles per hour with an annual occurrence of 35%.

Water Resources

- No streams or rivers flow through or near the Pantex Plant; the only natural onsite surface water bodies are numerous ephemeral playa basins.
- No federally designated Wild and Scenic Rivers exist in the ROI.

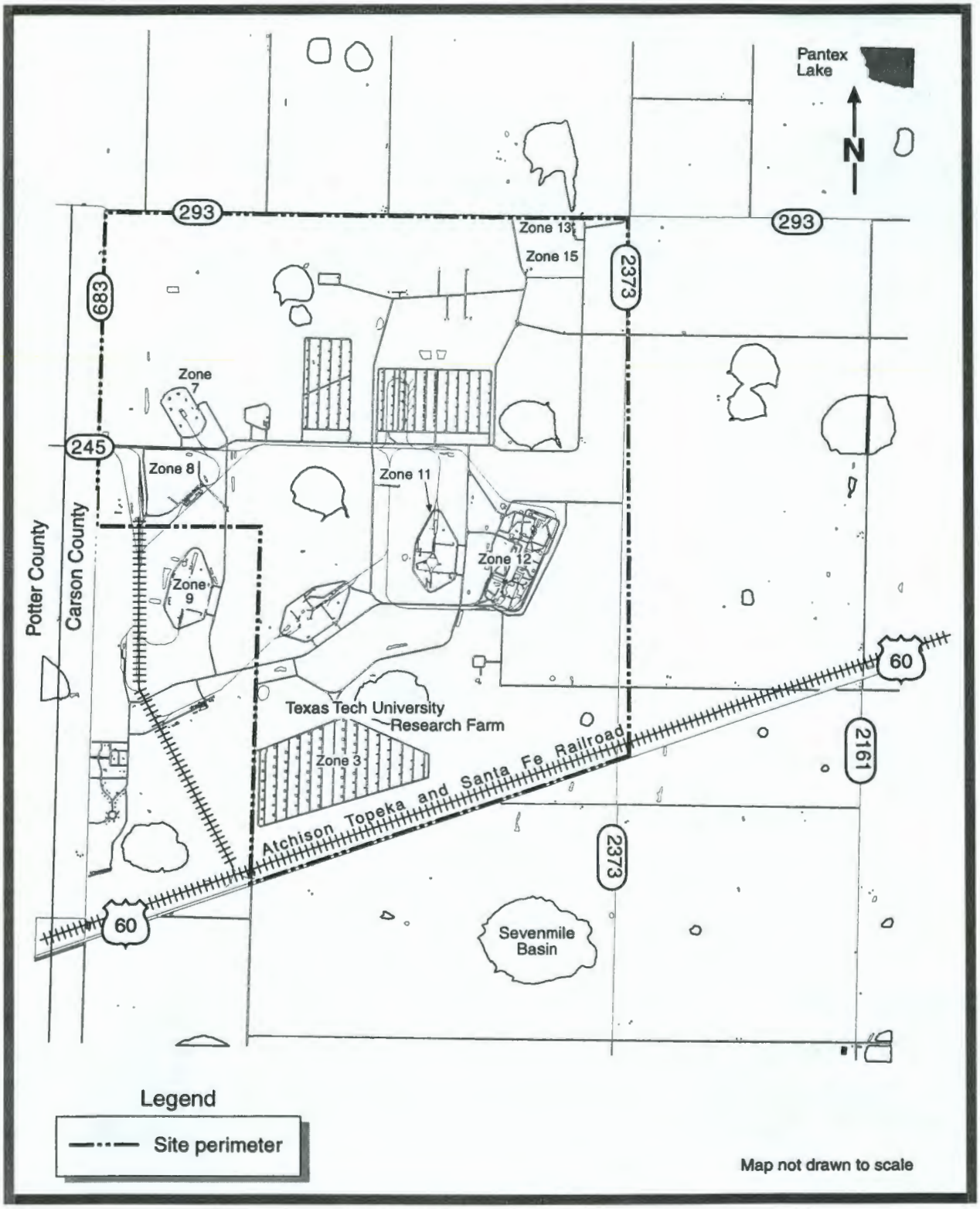


Figure 4.4–11. Pantex Plant

- Based on the results of a flood hazards analysis, the probability of flooding is low.
- Onsite playas receive treated wastewater.
- Onsite surface water sampling in 1992 showed concentrations of four parameters that exceeded comparison criteria. No offsite sampling was performed.
- Groundwater wells in the Ogallala Aquifer supply water.
- Major groundwater units include the Ogallala Aquifer, the primary source of water for the multi-billion-dollar agricultural industry in the Panhandle, and the underlying Dockum Group Aquifer. No aquifers are considered sole source aquifers.
- Groundwater monitoring in 1992 indicated that 10 parameters exceeded comparison criteria.
- The Pantex Plant is not located within a 500-year floodplain.

Geology and Soils

- The topography at the site is relatively flat and is characterized by rolling plains and numerous natural playa basins, or ephemeral lakes. Elevations range from approximately 3,500 to 3,600 feet above National Geodetic Vertical Datum.
- Major rock units include, from oldest to youngest, crystalline basement rocks, the Triassic Dockum Group (sedimentary rocks), the Ogallala Formation (sand, silt, clay, gravel, and some caliche), and the Blackwater Draw Formation (the surface deposit consisting of buried soils and silty clay and caliche).
- The primary soils at the site are deep clay loams and clays that occur on gentle slopes.
- No active surface faults occur in the ROI.
- Only 36 felt earthquakes have occurred in the Texas Panhandle between 1906 and 1986. Four earthquakes occurred near the site between 1982 and 1989. The potential for damage from earthquakes or volcanic activity is small.

Ecological Resources

- Very little relatively undisturbed habitat exists on the site. Vegetation consists of native and improved pasture, short-grass prairie, or planted vegetation.
- Wetlands are associated with five playas on the Pantex Plant; numerous smaller wetlands (10 acres or less) are on the western and southwestern parts of the site. The playas on the Pantex Plant constitute 376 acres.
- No critical habitat is known at the Pantex Plant. Federal and State endangered species found on or near the site include the American peregrine falcon, interior least tern, and whooping crane. The bald eagle

(Federal threatened and State endangered) is also found on or near the site. The Federal and State threatened Arctic peregrine falcon, the State-threatened white faced ibis and Texas horned lizard, and the State-endangered smooth green snake may also be found.

Socioeconomic Conditions

- The ROI for the Pantex Plant includes Carson, Potter, and Randall Counties. At least 96% of the site's employees reside in these counties.
- Total site employment in 1990 was 2,891. Total ROI employment by place of work in 1990 was 104,254.
- The ROI unemployment rate was 4.9% in 1991.
- The ROI per capita income in 1990 was $16,991.
- The total population in the ROI in 1990 was 194,123. Population demographics: Native Americans—0.7%; urban—87.2%.
- Housing: owner-occupied—64.7%; renter-occupied—35.3%.
- Sensitive populations: children (under 15 years old)— 24%; women of child-bearing age (ages 15 to 44)—23.2%; adults over 65—11.7%.

Environmental Justice

- Minorities—Figure C.4–17.
- Below poverty level—Figure C.4–34.
- Presence of Federally recognized Native American Tribes: none.

Land Use

- The site consists of 10,080 acres of DOE-owned land and 5,856 acres of land leased from Texas Tech University for a total of 15,936 acres. Of the DOE-owned land, approximately 2,000 acres are developed and 8,080 acres are undeveloped; of the undeveloped land, approximately 7,713 acres are available for future site development.
- Land use surrounding the site is predominantly agricultural, involving both farming and ranching operations.

Infrastructure

- Five production wells in the Ogallala Aquifer provide an average of 0.5 million gallons of water per day.

- An onsite wastewater treatment plant and an open ditch that drains to an onsite playa receive an average of 0.275 million gallons of sewage per day.
- The Southwestern Public Service Company supplies power; the current site load is 12.6 megawatts.
- Transportation in the region consists of local access roads (such as State Routes 293, 245, and 683), and major roads (such as Interstates 40 and 27 and U.S. Highways 60 and 287). The Atchison, Topeka, and Santa Fe Railroads are the providers of rail service to the Pantex Plant region.

Cultural Resources

- The site has 42 prehistoric archaeological sites and 3 historic farmstead sites. The Texas State Historic Preservation Office has not evaluated whether the Pantex Plant may contain additional unrecorded archaeological sites.

4.4.12 PORTSMOUTH GASEOUS DIFFUSION PLANT—PORTSMOUTH, OHIO

The Portsmouth Gaseous Diffusion Plant (PORTS) is approximately 22 miles northeast of Portsmouth in Pike County, Ohio, occupying an area of 6.3 square miles (4,003 acres). Construction of the site began in late 1952 and ended in 1956, one year after the start of uranium enrichment processing at the site. Portsmouth was operated through November 1986 for DOE and its predecessor agencies by the Goodyear Atomic Corporation. Since then, Portsmouth has been managed by Martin Marietta Energy Systems, Inc. The mission of Portsmouth continues to be uranium enrichment. Portsmouth is shown in Figure 4.4–12.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 639,602 based on 1990 Census data (DOC, 1991, DOE 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.260 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 3.0 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Pike County is currently classified by EPA as an attainment area for all six National Ambient Air Quality Standards criteria air pollutants.

