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SAND94–2728 • UC–721
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Printed November 1994

Framework for DOE Mixed Low-Level Waste Disposal: Site Fact Sheets

Marilyn M. Gruebel, Robert D. Waters, Maryann B. Hospelhorn, Margaret S.Y. Chu

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550
for the United States Department of Energy
under Contract DE-AC04-94AL85000

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Category UC-721

Framework For DOE Mixed Low-Level Waste Disposal: Site Fact Sheets

Marilyn M. Gruebel, Robert D. Waters,
Maryann B. Hospelhorn, and Margaret S.Y. Chu, Editors

Environmental Risk Assessment and Risk Management Department
Sandia National Laboratories
Albuquerque, NM 87185

ABSTRACT

The Department of Energy (DOE) is required to prepare and submit Site Treatment Plans (STPs) pursuant to the Federal Facility Compliance Act (FFCAct). Although the FFCAct does not require that disposal be addressed in the STPs, the DOE and the States recognize that treatment of mixed low-level waste will result in residues that will require disposal in either low-level waste or mixed low-level waste disposal facilities. As a result, the DOE is working with the States to define and develop a process for evaluating disposal-site suitability in concert with the FFCAct and development of the STPs. Forty-nine potential disposal sites were screened; preliminary screening criteria reduced the number of sites for consideration to twenty-six. The DOE then prepared fact sheets for the remaining sites. These fact sheets provided additional site-specific information for understanding the strengths and weaknesses of the twenty-six sites as potential disposal sites. The information also provided the basis for discussion among affected States and the DOE in recommending sites for more detailed evaluation.

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ACKNOWLEDGMENTS

The editors thank the site experts and the representatives of various groups within the States for their assistance. Their input to and thorough review of the data contained in the *Site Fact Sheets* contributed greatly to the accuracy of this report.

Mike Godwin (MK Corp.) provided Appendix B of this report; Diana Dobias and Angela Guerin (both 6622) provided documentation support. Dan Thompson and Sally Laundre-Woerner (both Tech Reps, Inc.) created or edited many of the maps in this report.

The DOE Disposal Work Group contributed significant technical input to the report and oversight for both the report and its impact on the entire project. Joel Case (DOE/Idaho) and Marty Letourneau (DOE/EM-33) provided managerial and technical oversight for the report and the project.

CONTRIBUTORS

Keith Asmussen	General Atomics
Rick Bower	Tech Reps, Inc.
Joel Case*	DOE/Idaho
John Chamberlain	West Valley Nuclear Services Co.
Rick DiSalvo	DOE/Rocky Flats
Alex Dong*	DOE/Oakland
Pat Duda	K Tech
Mary Ellen Giampaoli*	DOE/Nevada
Gerry Gaylord	Energy Technology Engineering Center
Bill Gilbert*	DOE/OR
Jerry Granzen	DOE/Brookhaven
Donna Green	DOE/Argonne
David Gregg	Lawrence Livermore National Laboratory
Scott Harrington	Raytheon Services
James Henderson*	Raytheon Services
James Johnson	DOE/Dayton Office
Dan Kapsch	EG&G
Keith Kelson	William Lettis & Associates
Mike Klimas	DOE/Chicago
Don Lee*	Oak Ridge National Laboratory
Martin Letourneau*	DOE/EM-33
John Loughead	Rogers & Associates
Claude Magnuson	DOE/EM-431
Elizabeth Matthews	DOE/West Valley
Jim McCord	Sandia National Laboratories
Lance Mezga*	Oak Ridge National Laboratory
Mark Monaco	Knolls Atomic Power Laboratory
Elmer Naples	Dept. of the Navy
Sue Nielson	DOE/Chicago
Dave Osugi	DOE/Oakland
Tom Pauling	DOE/WSSRAP
Roger Piscitella*	EG&G/INEL
Don Plowman*	Westinghouse/RL
Caroline Polanish	DOE/Brookhaven
Melda Rafferty	DOE/Portsmouth
Karen Reed	DOE/WSSRAP
Susan Rice	Envirocare
Jim Sage	Pittsburgh Naval Reactors Office
John Sattler	DOE/Fernald
Gary Schmidtke	DOE/Pinellas
Mickey Sizemore	DOE/Paducah
Ed Skintik	DOE/Fernald
Tim Sloan*	Los Alamos National Laboratory
John Starmer*	Environmental Resource Mgmt
Joanne Steingard*	BDM Federal
Dan Sullivan	DOE/West Valley
Glen Todzia	DOE/Brookhaven
Mike Torbert	DOE/EM-321
Dean Triebel	DOE/Amarillo
Ted Wolff	Sandia National Laboratories
Barbara Yoerg	DOE/Nevada

* -- DOE Disposal Workgroup Member

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1. INTRODUCTION

The Department of Energy (DOE) is required to prepare and submit Site Treatment Plans (STPs) pursuant to the Federal Facility Compliance Act (FFCAct). Although the FFCAct does not require that disposal be addressed in the STPs, DOE and the states recognize that treatment of mixed low-level waste will result in treatment residues that will require disposal in either low-level waste (LLW) or mixed low-level waste (MLLW) disposal facilities. As a result, DOE established the DOE MLLW Disposal Working Group in June 1993 to work with the states to define and develop a disposal-site suitability process in concert with the FFCAct and development of the STPs.

A site-screening process using three exclusionary criteria was established between the States and DOE in March 1994 for the 49 sites that currently store or may generate DOE MLLW in the near future. The three criteria are the following:

- Within a 100-year floodplain
- Located within 61 meters of an active fault
- Area to accommodate a 100 meter buffer zone

Prior to applying the three exclusionary criteria, sites that are in geographic proximity were grouped together for evaluation as one. This grouping reduced the number of sites to 44. The three exclusionary criteria effectively screened the 44 sites to 26 sites and the states concurred with this result later in March 1994. DOE agreed to prepare fact sheets for the remaining 26 sites. The fact sheets provide additional site-specific information for understanding the strengths and weaknesses of the 26 sites as potential disposal sites. Based on agreement with the States, the information contained in the fact sheets will also provide the basis for discussion among affected States and the DOE in recommending sites for more detailed evaluation.

This report contains *Site Fact Sheets* that present institutional and technical information important for disposal considerations for the 26 remaining sites (Figure 1-1 & Table 1-1). Information is also presented in Appendix A for Envirocare of Utah, which is a commercial disposal facility permitted to accept MLLW.

The fact sheets in the report present only published or readily available factual information about each site, and no evaluation of the suitability of any site has been undertaken. As a result, no decision concerning the ultimate suitability of a site for siting a MLLW disposal facility should be inferred.

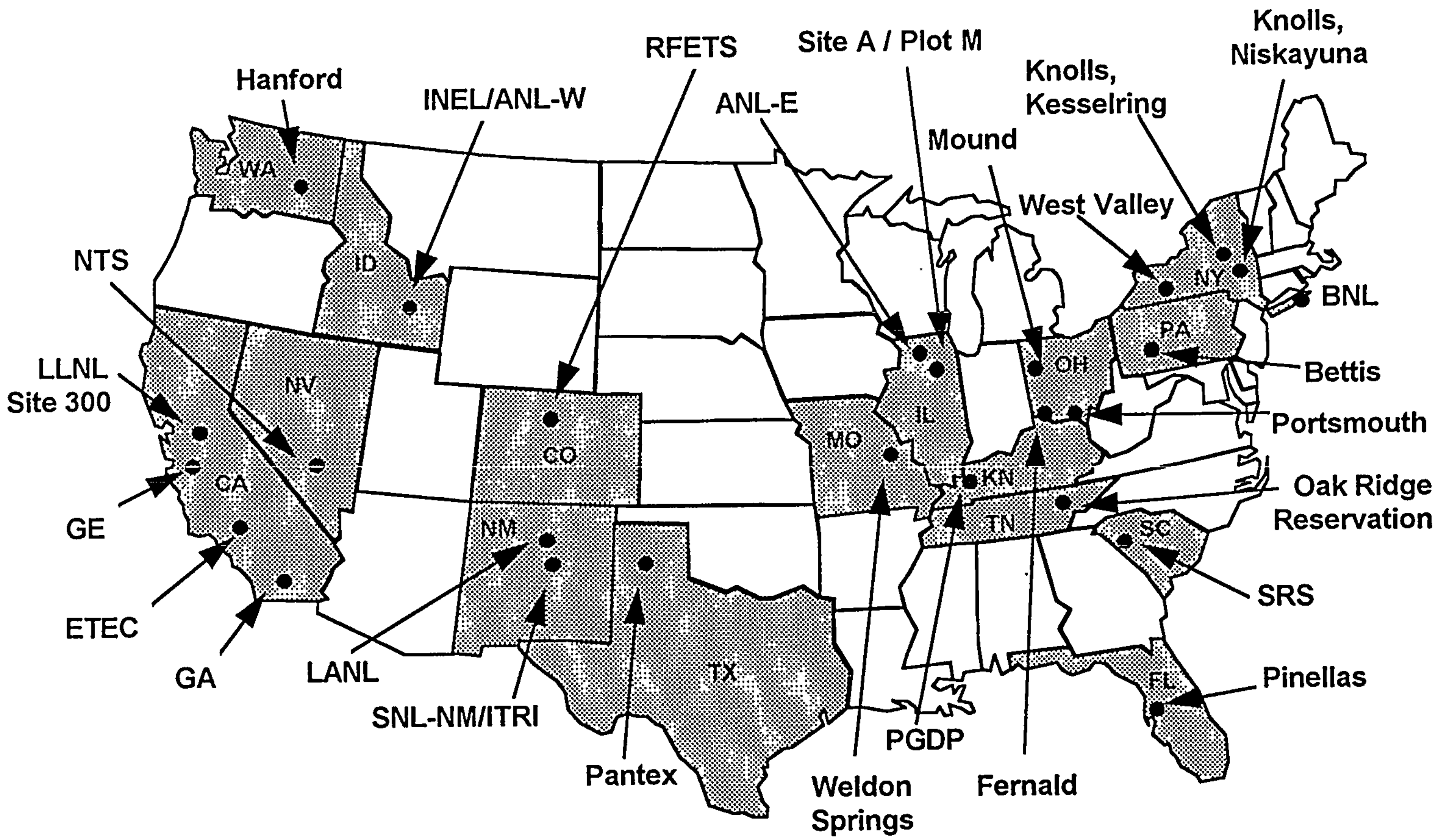


Figure 1-1. Twenty-Six Sites Represented by Fact Sheets in this Report

Table 1-1. Twenty-Six Sites Represented by Fact Sheets in this Report

California
- Energy Technology Engineering Center
- General Atomics
- General Electric Vallecitos
- Lawrence Livermore National Laboratory Site 300

Colorado
- Rocky Flats Environmental Technology Site

Florida
- Pinellas Plant

Idaho
- Idaho National Engineering Laboratory / ANL-West

Illinois
- Argonne National Laboratory-East
- Site A/Plot M

Kentucky
- Paducah Gaseous Diffusion Plant

Missouri
- Weldon Spring Site Remedial Action Project

Nevada
- Nevada Test Site

New Mexico
- Los Alamos National Laboratory
- Sandia National Laboratory-NM / ITRI

New York
- Brookhaven National Laboratory
- Knolls Atomic Power Laboratory, Kesselring
- Knolls Atomic Power Laboratory, Niskayuna
- West Valley Demonstration Project

Ohio
- Fernald Environmental Management Project
- Mound Plant
- Portsmouth Gaseous Diffusion Plant

Pennsylvania
- Bettis Atomic Power Laboratory

South Carolina
- Savannah River Site

Tennessee
- Oak Ridge Reservation

Texas
- Pantex Plant

Washington
- Hanford Site

The DOE is currently analyzing the potential suitability of forty-nine DOE installations for disposal of low-level radioactive waste and mixed low-level radioactive waste. The project supports the development of reasonable alternative disposal configurations for analysis in the Waste Management programmatic environmental impact statement (PEIS). Institutional and technical criteria were developed to assess the suitability of the 49 installations as potential disposal sites. Some of the information is similar to that in this report. During the preparation of this report, close coordination was carried out to ensure information exchange between the two groups. The main difference is that the factors considered in this report were jointly developed between DOE and the States, while the factors considered in the PEIS project were developed based on relevant and applicable regulations promulgated by the DOE, the EPA, and the States.

Basis for Technical and Institutional Factors in the *Site Fact Sheets*

Much work has been done over the years in developing information on the important characteristics of sites considered for disposal of radioactive and hazardous wastes. In this country, technical siting criteria have been established by NRC in 10CFR61 and NUREG 1199 and by DOE in DOE Order 5820.2A for radioactive waste disposal, while EPA has established siting criteria for hazardous wastes in RCRA. Individual states have generally adopted and expanded EPA and NRC siting criteria for hazardous waste and commercially-generated radioactive waste. The international community involved in nuclear waste management has also established siting criteria for radioactive waste disposal. While the details of the siting criteria of these organizations frequently differ, they are generally based on the same fundamental concepts: (1) avoiding major waste release initiators; (2) minimizing major consequences in the event of a release; and (3) adhering to certain institutional constraints. Factors addressed in the fact sheets in this report are derived from these fundamental concepts and from a compendium of requirements and regulations applicable to waste disposal.

Site characteristics that may initiate major waste releases are generally concerned with tectonic and volcanic hazards, site stability, groundwater intrusion, and surface water inundation. Criteria that attempt to minimize major consequences include considering nearby populations and population growth patterns, groundwater usage, and sensitive environments. Requirements in many disposal siting regulations also emphasize the importance of being able to evaluate the potential performance of a disposal site. These requirements generally dictate that a site be capable of being characterized, modeled, and analyzed for evaluation purposes. Institutional factors that may have a major impact on waste disposal siting decisions address non-technical considerations such as site ownership, volume of waste, existing agreements and regulatory requirements, and planned future site use.

Since assumptions on the effects of any manmade engineered barriers of a disposal facility depend on the specific characteristics of those barriers, only natural site geology and hydrology are considered at this time.