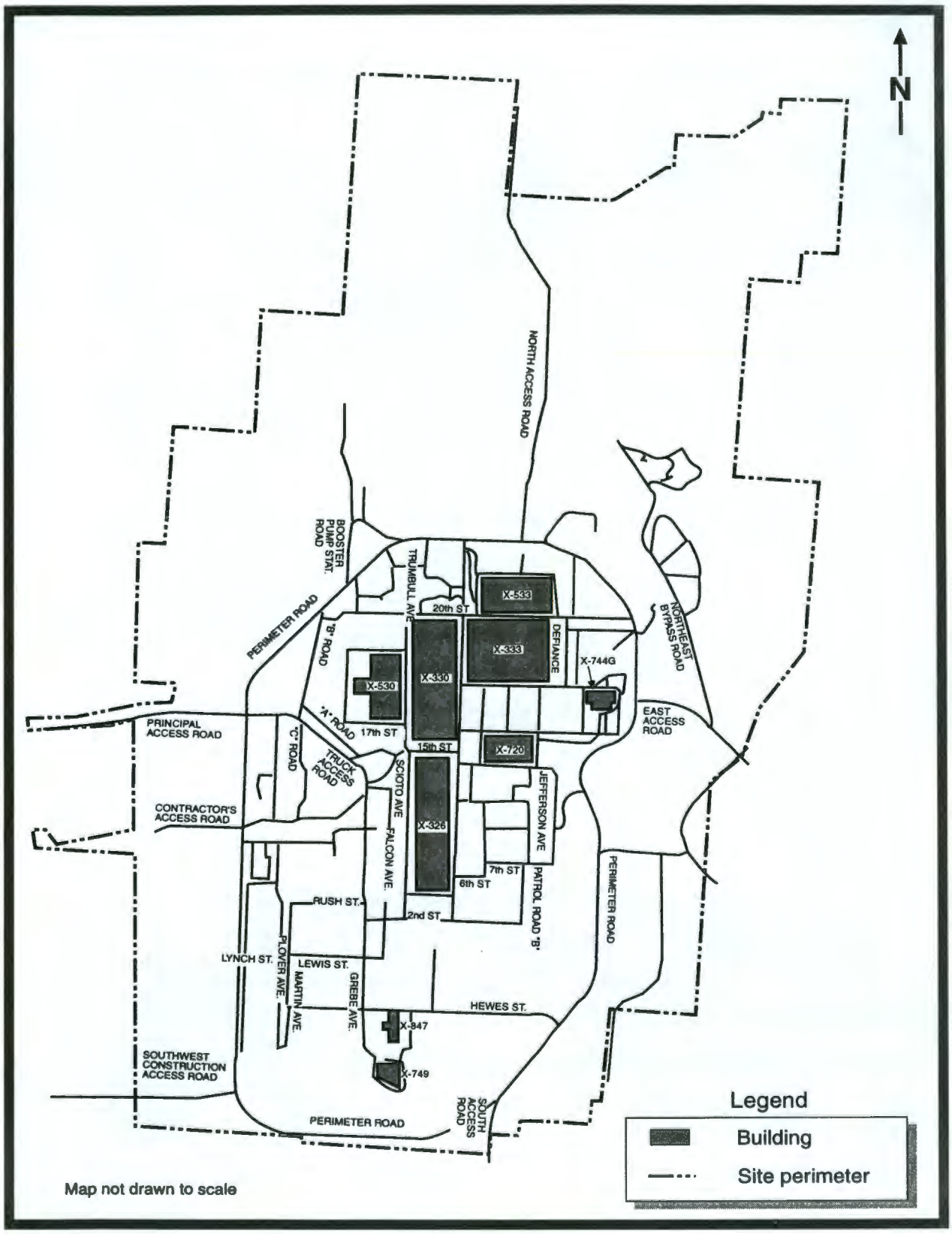


Figure 4.4–12. Portsmouth Gaseous Diffusion Plant

- The major sources of criteria pollutant emissions are three coal-fired boilers at the X-600 steam plant. Sources of radionuclide and fluoride emissions include purge cascade vents, cold recovery and wet evacuation vents, the X-345 high assay sampling area vent, the X-344 evacuation vent, and six seal exhaust vents.
- Prevailing winds at Portsmouth are from the south to southwest, with the south averaging the highest at just over 11%. Windspeeds average 5 mph, with winds up to 75 mph on record. The average annual temperature measured at Portsmouth during 1992 was 55°F, with seasonal average temperatures of 32°F or below in the winter, and 90°F or above in the summer.

Water Resources

- Major surface water features include the Scioto River and its onsite tributaries—Little Beaver Creek and Big Run Creek.
- No federally designated Wild and Scenic Rivers exist in the ROI.
- An alluvial aquifer and the Scioto River supply water.
- Onsite streams and the Scioto River receive treated wastewater.
- Surface water sampling in 1992 showed four parameters above their comparison criteria.
- Major groundwater units include the Mississippian shale and sandstone bedrock aquifer and the unconsolidated sediment aquifer.
- Onsite groundwater monitoring in 1992 showed eight parameters above comparison criteria; no contaminants exceeded comparison criteria in measurements of offsite groundwater.
- The site is located outside a 500-year floodplain.

Geology and Soils

- The site is on gently rolling land about 130 feet above the Scioto River with an average elevation of 670 feet above National Geodetic Vertical Datum.
- The predominant landform in the area is a relatively level, filled valley of the preglacial Portsmouth River, which runs north to south.
- Major rock units include, from oldest to youngest, the Ohio Shale, the Bedford Shale, the Berea Sandstone, the Sunbury Shale, and the Cuyahoga Shale.
- The site is in an abandoned river valley filled with fluvial materials. These unconsolidated sediments are the Gallia Sand Member and the Minford Clay Member.
- The soils in the fenced area are mostly urban land and are covered by roads, parking lots, buildings, and railroads. Other soils are well-drained, upland soils.

- No significant geologic faults exist in the ROI.
- The potential for damage from volcanic activity is small.

Ecological Resources

- Vegetation consists of pastureland, old fields, oak-hickory, upland mixed hardwood, bottomland mixed hardwood, pine, second-growth hardwood, and scrub thicket. All forests and old fields are second growth.
- Wetlands at Portsmouth are minimal and total only one acre.
- The Federal and State endangered Indiana bat has been identified in the vicinity of Portsmouth. One candidate species (listed as State threatened), four State endangered species, five State threatened species, four State potentially threatened species, and seven State special interest species occur near Portsmouth. No threatened or endangered plants have been located on the site.

Socioeconomic Conditions

- The ROI for Portsmouth comprises Pike, Jackson, Ross, and Scioto Counties. Ninety-two percent of the site's employees reside in these counties.
- Total site employment in 1990 was 2,386. Total ROI employment by place of work in 1990 was 77,806.
- The ROI unemployment rate in 1991 was 9.3%.
- The ROI per capita income in 1990 was $19,918 (1990 dollars).
- The total population in the ROI in 1990 was 204,136. Population demographics: Native Americans—0.34%; urban—35.62%.
- Housing: owner-occupied—70%; renter-occupied—30%.
- Sensitive populations: children (under 15 years old)—21.9%; women of child-bearing age (ages 15 to 44)—21.3%; adults over 65—13.7%.

Environmental Justice

- Minorities—Figure C.4–18.
- Below poverty level—Figure C.4–35.
- Presence of Federally recognized Native American Tribes: none.

Land Use

- The site occupies approximately 6.3 square miles (4,003 acres), of which 800 acres are developed and 3,203 acres are undeveloped; of the land that is undeveloped, nearly all is available for future site development.
- Land use surrounding the site is predominantly rural.

Infrastructure

- An onsite facility and 31 offsite supply wells provide an average of 14 million gallons of water per day.
- An onsite facility receives an average of 0.35 million gallons of sewage per day.
- The Ohio Valley Electric Corporation supplies power via an electrical and coal-fired system; the current site load is 1,537 megawatts of electricity and 4,500 tons of coal per month.
- Transportation in the region consists of local access roads (such as Piketon Hill Road and State Route 32) and major roads (such as Interstate 70 and U.S. Highways 23, 52, and 50). The Chesapeake and Ohio Railroad and Norfolk and Western Railroad are the primary providers of rail service to the Portsmouth region.

Cultural Resources

- The site has no recorded archaeological sites, standing structures, or traditional cultural properties, except for two cemeteries in the northeast corner of Portsmouth. This property has not been subject to a comprehensive cultural resources survey.

4.4.13 Rocky Flats Environmental Technology Site—Golden, Colorado

The Rocky Flats Environmental Technology Site (RFETS) occupies 6,500 acres approximately 16 miles northwest of Denver, in Jefferson County, Colorado, and employs 7,365 employees. From 1952 to 1992, the primary mission of RFETS was producing nuclear weapons components. The mission has now changed to special nuclear material stabilization and storage, as well as decontamination and decommissioning and cleanup. RFETS is shown in Figure 4.4–13.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 2,171,877 based on 1990 Census data (DOC, 1991, 1992b,c).

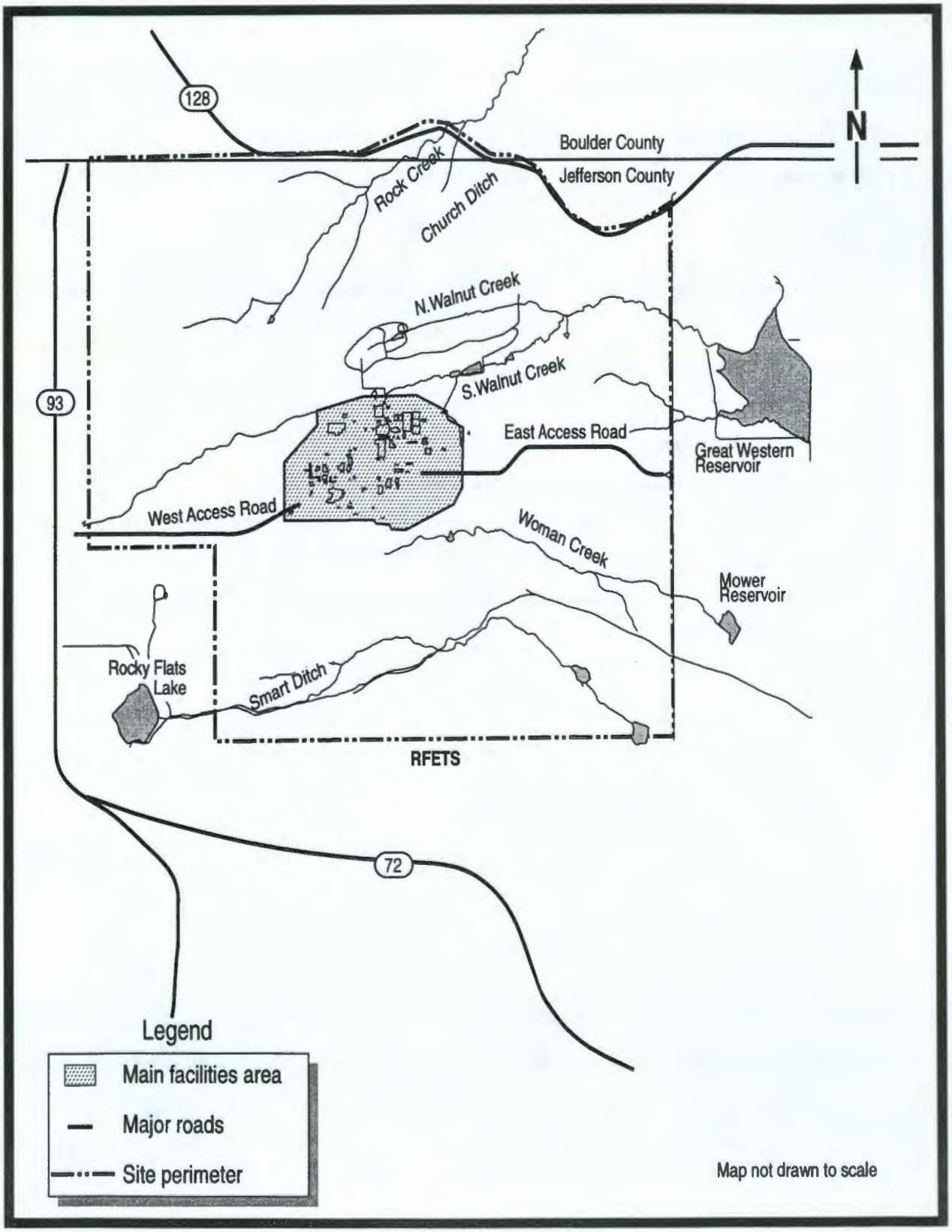


Figure 4.4–13. Rocky Flats Environmental Technology Site

- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0002 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 0.140 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Jefferson County is classified by EPA as a Federal nonattainment area for carbon monoxide, ozone, and particulate matter less than 10 micrometers in diameter (PM_{10}). The area is in attainment for the other three criteria air pollutants.
- The major sources of air pollution at the site are the emergency diesel generators and the natural-gas-powered boilers that produce steam for the site.
- Winds from the south were the most prevalent at Stapleton Airport in 1992 (14% of the time), and the most frequent windspeed was from 5 to 7 mph (45% annually). Mean windspeeds measured at RFETS in 1990 were 9.0 mph; highest was 88.6 mph. Mean temperature at RFETS in 1992 was 49.2°F, with temperatures ranging from a maximum monthly average in July of 77°F and a minimum monthly average in December of 17°F.