DOE is committed to complying with all applicable state and federal regulations pertaining to MLLW disposal in the permit applications for its disposal facilities. However, the fact sheets are not meant to be evaluation sheets and, due to the variety and explicit nature of the state-specific criteria, it is inappropriate if not impossible to discuss these criteria without a potential disposal facility location identified within a site. Therefore, state-specific criteria for disposal facilities are not specifically included in all fact sheets. However, it is important to note that state regulations related to radioactive waste disposal are derived from NRC's 10 CFR61 and are inherently addressed in the fact sheets. A summary of the major requirements of state laws can be found in Appendix B.

Other factors, such as socioeconomics are important to disposal siting discussions but are too subtle and value laden to present in a few pages. These issues will require more detailed discussion and are more appropriately discussed in an open forum with all affected participants. While these issues are extremely important, they are not addressed in the fact sheets.

Anatomy of a *Site Fact Sheet*

The outline of the *Site Fact Sheets* (Table 1-2) shows four major sections: Site Description, Institutional Factors, Technical Factors, and Sources. Each major section is divided into several subsections, which aids presentation of all sites in a consistent format. Information reported in the fact sheets is based on existing reports and documents, and no new studies were commissioned specifically to complete the fact sheets.

The Site Description section puts the site in the context of its surroundings and presents the framework for further discussion. Geographical location, site size, and the surrounding population are presented as well as the historical and current site mission and current employment.

The Institutional Factors section describes the current ownership of the site as well as commitments for the future. Sites that have operating LLW disposal facilities are identified in this section, as are sites that are actively pursuing approval for MLLW disposal facilities. The 1994 Mixed Waste Inventory Report estimates of currently stored and five-year projected volumes of MLLW are also reported in this section. Some sites are currently updating their estimates of these volumes. Existing regulatory agreements and commitments are discussed. EPA Designated Sole Source Aquifers beneath sites are also noted here due to their regulatory nature, and these aquifers are discussed more fully in the Hydrology subsection of the Technical Factors section.

The Technical Factors section is divided into four subsections: Climate, Geology, Hydrology, and Sensitive Environments.

The Climate subsection summarizes temperature, precipitation, evapotranspiration, and winds. Climate, especially precipitation and evapotranspiration, is a major potential driver of the mobility of waste constituents since infiltration and the resulting leaching of waste is the primary

Table 1-2. Outline of Site Fact Sheets

Site Description

location
population
geographic size
mission (historical and current)
employment

Institutional Factors

- Ownership
  - current and commitments for future
  - operating LLW disposal facilities
  - status of planned MLLW disposal facilities
- MLLW Storage and Generation (current and projected) Volumes
- Regulatory Considerations
  - RODs, Tri-party Agreements,Facility Compliance Agreements
  - other agreements
  - EPA designated sole source aquifer

Technical Factors

- Climate
  - temperature average and range
  - precipitation average and range
  - evapotranspiration average and range
  - predominant wind speeds and directions
- Geology
  - regional and local description
  - major geologic units
  - topographic features
  - tectonic and vulcanic hazard potential
  - soil stability (swelling, settlement, erosion, slope failure)
  - mined or drilled natural resources
- Hydrology
  - surface water hydrology at and near facility
  - on-site drainage and flooding potential and significant upstream watershed areas
  - vadose zone (if important)
  - groundwater hydrology system and use
- Sensitive Environment
  - historic
  - recreational
  - archeologic
  - threatened or endangered species or habitats
  - wetlands
  - wildlife refuges

Sources

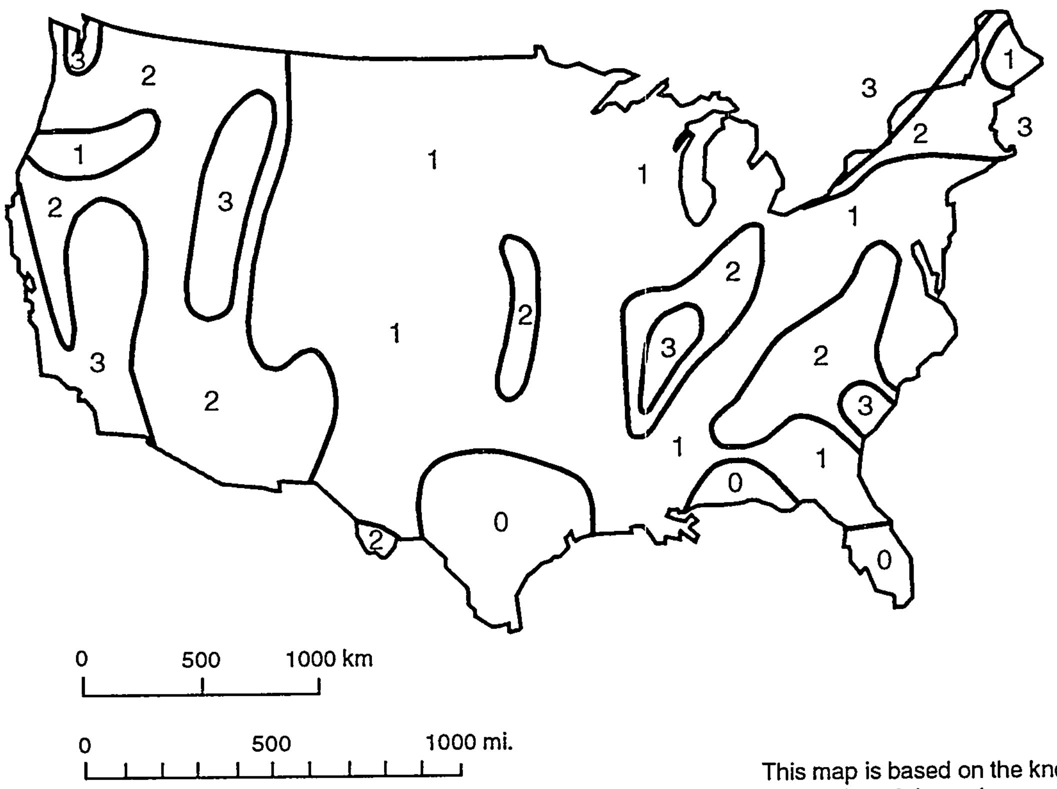
mechanism for transport of these constituents. Arid environments (where precipitation is less than evapotranspiration) are generally characterized by thick vadose zones and little infiltration, whereas humid environments (where precipitation is greater than evapotranspiration) are generally characterized by shallower groundwater with a higher potential to transport waste constituents.

Regional and local geology is described in the Geology subsection, including major geologic units, topographic features and structural features. Information pertaining to tectonic and volcanic hazard potential and soil stability (i.e., swelling, settlement, erosion, slope failure) is included. The presence of natural resources, which may tend to increase the likelihood of inadvertent intrusion (i.e., mining and drilling) into a disposal facility, is also presented. The disposal facility must be stable after closure both to avoid the need for future corrective actions and to minimize the possibility that performance assessment calculations based on current conditions will be invalid. High tectonic and volcanic potential must be minimized in the siting process. Seismic activity near a site is presented as a Seismic Risk Zone based on information in Figure 1-2. Soil stability is also important for near-surface disposal siting as it relates to the geotechnical and erosional stability of the disposal facility.