Water Resources

- Major surface water features include North Walnut Creek, South Walnut Creek, and Woman Creek, which are ephemeral streams draining the main site facilities in a west-to-east pattern.
- No federally designated Wild and Scenic Rivers exist in the ROI.
- The Denver Water Board, via the Ralston Reservoir and the South Boulder Diversion Canal, supplies water for the site.
- Walnut Creek receives treated wastewaters.
- No contaminants in the surface water exceeded comparison criteria in 1992.
- Major groundwater units include, from deep to shallow, the Laramie-Fox Aquifer, a shale aquitard (upper unit of the Laramie Formation), the Arapahoe Formation Aquifer, and the surficial Rocky Flats Alluvium. No aquifers beneath the site are sole source aquifers.
- In 1992, 12 contaminants in the groundwater exceeded comparison criteria.
- Existing facilities at RFETS lie outside the 500-year floodplain.

Geology and Soils

- The site lies on the eastern edge of the Rocky Flats Plateau, which flanks the eastern edge of the Front Range of the Rocky Mountains. Elevation is approximately 6,000 feet.
- Major underlying rock units include the Pierre Shale and Fox Hills Sandstone. RFETS is situated on the Rocky Flats Alluvium, which varies in thickness up to 100 feet and provides a gravelly cover over bedrock.
- The surface soils at the site consist of clay, cobbly clay, and sandy loams. The soils are moderately deep, well drained, and have moderate to low permeability.
- The Golden Fault is west of the site.
- Geologic hazards include little or no risk from subsidence, landslides, or earthquakes.

Ecological Resources

- The Rocky Flats Buffer Zone is mostly virgin grassland with relict tallgrass species on the western side. The site is in the transitional area, or ecotone, between the Rocky Mountains and the High Plains. The vegetation and animal populations have high biodiversity.
- Jurisdictional wetlands were designated and mapped by the U.S. Army Corps of Engineers in 1995. Some 1,100 wetlands comprising about 195 acres were mapped. Other small wetlands exist at the site.
- The federally listed threatened bald eagle and endangered American peregrine falcon (both State-endangered) have been reported at the site. Nine federal C2 (potentially listable) species occur. A threatened plant, *Spiranthes diluvalis* (Ute ladies' tresses), has been searched for, but not found, for three growing seasons. Extensive observations have been made of the Preble's meadow jumping mouse, a species the U.S. Fish and Wildlife Service was petitioned to list in 1994. Potential habitats for other species of concern exist at the site. Consultation on water depletions of the South Platte River by site operations is in progress.

Socioeconomic Conditions

- The ROI for RFETS comprises Jefferson, Adams, Arapahoe, Boulder, and Denver Counties. These counties are the residence of 92.5% of the site's employees.
- Total site employment in 1991 was 7,365. Total ROI employment by place of work in 1991 was 1,198,525.
- The ROI unemployment rate in 1991 was 4.5%.
- The ROI per capita income in 1990 was $20,961.
- The total population in the ROI in 1991 was 1,790,600. Population demographics: Native Americans—0.8%; urban—95%.

- Housing: owner-occupied—60.8%; renter-occupied—39.2%.
- Sensitive populations: children (under 15 years old)—21.7%; women of child-bearing age (ages 15 to 44)—25.4%; adults over 65—9.3%.

Environmental Justice

- Minorities—Figure C.4–19.
- Below poverty level—Figure C.4–36.
- Presence of Federally recognized Native American Tribes: Although not located in the RFETS ROI, the Arapaho and Cheyenne have expressed an interest in DOE's waste management strategy.

Land Use

- The site occupies approximately 6,500 acres, of which 498 acres are occupied by operational facilities and 6,002 acres are undeveloped; of the undeveloped land, approximately 5,753 acres are available for future site development.
- Land use immediately surrounding the site on three sides is mostly rural open space. Land uses immediately beyond these open spaces are grazing agricultural, industrial, mining, and low-density residential. Residential areas within 5 to 10 miles are growing rapidly.

Infrastructure

- The Denver Municipal Water District provides an average of 0.272 million gallons of water per day from the Ralston and Gross Reservoirs.
- An onsite wastewater treatment system consisting of primary, secondary, and tertiary treatment and using an activated sludge process receives an average of 0.15 million gallons of sewage per day.
- The Public Service of Colorado's Valmont and Cherokee Generating Station, via electricity and gas, provides power; the average loads are 18.3 megawatts of electricity and 1,750 million cubic feet of gas per day.
- Transportation in the region consists of roads and interstates (such as nearby State Route 93) and rail lines intersecting in Denver, a major railway hub.

Cultural Resources

- Native American groups have lived in the RFETS area since about 10,000 years ago. European occupation of the region began in the late 19th century.

- Portions of the site have been subject to a comprehensive cultural resource survey. Several historic and prehistoric archaeological sites have been identified. The site contains no recorded standing structures but has the potential to contain traditional cultural properties.

4.4.14 SANDIA NATIONAL LABORATORIES—ALBUQUERQUE, NEW MEXICO

Sandia National Laboratories, New Mexico (SNL-NM), is immediately southeast of Albuquerque, New Mexico, on Kirtland Air Force Base (KAFB). SNL-NM occupies two parcels of land on KAFB, which have been allocated to DOE. These parcels total 2,820 acres. SNL-NM is a research and development laboratory with a primary mission of developing, engineering, and testing nonnuclear components of nuclear weapons. SNL-NM is operated for DOE by Sandia Corporation, a subsidiary of Lockheed/Martin Corporation. The current workforce at the site consists of 40 DOE employees and 8,556 prime contractor employees. SNL-NM is shown in Figure 4.4–14.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 610,714 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0034 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 0.020 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Bernalillo County, in which SNL-NM is located, is classified by EPA as a nonattainment area for the criteria pollutant carbon monoxide. The county is in attainment for the other five criteria air pollutants.
- Major sources of air pollution at the site include vapor degreasers, solvents for cleaning benches, gasoline dispensing facilities, paint spray booths, and solvents vented from the Hazardous Waste Management facility fume hoods and bulking operations.
- Prevailing winds are from the north with a frequency of 10%. The dominant windspeed range is 5 to 7 mph, with an occurrence of almost 38%. The frequency of calm winds is 8%. Average monthly temperatures range from 35 to 78.8°F. Average annual precipitation is 8 inches.

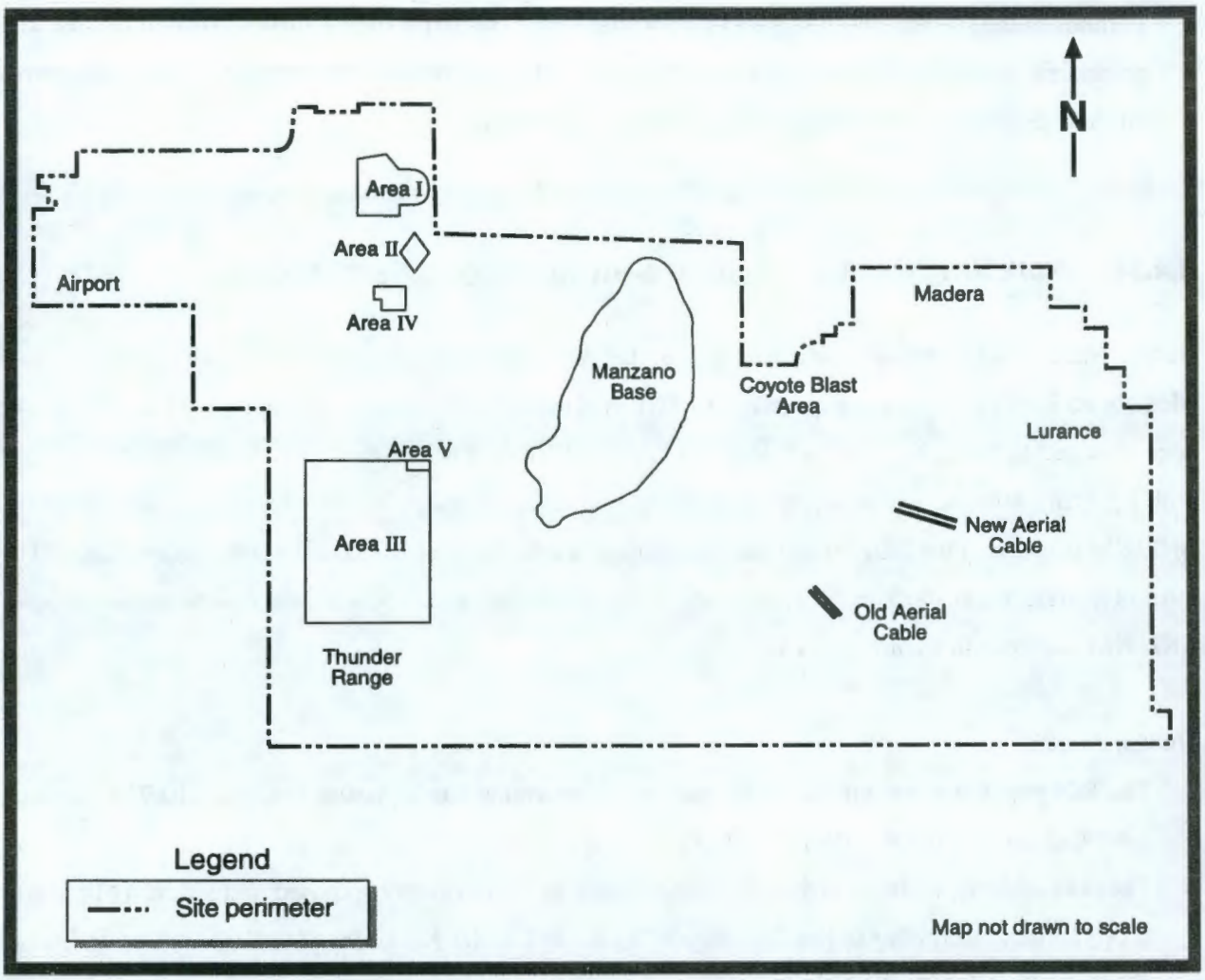


Figure 4.4–14. Sandia National Laboratories-New Mexico

Water Resources

- Major surface water features include the Rio Grande (6 miles from the western edge of KAFB) and onsite intermittent drainages such as Tijeras Arroyo and Arroyo del Coyote.
- No federally designated Wild and Scenic Rivers exist in the ROI.
- The city of Albuquerque and KAFB wells supply water for the site.
- The city of Albuquerque wastewater treatment plant and surface water impoundments receive wastewater.
- In 1992, surface water monitoring showed two parameters above their comparison criteria.
- The major groundwater unit is the Valley Fill Aquifer, consisting of unconsolidated and semiconsolidated sands, gravels, silts, and clays. No sole source aquifers exist in the ROI.

- Groundwater monitoring in 1992 showed that comparison criteria were exceeded for five parameters.
- All active facilities are located well outside the Rio Grande's 500-year floodplain.

Geology and Soils

- The topography at the site is generally flat, except for the steep-sided arroyos that cut through the mesa area.
- Major rock units below the eastern section of the site include basement rocks. Most of the rest of the site is underlain by the Santa Fe Group, which includes gravels, sands, silts, and clays deposited in a basin formed by the uplift of the mountains to the east. Ortiz gravel and Rio Grande fluvial deposits are surficial deposits in some places.
- The soils present include sandy, gravelly, loamy, stony, and very cobbly soils. Basalt, sandstone, and limestone outcrops are also present.
- Four faults, including two capable ones, cut across the site.
- The site is in an area characterized by high seismic activity but of low magnitude and intensity. Studies indicate that a nondamaging earthquake may be expected every 2 years, with a damaging event every 100 years.
- The potential for damage from volcanic activity is small.

Ecological Resources

- Vegetation includes grassland, arroyo banks/dissected terrace, and grassland on dune sand. Grassland vegetation dominates. Dominant shrub species are sand sagebrush and four-wing saltbush, which are widespread in the western United States. Unique habitat includes arroyos.
- Wetland habitat is extremely limited on KAFB.
- No known Federally listed threatened or endangered species have been found at SNL. The Federal and State endangered peregrine falcon could exist in woodland or canyons. Two candidate species exist and one candidate species potentially exists on KAFB; three State-listed endangered cacti are located within KAFB; five State-listed endangered fauna exist or potentially exist on KAFB; and four plants classified as State Priority 1 are located in the vicinity of KAFB.

Socioeconomic Conditions

- The ROI for SNL-NM includes Bernalillo, Cibola, Sandoval, Santa Fe, Torrance, and Valencia Counties. At least 90% of the site's employees reside in these counties.

- Total site employment in 1992 was 8,596. Total ROI employment by place of work in 1990 was 393,398.
- The ROI unemployment rate was 7.0% in 1991.
- The ROI per capita income in 1990 was $16,281.
- The total population in the ROI in 1990 was 722,138. Population demographics: Native Americans—5.85%; urban—85.3%.
- Housing: owner-occupied—67.88%; renter-occupied—32.12%.
- Sensitive populations: children (under 15 years old)—23%; women of child-bearing age (ages 15 to 44)—23.1%; adults over 65—10.3%.

Environmental Justice

- Minorities—Figure C.4-20a.
- Below poverty level—Figure C.4-37.
- Presence of Federally recognized Native American Tribes: Isleta, Laguna, Sandia, Santa Ana, Santo Domingo, and Zia Pueblos.

  Tribal lands—Figure C.4-20b.

Land Use

- The site occupies approximately 2,820 acres, of which 175 acres are currently developed and 206 acres are available for future site development.
- Land use surrounding the site includes the Kirtland Air Force Base.

Infrastructure

- Onsite wells provide an average of 1.0 million gallons of water per day.
- The City of Albuquerque sewer system receives sewage; a site load of 0.548 million gallons per day was recorded in 1991.
- KAFB, which purchases electricity from the Public Service Company of New Mexico and the Western Area Power Administration, supplies power. The current site load is 34.5 megawatts. The Gulf Gas Utilities Company supplies natural gas.
- The ROI contains local road and rail networks. The site is 6 miles southeast of downtown Albuquerque. I-40 and I-26 intersect within the city limits. There is no direct rail access to the site.

Cultural Resources

- The State Historic Preservation Office has not evaluated the site for unrecorded archaeological sites, architectural resources, or traditional cultural properties.

4.4.15 SAVANNAH RIVER SITE—AIKEN, SOUTH CAROLINA

The Savannah River Site (SRS) is approximately 25 miles southeast of Augusta, Georgia, and 20 miles south of Aiken, South Carolina, in Aiken, Barnwell, and Allendale Counties in southwest-central South Carolina. It is on approximately 198,000 acres of land in a principally rural area, with most of the land serving as a forestry research center. SRS was established in 1950 by the Atomic Energy Commission. The site is currently operated by Westinghouse Savannah River Company. SRS is shown in Figure 4.4–15.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 620,618 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.140 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 6.40 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- The areas encompassed by, and the counties surrounding, SRS are classified by EPA as attainment areas for all six of the National Ambient Air Quality Standards criteria air pollutants.
- The major source of criteria air pollutants are nine coal-burning and four fuel-oil-burning boilers, and the processing facilities for fuel and target fabrication. Non-SRS sources of toxic air pollutants consist primarily of industrial installations, small manufacturing shops, and residential wood combustion.
- Prevailing winds at the Bush Field Airport in 1992 are uniformly distributed with winds from the west-southwest 7% of the time and from the west-northwest 6% of the time on a yearly basis. The highest occurrence of windspeed is from 5 to 7 mph, with an annual occurrence of 35%. The annual average temperature is 66°F), with seasonal temperatures ranging from an average summertime daily maximum of 90.8°F to an average daily minimum in January of 37.9°F.

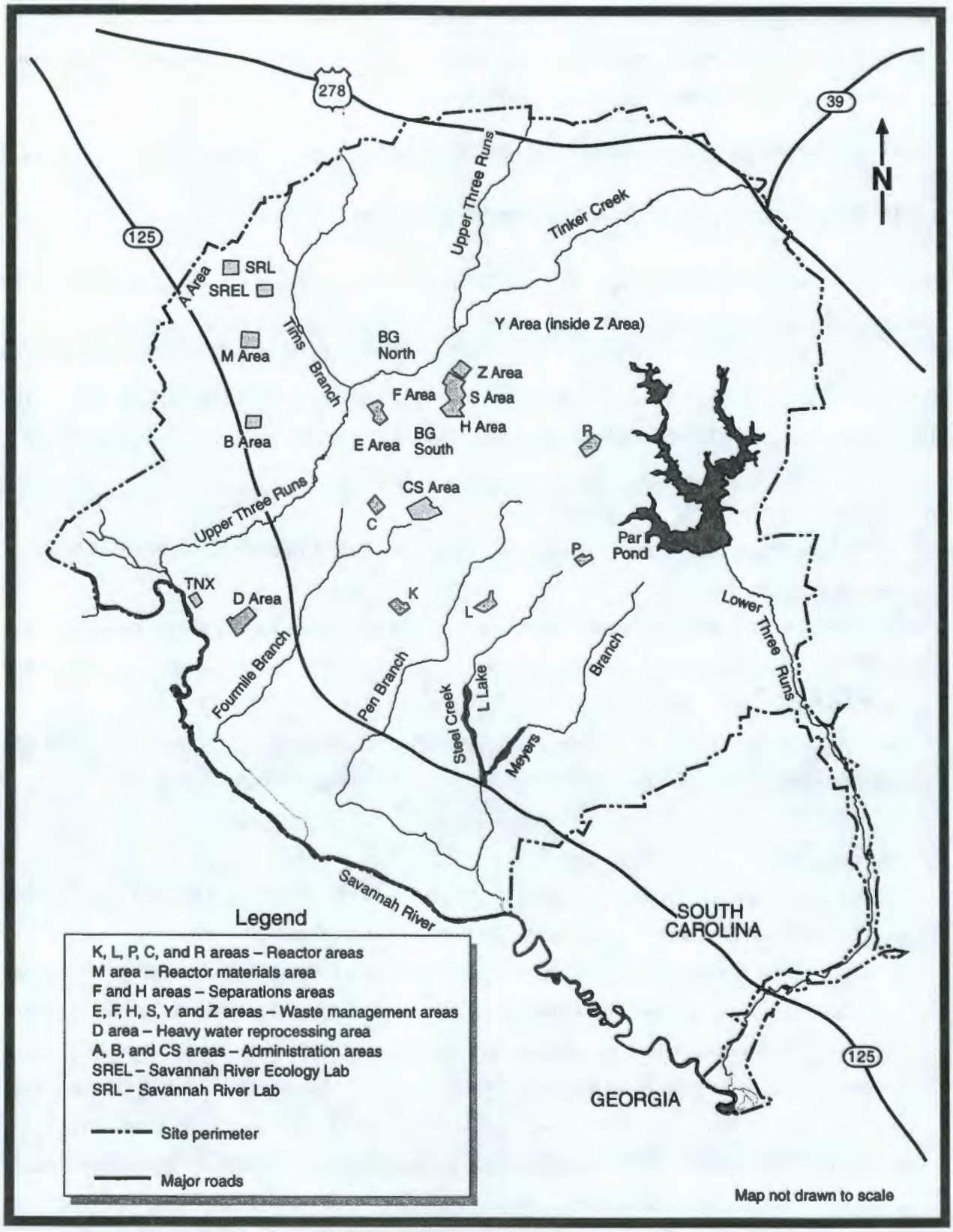


Figure 4.4–15. Savannah River Site

Water Resources

- Major surface water features include the Savannah River (which runs along the southwestern SRS border for 20 miles); onsite drainages such as Upper Three Runs, Fourmile Branch, Beaver Dam Creek, Pen Branch, Steel Creek, and Lower Three Runs; and numerous Carolina bays.
- No Federally designated Wild and Scenic Rivers exist in ROI.
- Groundwater wells and the Savannah River supply water for the site.
- Onsite streams and the Savannah River receive treated wastewater.
- Major groundwater units are the interbedded sandy clays and clayey sands of the coastal plain sediments. The sandy beds generally form aquifers, and the clay-rich beds act as aquitards. No sole source aquifers occur in the ROI.
- Onsite groundwater monitoring in 1992 showed that 42 parameters exceeded comparison criteria. Groundwater monitoring data indicate that contaminant plumes have not migrated into offsite water.
- The 100-year floodplain does not encroach on existing facilities.