The Hydrology subsection presents a general description of surface water hydrology at and near the facility; site drainage and flooding potential including significant upstream watershed areas; vadose zone information if it is hydrologically significant; and information on the groundwater hydrology system including recharge and discharge locations, depth to water table, karst terrain, flow direction, flow rate, and water usage.

Hydrology is one of the most important technical considerations related to siting near-surface disposal facilities because water transport is usually the principal pathway for release of waste constituents. Geologic materials at the disposal site are important because their geochemical and hydrological properties affect the site's ability to mitigate the leaching and transport of contaminants through groundwater. Karst terrain is present generally in limestone formations where some of the subsurface fractures may locally become very large and form an underground system of chambers, tunnels, pipes, and siphons through which most of the water flows. The absence of karst terrain is important in evaluating disposal sites because karst features tend to by-pass retardation mechanisms and provide conduits for transmitting large volumes of groundwater. Groundwater usage is important because releases from near surface disposal sites are generally directed toward the groundwater. Direction and rate of flow are important when considering pathways to human and ecological receptors.

The Sensitive Environment subsection summarizes information generally found in Environmental Impact Statements (EIS) and Environmental Assessments (EA). This information includes areas with historic, recreational, and archeological value as well as habitats for threatened and endangered species, wetlands, and other sensitive environments. Sites of historic value are those listed in the National Register of Historic Places. Areas of recreational value are national and state parks, forests, monuments, and preserves on or near the site.



Zone 0 - No damage.

Zone 1 - Minor damage; distant earthquakes may cause damage to structures with fundamental periods greater than 1.0 seconds; corresponds to intensities V and VI of the M.M. * Scale.

Zone 2 - Moderate damage; corresponds to intensity VII of the M.M. * Scale.

Zone 3 - Major damage; corresponds to intensity VIII and higher of the M.M. * Scale.

This map is based on the known distribution of damaging earthquakes and the M.M. * intensities associated with these earthquakes; evidence of strain release; and consideration of major geologic structures and provinces believed to be associated with earthquake activity. The probable frequency of occurrence of damaging earthquakes in each zone was not considered in assigning ratings to the various zones.

* Modified Mercalli Intensity Scale of 1931.

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Figure 1-2. Seismic Risk Zone Map

Since the *Site Fact Sheets* provide summaries of many important technical and institutional factors, the Sources section is included to provide reference to more detailed information about each site. These publicly available reports and documents provide extensive data and references to other sources of data that may be useful to those interested in greater detail than the fact sheets present.

Organization of Report

Section 2 provides a summary of the fact sheets by major subheading. Section 3 contains the *Site Fact Sheets* in alphabetical order by state and by site name within the state. Appendix A contains information on Envirocare of Utah. Appendix B summarizes major state laws and regulations pertaining to disposal of hazardous and radioactive wastes.

2. SUMMARY

The *Site Fact Sheets* present summary information of site description, institutional factors, and technical factors for the 26 sites that currently store or may generate DOE MLLW in the near future. This section provides a summary of the factors contained in the fact sheets. Factors pertaining to all sites are summarized by each major subheading in the fact sheets in one or more tables and figures.

Site Description

For the major heading Site Description, factors related to the subheadings Site Size and Population are summarized.

Site Size is listed in square kilometers (km^2) for each of the 26 sites in Table 2-1. Site sizes range from less than 0.1 km^2 for Site A/Plot M in Illinois to 3500 km^2 for the Nevada Test Site. Figure 2-1 presents the sizes of the 26 sites in order of decreasing size.

Estimates for population within 10 km and 50 km radii of the sites are presented in Table 2-2. Populations within 10 km radii of the sites range from zero at NTS to approximately 500,000 at Argonne-East. Populations within 50 km radii of the sites range from approximately 4000 at NTS to approximately seven million at Argonne-East. Figure 2-2 shows the population estimates surrounding the 26 sites in order of increasing population within 10 km radii of the sites.

Institutional Factors

For the major heading Institutional Factors, factors related to the subheadings Ownership, MLLW Storage and Generation, and Regulatory Considerations are summarized.

Ownership of the land at each site is shown in Table 2-3. Of the 26 sites, three are privately-owned (ETEC, General Atomic and General Electric), one is state-owned (West Valley), one is county-owned (Site A/Plot M), and the remaining 21 sites are federally owned.

MLLW volumes currently stored and potentially generated in the near future are shown in Table 2-4. Three sites (General Electric, Pinellas and Site A/Plot M) currently do not store MLLW and do not expect to generate MLLW within the next five years. An additional three sites (ETEC, General Atomics, and Weldon Spring) do not expect to generate MLLW within the next five years.

The majority of waste currently stored at the 26 sites is located at eight of the sites (Oak Ridge, INEL, Rocky Flats, Savannah River, Portsmouth, Fernald, Hanford, and Weldon Spring). The majority of waste projected to be generated by the 26 sites in the next five years is located at ten of the sites (Hanford, Nevada Test Site, Oak Ridge, Portsmouth, Savannah River, Rocky Flats, Paducah, INEL, Argonne-East, and Lawrence Livermore).

Table 2-1. SITE SIZE

	SITE	
CA	Energy Technology Engineering Center	0.4 km^2
	General Atomics	0.2 km^2
	General Electric Vallecitos	6.4 km^2
	Lawrence Livermore National Lab Site 300	28 km^2
CO	Rocky Flats Environmental Technology Site	26.3 km^2
FL	Pinellas Plant	0.4 km^2
ID	Idaho National Eng. Lab/ANL-West	2,300 km^2
IL	Argonne National Laboratory-East	6.9 km^2
	Site A/Plot M	< 0.1 km^2
KY	Paducah Gaseous Diffusion Plant	13.9 km^2
MO	Weldon Spg. Site Remedial Action Project	0.9 km^2
NV	Nevada Test Site	3,500 km^2
NM	Los Alamos National Laboratory	112 km^2
	Sandia National Laboratory-NM/ITRI	11.3 km^2
NY	Brookhaven National Laboratory	21.3 km^2
	Knolls Atomic Power Lab., Kesselring	15.8 km^2
	Knolls Atomic Power Lab., Niskayuna	0.7 km^2
	West Valley Demonstration Project	0.9 km^2
OH	Fernald Environmental Mgmnt. Project	4.2 km^2
	Mound Plant	1.2 km^2
	Portsmouth Gaseous Diffusion Plant	16.2 km^2
PA	Bettis Atomic Power Laboratory	0.8 km^2
SC	Savannah River Site	780 km^2
TN	Oak Ridge Reservation	150 km^2
TX	Pantex Plant	64.7 km^2
WA	Hanford Site	1,450 km^2