Geology and Soils

- The topography of the area is generally flat, with some rolling hills and knolls. Elevations range from 85 to 427 feet above mean sea level.
- Major rock units include, from oldest to youngest, the crystalline basement rocks, the Dunbarton Triassic Basin, and the Atlantic Coastal Plain sediments.
- The soils in the area are primarily sandy loams that occur on alluvial terraces of the Savannah River and on the Aiken Plateau.
- Several interbasinal faults are located in the down-faulted Dunbarton Triassic Basin. However, no conclusive evidence exists of recent displacement along any fault within 186 miles of SRS.
- Two major earthquakes have occurred within 186 miles of the site. The probability of future seismic damage is moderate.

Ecological Resources

- Major plant communities include cypress-gum and lowland hardwood swamps, sandhills, and old agricultural fields. Ninety percent of SRS land cover is comprised of upland pine forests and bottomland hardwood forests. Important terrestrial habitats include old fields, sandhills, upland pine forests, bottomland and upland hardwood forests, and swamp forests. Longleaf pine/wiregrass communities support sensitive species, such as the red-cockaded woodpecker. SRS was designated a National Environmental Research Park in 1972.

- SRS contains approximately 43,000 acres of wetlands (20% of SRS), consisting of emergent marsh, cypress/tupelo, bottomland hardwood, and open water. These wetlands include the Savannah River swamp (about 10,000 acres) and over 200 Carolina bays scattered throughout the SRS.
- Federal and State endangered Kirtland's warbler, peregrine falcon, wood stork, red-cockaded woodpecker, and shortnose sturgeon are present on SRS. The Federally endangered smooth coneflower is also present. Two Federal threatened species and 11 candidate species are found on the site. The State-endangered Rafinesque's big-eared bat is present as well as the State-threatened Bewick's wren. Over 50 plants and animals on the State list are found on SRS. Additional listed species are located near SRS.

Socioeconomic Conditions

- The ROI for SRS includes Aiken, Barnwell, Allendale, and Bamberg Counties in South Carolina and Burke, Columbia, Richmond, and Screven Counties in Georgia. At least 90% of the site's employees reside in these counties.
- Total site employment in 1990 was 19,201. Total ROI employment by place of work in 1990 was 254,777.
- The ROI unemployment rate was 8.4% in 1991.
- The ROI per capita income in 1990 was $15,837.
- The total population in the ROI in 1990 was 460,028. Population demographics: Native Americans—0.2%; urban—69.6%.
- Housing: owner-occupied—67.1%; renter-occupied—32.9%.
- Sensitive populations: children (under 15 years old)—23.7%; women of child-bearing age (ages 15 to 44)—24.3%; adults over 65—10.3%.

Environmental Justice

- Minorities—Figure C.4-21.
- Below poverty level—Figure C.4-38.
- Presence of Federally recognized Native American Tribes: Three Native American groups, the Yuchi Tribal Organization, the Nubiunal Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy, have expressed general concerns about SRS and the Central Savannah River Area regarding several plant species traditionally used in tribal ceremonies.

Land Use

- The site occupies approximately 198,000 acres of land, most of which serves as a forestry research center. SRS was designated a National Environmental Research Park in 1972. Of the total area, approximately 15,840 acres are developed and 182,160 are undeveloped; of the undeveloped land, approximately 145,400 acres are available for future site development.
- Land use surrounding the site is predominantly rural.

Infrastructure

- Onsite wells provide an average of 1.6 million gallons of water per day.
- Onsite treatment plants receive an average of 0.5 million gallons of sewage per day.
- South Carolina Gas and Electric Company and onsite generation provide power; the current site load is 130 megawatts.
- Transportation in the region consists of local access roads (such as U.S. 278 and State Route 125) and major roads (such as Interstates 20 and 95). The Seaboard Coast and Southern Railroads are the primary providers of rail service to the SRS region, including onsite rail spurs.

Cultural Resources

- Native American occupation of the area began about 11,000 years ago.
- Over 800 prehistoric sites and about 400 historic sites have been identified at SRS.
- Fifty-five sites have been determined eligible for the National Register of Historic Places.

4.4.16 Waste Isolation Pilot Plant—New Mexico

The Waste Isolation Pilot Plant (WIPP) is in Eddy County in southeastern New Mexico, approximately 25 miles east-southeast of Carlsbad in an area known as Los Medanos (The Dunes). The area, which totals 10,245 acres, is a sparsely inhabited plateau with little water and limited land uses. WIPP is a DOE facility authorized in 1980 to demonstrate the technical and operational principles involved in the permanent disposal of defense-generated transuranic waste. WIPP is shown in Figure 4.4–16.

Human Health

- Because WIPP is not open for TRUW disposal, only preoperational radiation surveillance has been conducted to establish background information at the site. Radiological measurements will also be performed to monitor any radionuclide release from the site after its opening for TRUW disposal.

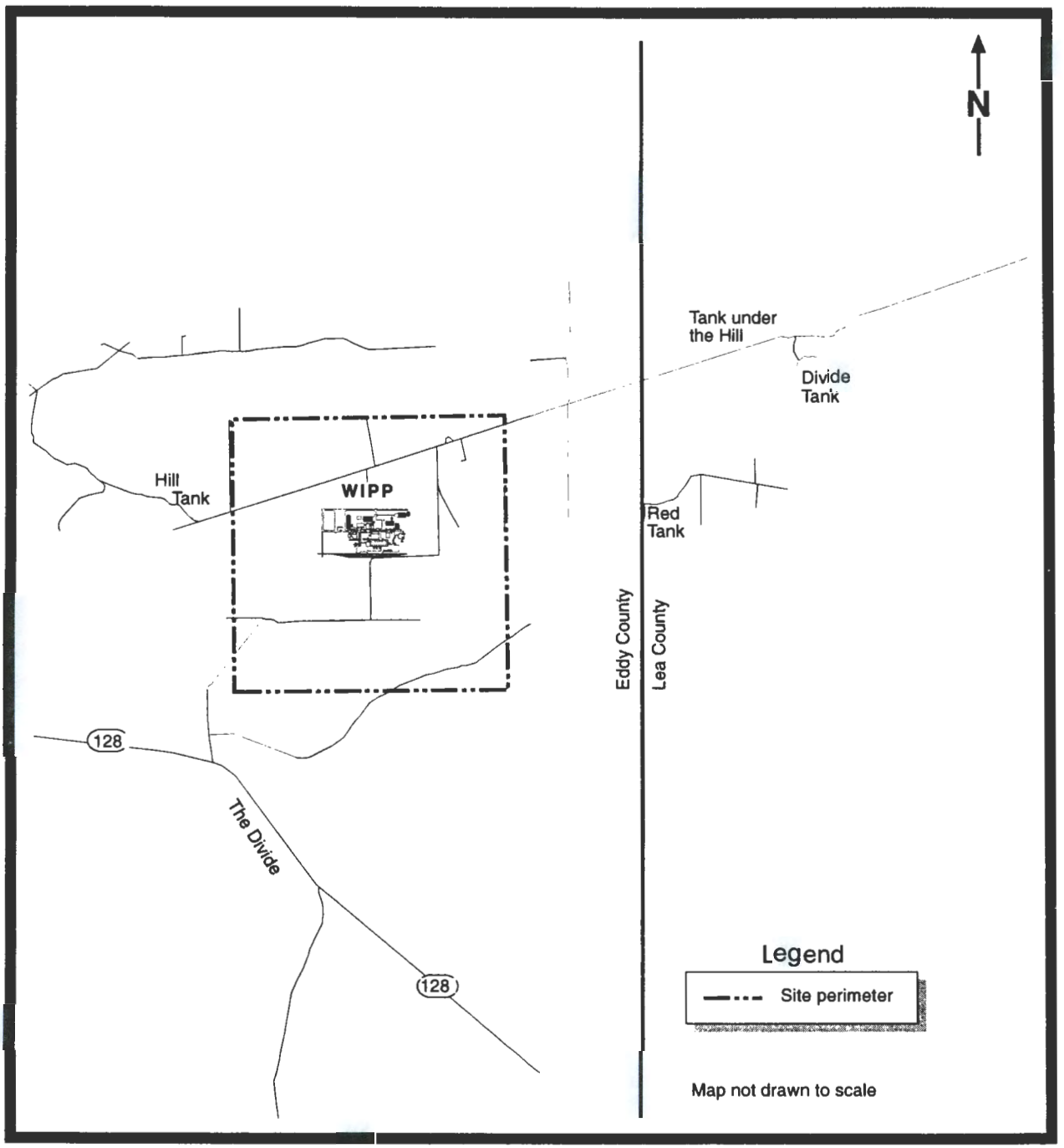


Figure 4.4–16. Waste Isolation Pilot Plant

- The ROI population used for PEIS health risk analyses is 99,889.

Air Quality

- Eddy County is currently classified by EPA as an attainment area for all six of the criteria air pollutants.
- Operations involving radioactive waste are expected to begin upon receipt of wastes shipped to WIPP for disposal. These operations would be the major source of air pollution at the site.
- Prevailing winds are from the southeast approximately 13% of the time, and the dominant windspeed ranges from 5 to 7 mph with an occurrence of almost 38%. The frequency of calm winds less than 2 mph is 4%. The average annual temperature for the WIPP area in 1992 was 63°F. The annual precipitation in 1992 was 16.58 inches, which is 4.33 inches above the long-term average for the area.

Water Resources

- Major surface water features include the Pecos River (14 miles west of the site); surface water runoff impoundments called "tanks" scattered throughout the nearby area; Laguna Grande de la Sal (10 miles south of the site), which is a large catchment basin for limited surface drainage; and artesian saline springs.
- No Federally designated Wild and Scenic Rivers exist in the ROI.
- The city of Carlsbad supplies water for the site.
- The WIPP sewage lagoon, a zero-discharge treatment facility, receives wastewaters.
- Surface water analysis in 1987 for various metals and organics showed elevated levels of six contaminants resulting from the natural saline springs in the area. Radionuclide concentrations fall within expected levels.
- Groundwater units include, from deepest to shallowest, the Bell Canyon Formation (water-bearing), the Castile Formation, the Rustler Formation (containing five water-bearing zones including the Culebra Dolomite), and the Dewey Lake Red Beds (sand beds). No sole source aquifers occur at the site. In the vicinity of WIPP, water is of low quality (ranging from brackish to brine). There are no aquifers on the WIPP site.
- Groundwater monitoring in 1992 showed naturally high concentrations of constituents in the Culebra Dolomite and seven constituents in the Dewey Lake Red Beds. Maximum concentrations of constituents in groundwater are provided in Table 2.21–3 of the affected environment technical report (DOE, 1996).
- WIPP is more than 400 feet above the floodplain of the Pecos River, well outside areas that may be flooded.

Geology and Soils

- The site is on a slight hummocky plain covered with caliche and sand within the Delaware Basin of the Pecos Valley. Elevations range from 3,250 to 3,570 feet.
- Major rock units include, from oldest to youngest, the Bell Canyon Formation (sandstones, shales, siltstones, and limestones), the Castile Formation (anhydrite and halite), the Salado Formation (anhydrite and halite), the Rustler Formation (anhydrite, siltstone/claystone, halite, and carbonate), the Dewey Lake Red Beds (siltstones and claystones, with subordinate sandstones), the Santa Rosa Sandstone, the Gatuna Formation sandstones, the Mescalero caliche, and Recent-age sands.
- Soils are made up of noncalcareous loose sands. Permeability and the potential for wind erosion are very high.
- Because of karst features in the area, dissolution and subsidence has occurred, and may continue to occur. These events are limited in extent and do not affect the integrity of the Salado Formation near repository depth.
- The Delaware Basin is considered to be tectonically stable. No surface faulting is known at the site.

Ecological Resources

- WIPP is characterized by stabilized sand dunes. Dominant vegetation includes Harvard Shin oak, mesquite, sand sage and plains yucca, and numerous species of forbs and perennial grasses. Dominant shrubs are deep-rooted species with extensive root systems.
- Wetlands are not present at WIPP.
- The Federal and State endangered American peregrine falcon and the Federal threatened and State endangered bald eagle may be located at WIPP, as well as four Federal Notice of Review species (one is State threatened). No critical habitat for terrestrial endangered species has been identified at WIPP.

Socioeconomic Conditions

- The ROI for WIPP comprises Eddy, Otero, Chaves, and Lea Counties in New Mexico and Culberson and Loving Counties in Texas. Ninety percent of the site's employees reside in these counties.
- Total site employment for 1990 was 932. Total ROI employment by place of work in 1990 was 99,707.
- The ROI unemployment rate in 1991 was 6.1%.
- The ROI per capita income in 1990 was $13,557 (1990 dollars).
- The total population in the ROI in 1990 was 217,661. Population demographics: Native Americans—1.83%; urban—73.64%.
- Housing: owner-occupied—69.2%; renter-occupied—30.8%.

- Sensitive populations: children (under 15 years old)—26.4%; women of child-bearing age (ages 15 to 44)—21.4%; adults over 65—12.3%.

Environmental Justice

- Minorities—Figure C.4–22.
- Below poverty level—Figure C.4–39.
- Presence of Federally recognized Native American Tribes: Although not located in the WIPP ROI, the Mescalero Apache Tribe has expressed an interest in DOE's waste management strategy.

Land Use

- The site occupies approximately 10,245 acres of land, of which approximately 10,210 acres are available for future site development, although a 1-mile buffer zone is planned to be provided around the area above the maximum extent of underground development.
- Land surrounding the site is sparsely inhabited, with limited land uses.

Infrastructure

- An offsite well system from the city of Carlsbad provides an average of 0.075 million gallons of water per day.
- An onsite sewage lagoon receives an average of 0.012 million gallons of sewage per day.
- The Southwestern Public Service Company supplies power; the current site load is 4,579 kilovolt-amperes.
- Direct access to the site is available from Routes 128 and 31. A rail spur to the site connects to the Atchison, Topeka, and Santa Fe Railroad.

Cultural Resources

- Since 1976, a total of 98 archaeological sites and numerous isolated artifact finds have been recorded within the 16-square-mile WIPP site.

4.4.17 WEST VALLEY DEMONSTRATION PROJECT—WEST VALLEY, NEW YORK

The West Valley Demonstration Project (WVDP) occupies 220 acres of the Western New York Nuclear Services Center (WNYNSC) in West Valley, New York, a rural setting approximately 31 miles south of Buffalo, in Cattaraugus County, a largely rural area. The WNYNSC was established in 1961. The New

York State Energy Research and Development Authority formed a private company—Nuclear Fuel Services, Inc. (NFS)—to construct and operate a nuclear fuel reprocessing plant. NFS leased WNYNSC, constructed the site, and began operations in 1966 to recycle fuel from commercial and Federally owned reactors. In the late 1970s, the site was shut down. WVDP is shown in Figure 4.4–17.

Human Health

- The ROI population used in the PEIS analyses to determine human health risk was 1,698,391 based on 1990 Census data (DOC, 1991, 1992b,c).
- The radiation dose from airborne radionuclides to a maximally exposed individual (MEI) was 0.0003 mrem according to the *Summary of Radionuclide Air Emissions from Department of Energy Facilities for CY 1992* (DOE, 1994a).
- The collective radiological dose from airborne radionuclide emissions to the site ROI health risk population was 0.011 person-rem according to the 1992 DOE summary report (DOE, 1994a).

Air Quality

- Cattaraugus County, in which WVDP is located, is classified by EPA as an attainment area for all six criteria air pollutants.
- Major sources of air pollution at the site are radiological and include the main ventilation stack, cement solidification system ventilation stack, contact size-reduction facility ventilation stack, and supernatant treatment system ventilation stack.
- Prevailing winds were from the south-southeast with a frequency of 17% in 1992. The frequency of calm winds was 1%. Precipitation for the year was almost 7 inches above the annual average of 41 inches.

Water Resources

- Major surface water features include Cattaraugus Creek (2.4 miles from the site), Buttermilk Creek (0.5 mile from the site), and onsite tributaries (Quarry Creek, Erdman Brook, and Frank's Creek). The WVDP site and these streams are within the Cattaraugus Creek drainage basin, which ultimately flows into Lake Erie.
- No federally designated Wild and Scenic Rivers exist in the ROI.
- Two reservoirs, formed by damming tributaries to Buttermilk Creek, supply water for the site.
- Erdman Brook receives treated wastewater.
- One constituent was above comparison criteria in surface waters in 1991.

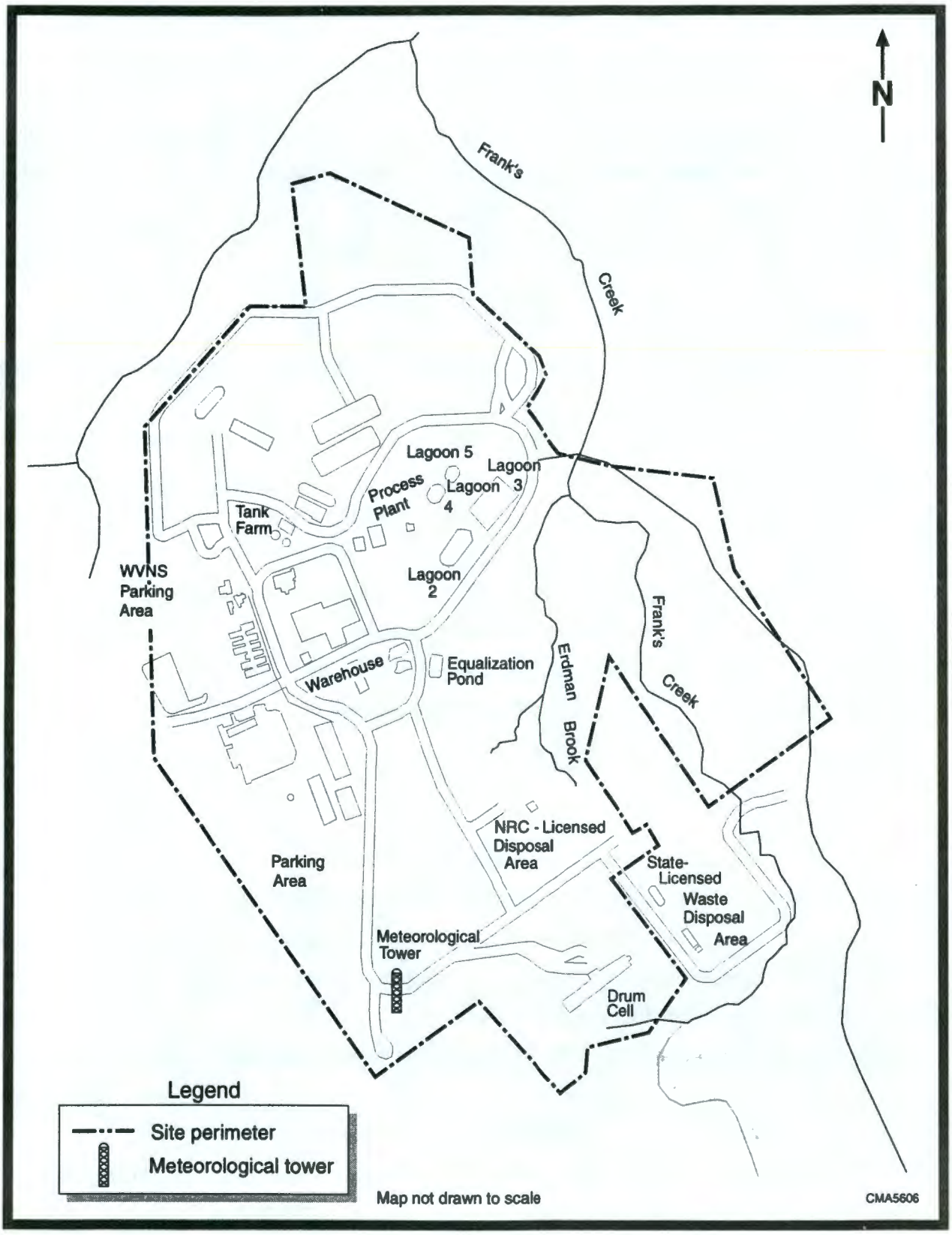


Figure 4.4–17. West Valley Demonstration Project

- Major groundwater units include a shallow aquifer composed of weathered Lavery till and alluvial gravels and a bedrock aquifer consisting of decomposed shale and rubble. The Cattaraugus Creek Basin Aquifer System is considered a sole source aquifer.
- Groundwater monitoring in 1991 showed that all parameters except gross beta and tritium were within comparison criteria. Monitoring at 10 offsite residential wells indicated no evidence of contamination by activities at WVDP.
- No safety-related WVDP facilities are in a 100-year floodplain.