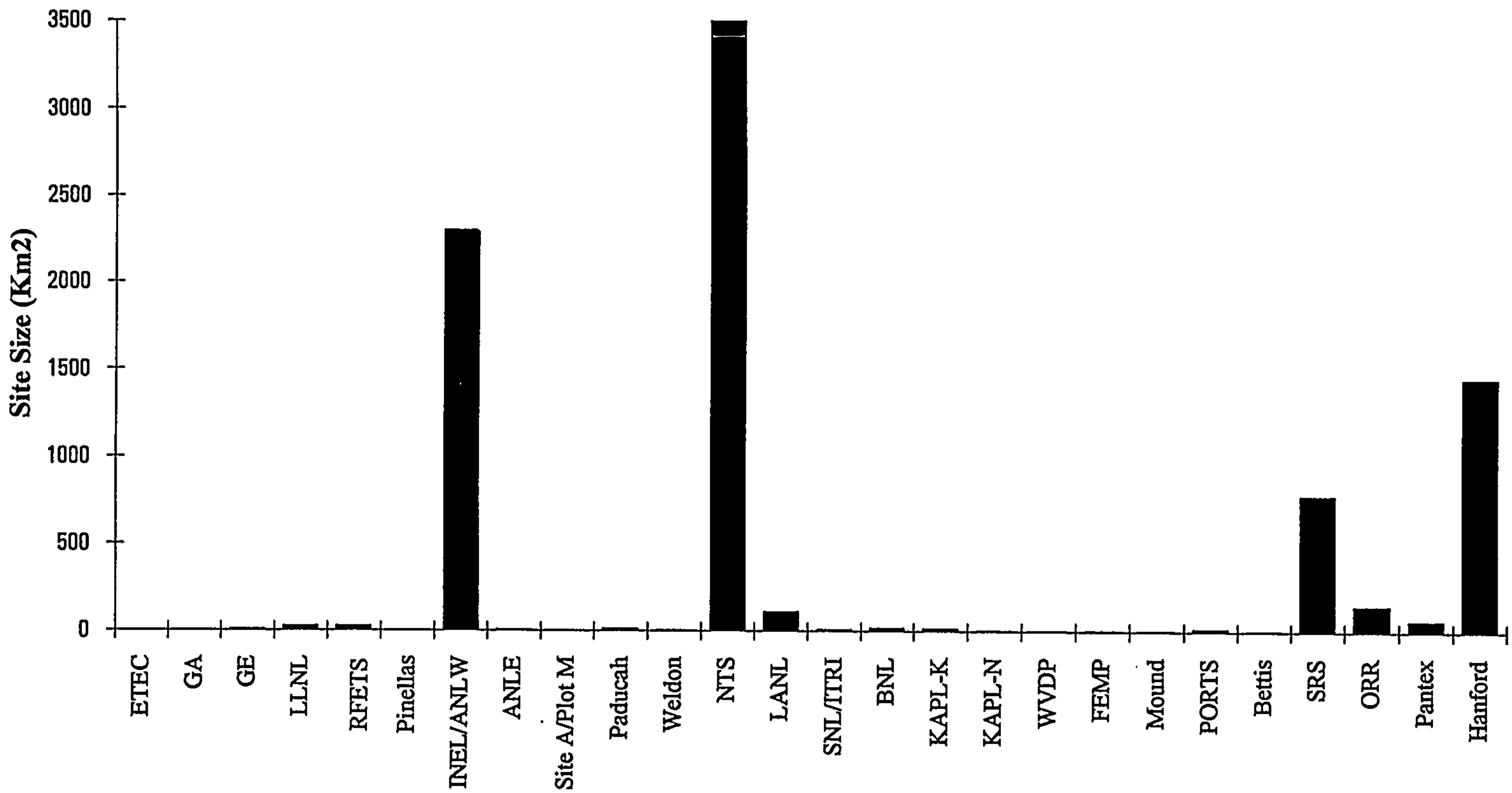

Figure 2-1. Site Size

Table 2-2. POPULATION

	SITE:	WITHIN 10 K	WITHIN 50 K
CA	Energy Technology Engineering Center	10,000	10,000,000
	General Atomics	4,860	2,056,000
	General Electric Vallecitos	51,000	2,718,000
	Lawrence Livermore Nat'l Lab Site 300	<1,000	1,900,000
CO	Rocky Flats Environmental Technology Site	76,000	1,055,000
FL	Pinellas Plant	213,500	1,141,300
ID	Idaho National Eng. Lab/ANL-West	<1,000	~ 60,000
IL	Argonne National Laboratory-East	500,000	7,000,000
	Site A/Plot M	150,000	7,000,000
KY	Paducah Gaseous Diffusion Plant	2,000	106,500
MO	Weldon Spg. Site Remedial Action Project	<1,000	667,000
NV	Nevada Test Site	0	4,000
NM	Los Alamos National Laboratory	18,500	102,500
	Sandia National Laboratory-NM/ITRI	385,000	459,000
NY	Brookhaven National Laboratory	180,000	1,800,000
	Knolls Atomic Power Lab., Kesselring	2,000	400,000
	Knolls Atomic Power Lab., Niskayuna	135,000	432,000
	West Valley Demonstration Project	500	182,000
OH	Fernald Environmental Mgmt. Project	8,600	1,500,000
	Mound Plant	40,000	1,478,000
	Portsmouth Gaseous Diffusion Plant	2,500	231,000
PA	Bettis Atomic Power Laboratory	352,000	900,000
SC	Savannah River Site	<1,000	420,000
TN	Oak Ridge Reservation	30,000	308,000
TX	Pantex Plant	2,400	200,000
WA	Hanford Site	0	230,000