Geology and Soils

- The topography at the site is generally gently rolling, with slopes between 5 and 15% and an average elevation of 1,300 feet above National Geodetic Vertical Datum.
- Major rock units include, from oldest to youngest, crystalline basement rocks; the Canadaway and Conneaut Groups (shales and siltstones); the Kent and Olean clayey silt tills; a lacustrine unit of silt, clay, sand, and gravel; and the Lavery silty clay till. Alluvial sands and gravels cover glacial till in some places.
- The major soils present include a well-drained gravelly loam and a poorly drained silt loam.
- No faulting of any consequence is recognized within the site.
- The site is in a region that has experienced a moderate amount of minor seismic activity.
- The potential for damage from volcanic activity or subsidence is small.
- The site is currently experiencing some erosion.

Ecological Resources

- Vegetation communities at WVDP include mixed hardwood forest (40% of the site), evergreen forest, bottomland forest, old-field successional areas, and forest-stage successional areas. WVDP is equally divided between forest and abandoned farm fields, which are becoming re-established with native vegetation. The State has designated the site as critical habitat because white-tail deer use it extensively as a wintering area. Unique habitats include rock faces.
- Delineated wetlands total approximately 35 acres and include wet meadows, emergent marshes and pond fringes, shrub swamps, forested swamps, and bogs and fens. A riparian area on Cattaraugus Creek is recognized by the State as Habitat Significant for Wildlife.
- No Federal-listed threatened or endangered species or critical habitats are found on WVDP. No State-listed endangered species have been recorded on the site, but 1 State threatened bird species, 38 plant species listed as protected, and 31 species considered exploitable vulnerable have been recorded on the

site. The Federal and State endangered Indiana bat, 3 State endangered, 4 State threatened, and 16 State species of special concern may potentially exist on the site.

Socioeconomic Conditions

- The ROI for WVDP comprises Cattaraugus and Erie Counties. Ninety-six percent of the site's employees reside in these counties.
- Total site employment in 1990 was 1,100. Total ROI employment in 1990 was 569,246.
- The ROI unemployment rate in 1991 was 8%.
- The ROI per capita income in 1990 was $17,937.
- The total population in the ROI in 1990 was 1,052,766. Population demographics: Native Americans—0.7%; urban—84%.
- Housing: owner-occupied—64.4%; renter-occupied—35.6%.
- Sensitive populations: children (under 15 years old)—19.9%; women of child-bearing age (ages 15 to 44)—23%; adults over 65—15.1%.

Environmental Justice

- Minorities—Figure C.4-23a.
- Below poverty level—Figure C.4-40.
- Presence of Federally recognized Native American Tribes: Seneca Nation.
  Tribal lands — Figure C.4-23b.

Land Use

- The site occupies approximately 220 acres of land; approximately 165 acres are available for future site development.
- Land use surrounding the site is predominantly rural. The site occupies a portion of the WNYNSC.

Infrastructure

- An onsite facility supplied from a reservoir provides an average of 0.07 million gallons of water per day.
- An onsite wastewater treatment plant receives an average of 0.07 million gallons of sewage per day.
- The Niagara Mohawk Power Company supplies electrical service; the WVDP electric load in December 1993 was 2.9 megawatts. Natural gas service is provided by National Fuel Gas Distribution Corporation; the natural gas usage in December 1993 was 15,880 British Thermal Units.

- Access to I-90 from WVDP is by Route 219, 5 miles west of the site. Route 17 is located 20 miles south of the site. An inactive rail spur is available on the site.

Cultural Resources

- The undeveloped portions of WVDP have not been evaluated by the New York State Historic Preservation Office.

4.5 Brief Descriptions of Other Sites

In this section, information is presented to characterize the activities that have produced waste at other sites. This includes all sites except the 17 major sites and those sites located within the same geographical location as one of the 17 major sites.

Ames Laboratory—Ames, Iowa. Ames Laboratory grew out of Iowa State University's involvement in the Manhattan Project starting in 1942. Ames furnished most of the uranium used in the first successful nuclear chain reaction in 1942. Uranium production continued throughout World War II. Current research includes innovative materials, superconductors, and environmental restoration technologies. Responsibilities at this Site include remediation of a chemical disposal site (1 acre) and a diesel fuel oil underground storage tank (1 acre). The laboratory occupies approximately 15 acres at the University.

Battelle Columbus Laboratories—Columbus, Ohio. Battelle Columbus Laboratories is made up of two major research complexes covering 10 acres, one in the city of Columbus and one in rural Madison County, Ohio. The Columbus Site houses corporate offices and general research laboratories. The other site is made up of a number of facilities formerly dedicated to nuclear research. Since mid-1943, the Battelle Memorial Institute has continuously performed contract research and development work for DOE and its predecessor agencies. The Battelle Columbus Laboratories are privately owned. DOE no longer needs the facilities and is obligated contractually to remove the contamination so that the laboratories can be used by Battelle without radiological restriction. Fifteen buildings, or portions thereof, and associated soil areas are radioactively contaminated as a result of work done under government contract.

Bettis Atomic Power Laboratory—West Mifflin, Pennsylvania. Bettis Atomic Power Laboratory is located on a 202-acre tract in West Mifflin, Pennsylvania, about 8 miles southeast of Pittsburgh. Bettis is

one of four DOE Laboratories participating in the joint DOE and Department of the Navy Naval Nuclear Propulsion Program. The Laboratory is operated for DOE by the Westinghouse Electric Corporation and is engaged solely in designing and developing naval nuclear propulsion plants. Laboratory operations include developing and testing nuclear fuel materials and reactor materials including radiochemical analyses.

Charleston Naval Shipyard—Charleston, South Carolina. The Charleston Naval Shipyard is a U.S. Navy facility that repairs, overhauls, and maintains Navy ships, including nuclear-powered ships. The activities relating to nuclear propulsion systems are performed in accordance with the requirements and authority of the Naval Nuclear Propulsion Program, a joint program of DOE and the Department of the Navy. The activity at the Charleston Naval Shipyard is being phased out as the operation is shut down.

Colonie Interim Storage Site—Colonie, New York. The 10-acre Colonie Site was used to manufacture a variety of products from depleted uranium. Since termination of AEC contracts, work has been limited to fabrication of shielding components, ballast weights, and projectiles from depleted uranium. In 1983, Congress assigned DOE the responsibility for site cleanup. Radiological surveys conducted from 1983 through 1987 identified 56 vicinity properties requiring corrective actions. Remedial action is expected to be completed by 1998.

Energy Technology Engineering Center (ETEC)—Los Angeles, California. ETEC is operated by the Rocketdyne Division of Rockwell International Corporation for DOE at 50 DOE-owned facilities located on a 90-acre area within Area IV of the Santa Susana Field Laboratory (SSFL) site. In 1946, the ETEC facilities began work in nuclear energy research and development. Small test and demonstration reactors and critical assemblies were built and operated, reactor fuel elements were fabricated, and used reaction fuel elements were disassembled and the cladding was removed from around the fuel. Since 1956, ETEC facilities were used to conduct manufacturing, engineering, and R&D activities for the AEC, the Energy Research and Development Administration (ERDA), and DOE. In 1966, ETEC was associated with the Liquid Metal Fast Breeder Program. Since 1987, no work with nuclear materials has been done at ETEC, and the only work related to its earlier operations has been cleanup and decontamination of the remaining inactive nuclear facilities. Currently all ETEC projects involve decontamination and decommissioning.

Fermi National Accelerator Laboratory—Chicago, Illinois. Fermi National Accelerator Laboratory (Fermi) is operated by a consortium of U.S. and Canadian universities for DOE. It explores the fundamental structure of matter using high-energy accelerators. Fermilab's accelerator, the Tevatron, is the

world's highest energy accelerator. Environmental restoration includes cleanup of polychlorinated biphenyls (PCBs).

General Atomics—San Diego, California. General Atomics (GA) Technologies was founded in 1955 and was one of the first private organizations to engage in fusion power research. DOE awarded a contract in January 1991 to GA to provide inertial confinement fusion (ICF) target component fabrication and technology development support to DOE for laboratories engaged in ICF experimental activities. DOE is responsible for the management, cleanup, and disposal of radioactive waste generated from DOE programs at this site, which is on less than 1 acre of land. Decontamination and decommissioning planning activities for the GA Hot Cell Facility were initiated in Fiscal Year (FY) 1992 and are expected to be completed by FY 1997.

General Electric Vallecitos Nuclear Center—Vallecitos, California. The Vallecitos Nuclear Center was used for mixed oxide fuel fabrication and development from 1962 to 1979. DOE is responsible for the management, cleanup, and disposal of the radioactive waste generated from DOE programs at this facility. Decontamination and decommissioning (D&D) planning activities for an alpha cell located within General Electric's Hot Cell Facility were initiated in FY 1992. D&D of the Hot Cell Facility has been delayed by waste disposition issues and is expected to be reinitiated in FY 1997.

Grand Junction Projects Office—Grand Junction, Colorado. The Grand Junction Projects Office (GJPO) supported the development of uranium ore processing and milling technology between 1942 and 1974. GJPO was accepted into the decontamination and decommissioning program in 1988. Remediation of the GJPO Site began in 1990 and, with the anticipated addition of 12 contaminated buildings in the program, is expected to be completed in FY 1998.

Inhalation Toxicology Research Institute—Albuquerque, New Mexico. The Inhalation Toxicology Research Institute (ITRI) covers about 135 acres on the Kirtland Air Force Base. The principal mission is to investigate human health effects from inhalation of airborne particulates, including fission products, fuel cycle actinides, insulating materials, and diesel exhaust. Radioactive waste is disposed at DOE-owned sites. Underground storage tank leaks have produced diesel oil contamination of the groundwater below lagoons used for the disposal of sanitary waste. Complete groundwater cleanup is expected by 1996.

Kansas City Plant—Kansas City, Missouri. Established in 1949, the Kansas City Plant (KCP), which covers 141 acres, manufactures rubber, plastic, electronic, and other nonnuclear parts for nuclear weapons. The plant also provides development hardware for research programs conducted at DOE laboratories. KCP has recently been assigned several additional missions as part of the nonnuclear consolidation of the DOE weapons complex. The facility was formerly used as an airplane engine production plant for the U.S. Department of Defense. Onsite groundwater, soil, and air release contamination has resulted from the use of solvents and spillage of transformer oils contaminated with polychlorinated biphenyls (PCBs). Complete cleanup of contaminated sites is expected by 2000 (except long-term and ongoing groundwater treatment).

Knolls Atomic Power Laboratory—Kesselring Site, West Milton, New York. The Knolls Atomic Power Laboratory, Kesselring (KAPL–K), is in Saratoga County near West Milton, New York, approximately 17 miles north of the city of Schenectady, 9 miles southwest of Saratoga Springs, and 13 miles northeast of Amsterdam. KAPL–K consists of 3,900 acres of Government-owned land. Facilities construction began in 1951, and the site was originally developed as a test site for liquid metal fast breeder reactors. In the early 1950s, the site was then developed for the Navy Nuclear Propulsion Program. KAPL–K's mission is to test prototype nuclear propulsion plants for submarines and surface ships and to train U.S. Navy Nuclear propulsion plant operators.

Knolls Atomic Power Laboratory—Niskayuna, New York. The Knolls Atomic Power Laboratory, Niskayuna (KAPL-N), is located on a 170-acre tract in Niskayuna, New York, about 2 miles east of Schenectady, on the south bank of the Mohawk river. KAPL-N is operated by KAPL, Inc., a wholly owned subsidiary of the Lockheed Martin Corporation under contract with DOE. KAPL consists of three sites: the Niskayuna and Kesselring sites in New York and the Windsor Site in Connecticut. These sites are engaged solely in research and development for the design and operation of naval nuclear propulsion plants in conjunction with the joint DOE and Department of the Navy Naval Nuclear Propulsion Program. The KAPL-N is the primary KAPL site, and its mission is to design and develop improved naval propulsion plants and reactor cores.

Knolls Atomic Power Laboratory—Windsor, Connecticut. The Knolls Atomic Power Laboratory, Windsor (KAPL-W), is located on a 10.8-acre tract about 5 miles north of Hartford, Connecticut, in the town of Windsor. The KAPL-W conducts full-scale testing of a pressurized-water naval nuclear propulsion plant and associated propulsion plant hardware, and trains personnel to operate these plants. This testing

propulsion plant was shut down in March 1993 and has been defueled. The draft EIS for the disposal of this plant was published in June 1996.

Laboratory for Energy-Related Health Research—Davis, California. A less-than-1-acre DOE-owned facility located 1 mile from the main campus of the University of California, Davis, the Laboratory for Energy-Related Health Research investigates health effects of exposure to low levels of radiation. The removal, treatment, packing, and disposal of 35,000 gallons of sludge waste was completed in 1991-1992. Complete decontamination and decommissioning of the facilities is expected by FY 1995. Complete Comprehensive Environmental Response, Compensation, and Liability Act remedial actions are expected by 1997 at which time the Site will be released to the University.

Lawrence Berkeley Laboratory—Berkeley, California. The Lawrence Berkeley Laboratory (LBL) occupies a 133-acre site within the University of California, Berkeley, campus. The LBL site is leased by DOE through a series of 50-year lease agreements. The lab originated on the Berkeley campus of the University of California in 1931. From 1948 to 1972, the Laboratory was operated by the University of California for the U.S. Atomic Energy Commission (AEC). During this period, pioneering discoveries were made in nuclear and elementary particle physics, nuclear chemistry, biology, and nuclear medicine. Three of the basic modern types of accelerator—the cyclotron, the Alvarez Linear accelerator, and the synchrotron—were invented and developed at LBL. In 1972 the Lawrence Radiation Laboratory became the Lawrence Berkeley Laboratory with major funding from ERDA, which replaced the AEC. Today, LBL is operated as one of nine multi-program National Laboratories of the DOE. LBL's major role is to conduct basic and applied science research that is appropriate for an energy research Laboratory.

Mare Island Naval Shipyard—Vallejo, California. The Mare Island Naval Shipyard is a U.S. Navy facility that repairs, overhauls, and maintains Navy ships, including nuclear-powered ships. The activities relating to nuclear propulsion systems are performed in accordance with the requirements and authority of the Naval Nuclear Propulsion Program, a joint program of DOE and the Department of the Navy. These activities are being phased out as the Mare Island Naval Shipyard is shutting down.

Middlesex Sampling Plant—Middlesex, New Jersey. The Middlesex Sampling Plant (MSP) is on a 9.6-acre site in north central New Jersey currently used for storage of radioactively contaminated soil. The MSP is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). The MSP was established in 1943 by the Manhattan Engineer District (MED) to sample, store, and ship uranium, thorium, and

beryllium ores. In 1955, the AEC, successor to MED, terminated operations and later used the site for storage and limited sampling of thorium residues. In 1967, AEC activities ceased, onsite structures were decontaminated, and the site was certified for unrestricted use under criteria applicable at that time. Between 1968 and 1980 the site was used by the General Services Administration and then by the Navy as a U.S. Marine Corps training center. In 1980, custody of MSP was returned to DOE, which then began remedial action to clean up vicinity properties.

Mound Plant—Miamisburg, Ohio. Established in 1948, the 306-acre Mound Plant made nonnuclear and tritium components for nuclear weapons, which are assembled at another site. Its other activities include: the separation, purification, and sale of stable isotopes of the noble gases; solar energy research; fossil fuels research; nuclear safeguards; waste management; heat-source testing (plutonium); and fusion fuel systems. Decontamination and decommissioning operations began in 1978 and will continue until FY 2003. Cleanup of all operable units is expected by FY 2015.

Norfolk Naval Shipyard—Portsmouth, Virginia. The Norfolk Naval Shipyard is a U.S. Navy facility that repairs, overhauls, and maintains Navy ships, including nuclear-powered ships. The activities relating to nuclear propulsion systems are performed in accordance with the requirements and authority of the Naval Nuclear Propulsion Program, a joint program of DOE and the Department of the Navy.

Palos Forest—Chicago, Illinois. Site A/Plot M at Palos Forest was a reactor site for the Manhattan Project. Two reactors were decommissioned by 1956. Some of the resulting waste was buried at this 20-acre site. Characterization and assessment efforts are currently being performed.

Pearl Harbor Naval Shipyard—Pearl Harbor, Oahu, Hawaii. The Pearl Harbor Naval Shipyard is a U.S. Navy facility that repairs, overhauls, and maintains Navy ships, including nuclear-powered ships. The activities relating to nuclear propulsion systems are performed in accordance with the requirements and authority of the Naval Nuclear Propulsion Program, a joint program of DOE and the Department of the Navy.

Pinellas Plant—St. Petersburg/Largo, Florida. The Pinellas Plant, which covers about 99 acres, was established in 1956 to manufacture neutron generators and other electronic and mechanical components of nuclear weapons. In 1993, DOE decided to transfer the missions of the Pinellas Plant to other DOE facilities, and the Pinellas Plant is now shifting to solely a cleanup mission. Interim groundwater cleanup

actions are underway. Remediation of a 4.5-acre parcel adjacent to the Pinellas Plant began in FY 1990 and is expected to be completed by FY 1999. The Pinellas Plant sent 3,605 gallons of waste oil in 1978 and 1979 to Peak Oil. Peak Oil used a refining process to purify used oils and lubrication fluids. Mismanagement of waste oil and hazardous waste resulted in extensive soil and groundwater contamination. Pinellas Plant was consequently identified as a Potentially Responsible Party and is partially responsible for cleanup.

Portsmouth Naval Shipyard—Kittery, Maine. The Portsmouth Naval Shipyard is a U.S. Navy facility that repairs, overhauls, and maintains Navy ships, including nuclear-powered ships. The activities relating to nuclear propulsion systems are performed in accordance with the requirements and authority of the Naval Nuclear Propulsion Program, a joint program between DOE and the Department of the Navy.

Princeton Plasma Physics Laboratory—Princeton, New Jersey. Located on the Princeton University campus, the Princeton Plasma Physics Laboratory (PPPL) researches magnetic confinement fusion and the practical application of plasma physics. PPPL operates two major magnetic fusion devices, the Tokamak Fusion Test Reactor and the Princeton Beta Experiment-Modification, and a smaller device, the Current Drive Experiment-Upgrade. Remedial actions include characterization of soil and groundwater contamination on the 72-acre site.

Puget Sound Naval Shipyard—Bremerton, Washington. The Puget Sound Naval Shipyard is a U.S. Navy facility that repairs, overhauls, and maintains Navy ships, including nuclear-powered ships. The activities relating to nuclear propulsion systems are performed in accordance with the requirements and authority of the Naval Nuclear Propulsion Program, a joint program between DOE and the Department of the Navy. Puget Sound is the only naval shipyard that removes for safe disposal defueled reactor compartments from decommissioned nuclear submarines.

Reactive Metals, Inc.—Ashtabula, Ohio. Established in 1952, Reactive Metals, Inc. extruded slightly enriched uranium metal for use as a production reactor fuel element. The 60-acre site ceased production in October 1990. Cleanup is being carried out and remediation of buildings and onsite soils is in progress.

Sandia National Laboratories (California)—Livermore, California. The Sandia National Laboratories (California) (SNL-CA) is located on 413 acres next to and south of the LLNL Livermore Site, which is 15 miles due east of Livermore, California. In 1956, SNL established the Livermore facility to provide a

closer relationship with LLNL's nuclear weapons research design work. Today LLNL's mission includes laser fusion, laser isotope separation, and biomedical and environmental research, as well as environmental restoration and waste management. Owing to the proximity of SNL-CA to LLNL, the summary descriptions of environmental features presented for LLNL (Section 4.4.6) largely reflect the situation at SNL-CA.

Stanford Linear Accelerator Center (SLAC)—Palo Alto, California. Established in 1962, the Stanford Linear Accelerator Center (SLAC) conducts theoretical and experimental research in high-energy particle physics. It also develops new techniques in high-energy accelerators. SLAC, which is on 426 acres of land, is assessing onsite soil and groundwater contamination from volatile organic compounds and onsite and offsite contamination from polychlorinated biphenyls (PCBs).

University of Missouri—Columbia, Missouri. The University of Missouri is located in Columbia, Missouri. The University is contracted by Rockwell International to conduct experiments to separate radioactive actinide elements from spent fuel using the PUREX process. No experiments have been performed using reactor spent fuel; only pure actinides are present in waste material generated in the experiments. The DOE plans to decontaminate the hot cells to their original condition upon completion of testing. The university also operates the Columbia Research Reactor, a 10-megawatt light-water moderated reactor that uses plate-type fuel containing 93% enriched uranium-235. The university currently stores spent fuel from the reactor in a wet storage facility.

Weldon Spring Remedial Action Project—St. Louis, Missouri. In the 1940s, the Army used the Weldon Spring Site as an ordnance works. In the 1950s and 1960s, the AEC used it for processing uranium and thorium. The site occupies approximately 100 acres, including a 9-acre quarry. Cleanup includes the quarry, a chemical plant, and contaminated groundwater onsite and offsite.

Chapter 4
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