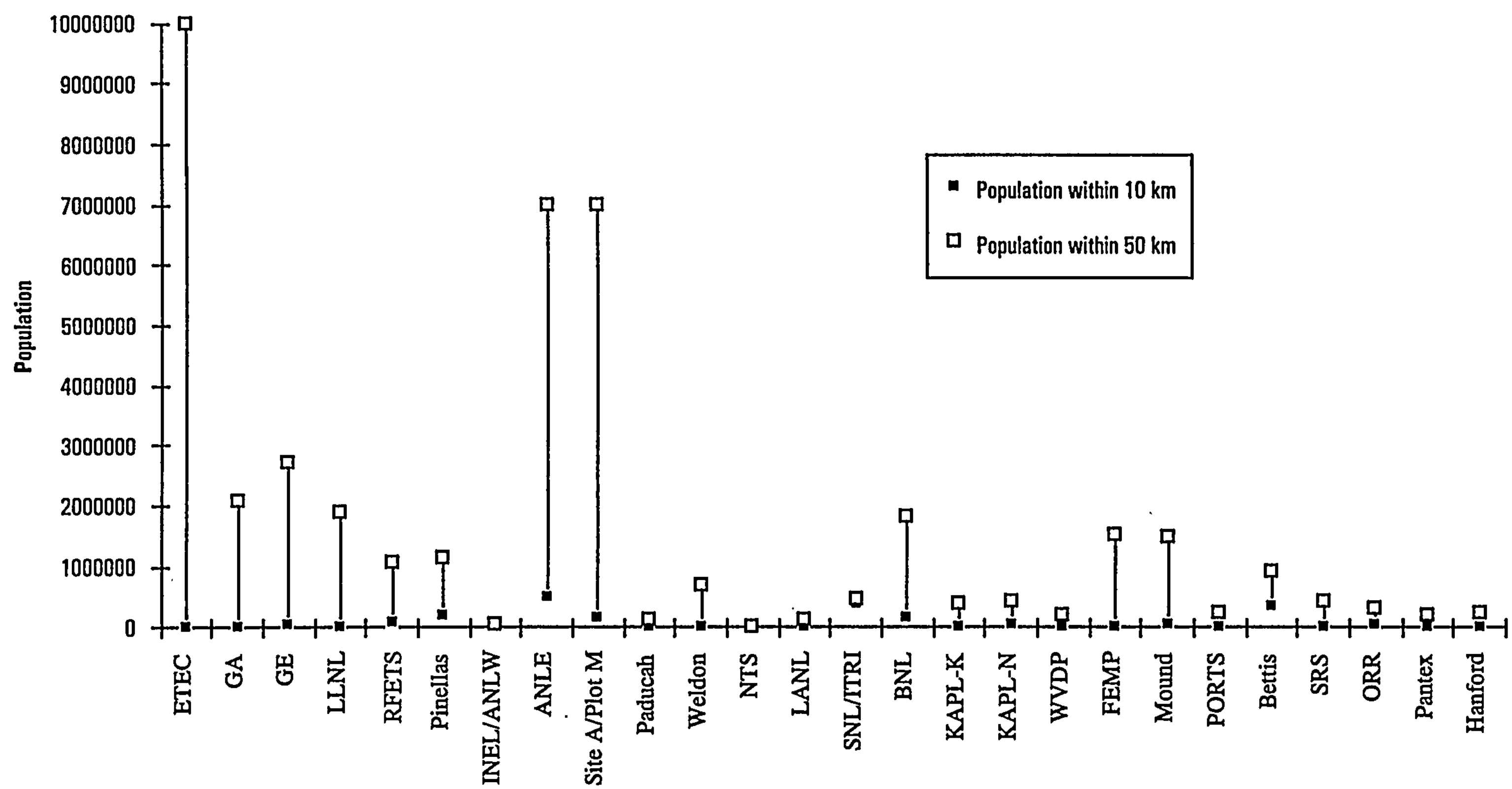

Figure 2-2. Population within 10 km and 50 km of the Sites

Table 2-3. OWNERSHIP (current & future, DOE or private)

	SITE:	
CA	Energy Technology Engineering Center	**Owned by Rockwell**
	General Atomics	**Owned by General Atomics**
	General Electric Vallecitos	**Owned by General Electric**
	Lawrence Livermore Nat'l Lab Site 300	**Owned by DOE**
CO	Rocky Flats Environmental Technology Site	**Owned by DOE**
FL	Pinellas Plant	**Owned by DOE**
ID	Idaho National Eng. Lab/ANL-West	**Administered by Bureau of Land Management; Managed by DOE and administed by three others**
IL	Argonne National Laboratory-East	**Owned by DOE**
	Site A/Plot M	**Owned by Forest Preserve District of Cook County**
KY	Paducah Gaseous Diffusion Plant	**Owned by DOE**
MO	Weldon Spg. Site Remedial Action Project	**Owned by DOE**
NV	Nevada Test Site	**Owned by DOE**
NM	Los Alamos National Laboratory	**Owned by DOE**
	Sandia National Laboratory-NM/ITRI	**Owned by DOE**
NY	Brookhaven National Laboratory	**Owned by DOE**
	Knolls Atomic Power Lab., Kesselring	**Owned by DOE**
	Knolls Atomic Power Lab., Niskayuna	**Owned by DOE**
	West Valley Demonstration Project	**Owned by NYSERDA**
OH	Fernald Environmental Mgmt. Project	**Owned by DOE**
	Mound Plant	**Owned by DOE**
	Portsmouth Gaseous Diffusion Plant	**Owned by DOE**
PA	Bettis Atomic Power Laboratory	**Owned by DOE**
SC	Savannah River Site	**Owned by DOE**
TN	Oak Ridge Reservation	**Owned by DOE**
TX	Pantex Plant	**Owned by DOE**
WA	Hanford Site	**Owned by DOE**

Table 2-4. MLLW STORAGE, GENERATION

	SITE	CURRENTLY STORED (m^3)*	FIVE-YEAR PROJECTION (m^3)*
CA	Energy Technology Engineering Center	656.6	600
	General Atomics	42.9	0.4
	General Electric Vallecitos	0	0
	Lawrence Livermore National Lab Site 300	215	1,075
CO	Rocky Flats Environmental Technology Site	56,029.6	3,369
FL	Pinellas Plant	0	0
ID	Idaho National Eng. Lab/ANL-West	25,495.3	2,460
IL	Argonne National Laboratory-East	113.8	2,177
	Site A/Plot M	0	0
KY	Paducah Gaseous Diffusion Plant	5,965	0
MO	Weldon Spg. Site Remedial Action Project	1,678.8	0
NV	Nevada Test Site	0.4	0.2
NM	Los Alamos National Laboratory	665.4	529
	Sandia National Laboratory-NM/ITRI	69.3	11
NY	Brookhaven National Laboratory	84.9	27
	Knolls Atomic Power Lab., Kesselring	2	27
	Knolls Atomic Power Lab., Niskayuna	1.3	31
	West Valley Demonstration Project	22.9	13
OH	Fernald Environmental Mgmnt. Project	2,597.3	43
	Mound Plant	76.6	4
	Portsmouth Gaseous Diffusion Plant	9,050	6,383
PA	Bettis Atomic Power Laboratory	32.9	6
SC	Savannah River Site	6,554.4	4,432
TN	Oak Ridge Reservation	42,038.5	8,295
TX	Pantex Plant	133.9	344
WA	Hanford Site	3,102	119,980 **

* Based on DOE's 1994 *Mixed Waste Inventory Report*

** Includes Liquid MLLW from Tank Farms Evaporation Processing

Figure 2-3 presents the volume of currently stored DOE MLLW and DOE MLLW projected to be generated in the next five years in order of decreasing total volume.

Regulatory Considerations are summarized in Table 2-5. Regulatory considerations summarized include Triparty Agreements, Records of Decision, and other major agreements.

Technical Factors

For the major heading Technical Factors, factors related to the subheadings Climate, Geology, Hydrology and Sensitive Environment are summarized. Please refer to the individual fact sheets for more detailed information.

Climate, specifically annual average precipitation and evapotranspiration, are shown in Table 2-6 for the 26 sites. Average annual precipitation ranges from a low of four inches at Nevada Test Site to a high of 54 inches at Oak Ridge Reservation. Average annual evapotranspiration ranges from a low of 9 inches at LLNL to a high of over 70 inches at Pantex. It is important to note that the more conservative value for shallow lake evaporation has been used when site-specific evapotranspiration data are not available. Figure 2-4 presents average annual precipitation and evapotranspiration of the sites in order of increasing precipitation. The relative magnitude of precipitation and evapotranspiration determines whether a site is in an arid or humid region.

Factors related to geology of the 26 sites are shown in Table 2-7. The factors include seismic and volcanic risk, types of geologic materials underlying the site, and steep slopes and unstable soil stability.

Factors related to hydrology and groundwater resources of the 26 sites are shown in Table 2-8 and Table 2-9. The factors include major surface water bodies (lakes and rivers), depth to groundwater, and sole source aquifers.

Sensitive environments are summarized in Table 2-10 for the 26 sites. The factors include historic, recreational, and archaeologic areas on or near the site, threatened or endangered species or habitats, wetlands, and wildlife refuges located on the site.

More detailed information for each of these important factors are found in the fact sheets for each site.

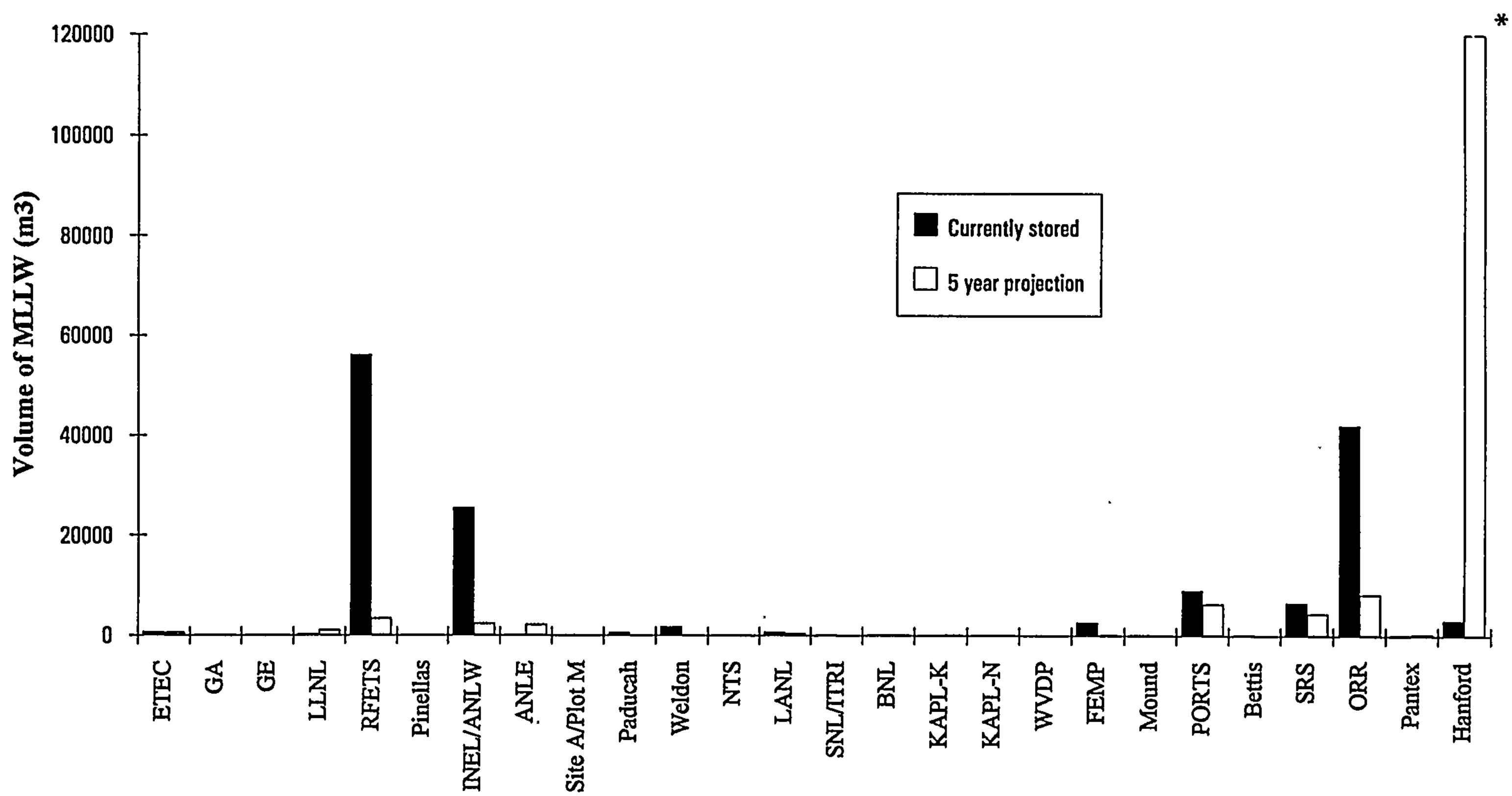

Figure 2-3. Volume of Currently Stored and 5 Year Projection of MLLW(m^3) Based on Mixed Waste Inventory Report (* Hanford 5-Year Projection Includes Liquid MLLW from Tank Farms Evaporation Processing)

Table 2-5. SIGNIFICANT REGULATORY CONSIDERATIONS

	SITE:	
CA	Energy Technology Engineering Center	
	General Atomics	Local zoning restrictions for disposal
	General Electric Vallecitos	
	Lawrence Livermore Nat'l Lab Site 300	CERCLA NPL; Federal Facilities Compliance Agreement
CO	Rocky Flats Environmental Technology Site	Federal Facilities Compliance Agreement; Intragency agreement between DOE, EPA, State
FL	Pinellas Plant	
ID	Idaho National Eng. Lab/ANL-West	Federal Facilities Compliance Agreement; consent order between DOE, EPA, State
IL	Argonne National Laboratory-East	
	Site A/Plot M	
KY	Paducah Gaseous Diffusion Plant	
MO	Weldon Spg. Site Remedial Action Project	CERCLA NPL; Record of Decision denying disposal of off-site waste issued in 1993
NV	Nevada Test Site	Intragency agreement between DOE and NDEP for storage of mixed waste
NM	Los Alamos National Laboratory	Federal Facilities Compliance Agreement; Agreements with local Indian tribes
	Sandia National Laboratory-NM/ITRI	
NY	Brookhaven National Laboratory	CERCLA NPL; Intragency agreement between DOE, EPA, and State
	Knolls Atomic Power Lab., Kesselring	Designated exclusion area by 10 CFR 100
	Knolls Atomic Power Lab., Niskayuna	
	West Valley Demonstration Project	Federal Facilities Compliance Agreement; West Valley Demonstration Project Act
OH	Fernald Environmental Mgmt. Project	CERCLA NPL; Intragency agreement between DOE, EPA, and State; Federal Facilities Compliance Agreement
	Mound Plant	CERCLA NPL; Intragency agreement between DOE, EPA, and State
	Portsmouth Gaseous Diffusion Plant	Federal Facilities Compliance Agreement; judicial consent decree; EPA consent order
PA	Bettis Atomic Power Laboratory	
SC	Savannah River Site	Federal Facilities Compliance Agreement
TN	Oak Ridge Reservation	CERCLA NPL; Federal Facilities Compliance Agreement
TX	Pantex Plant	CERCLA NPL; Agreement with State regarding MLLW
WA	Hanford Site	Tri-Party Agreement between DOE, EPA, and State

Table 2-6. CLIMATE (Precipitation and Evapotranspiration)

	SITE:	PRECIPITATION	EVAPOTRANSPIRATION
CA	Energy Technology Engineering Center	18.00"	*potentially 46"
	General Atomics	11"	*potentially 48"
	General Electric Vallecitos	20"	*potentially 42"
	Lawrence Livermore Nat'l Lab Site 300	10"	9.0"
CO	Rocky Flats Environmental Technology Site	16"	10.0"
FL	Pinellas Plant	47"	35.0"
ID	Idaho National Eng. Lab/ANL-West	8.5"	*potentially 36"
IL	Argonne National Laboratory-East	33"	26"
	Site A/Plot M	33"	*32"
KY	Paducah Gaseous Diffusion Plant	47"	*36"
MO	Weldon Spg. Site Remedial Action Project	37"	37"
NV	Nevada Test Site	4"	potentially40"
NM	Los Alamos National Laboratory	19"	*potentially54"
	Sandia National Laboratory-NM/ITRI	8"	*potentially56"
NY	Brookhaven National Laboratory	48"	21"
	Knolls Atomic Power Lab., Kesselring	36"	*27"
	Knolls Atomic Power Lab., Niskayuna	36"	*28"
	West Valley Demonstration Project	41"	36"
OH	Fernald Environmental Mgmt. Project	41"	32"
	Mound Plant	36"	32"
	Portsmouth Gaseous Diffusion Plant	39"	21"
PA	Bettis Atomic Power Laboratory	32"	*28"
SC	Savannah River Site	48"	*44"
TN	Oak Ridge Reservation	54"	*33"
TX	Pantex Plant	20"	potentially 70"
WA	Hanford Site	6.3"	potentially 53"

* Based on average annual evaporation from shallow lakes

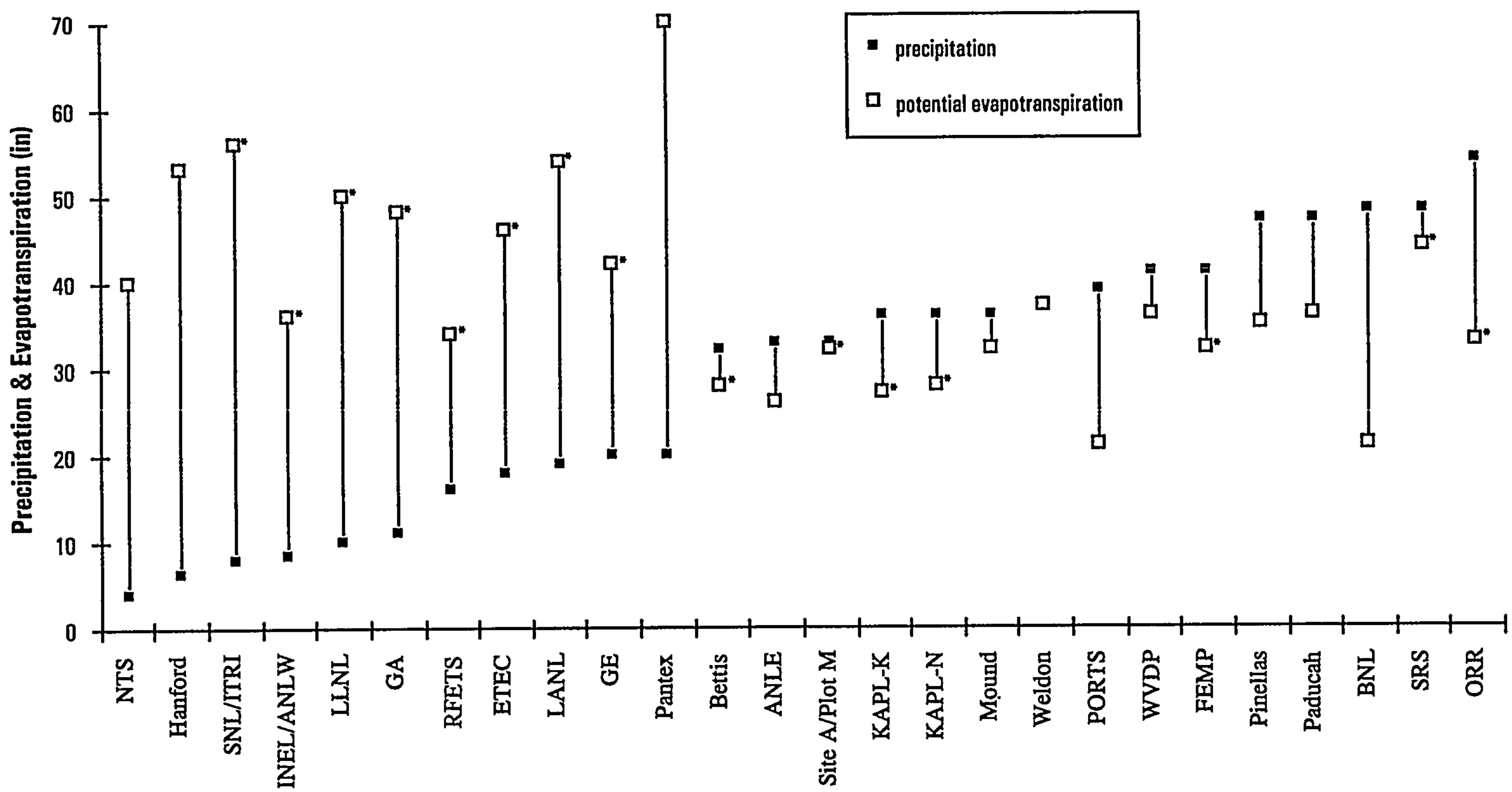

Figure 2-4. Precipitation and Potential Evapotranspiration for Each Site in Order of Increasing Precipitation (* - Evapotranspiration from Shallow Lakes)

Table 2-7. GEOLOGY

	SITE:	
CA	Energy Technology Engineering Center	**Numerous evidences of crisscrossing faults; Seismic Risk Zone 3**
	General Atomics	**Steep slopes (20-25%) on available land; 3 small, local faults; Seismic Risk Zone 3**
	General Electric Vallecitos	**Several active strike/slip faults; close to 3 active faults; area of landslides; severe erosion; several mining sites; Seismic Risk Zone 3**
	Lawrence Livermore Nat'l Lab Site 300	**Narrow (steep) valleys; limited areas have possible liquefaction potential; slope instability due to landslides/steep slopes; petroleum resources; major fault systems; Seismic Risk Zone 3**
CO	Rocky Flats Environmental Technology Site	**Some steep slopes; headwarderosion of valleys into the Rocky Flats Plateau; unstable soils; open pit mining; Seismic Risk Zone 1**
FL	Pinellas Plant	**Potential karst terrain (sinkhole formation); poorly drained soils; Seismic Risk Zone 0**
ID	Idaho National Eng. Lab/ANL-West	**Thick sequence of basalts; some volcanic hazard; 3 faults; Seismic Risk Zone 2B-3; plain has low seismicity**
IL	Argonne National Laboratory-East	**Gently rolling topography; 30 m of glacial till; Seismic Risk Zone 1**
	Site A/Plot M	**Gently rolling topography, 40 m of glacial till; possible slope instability and foundation settlement; Seismic Risk Zone 1**
KY	Paducah Gaseous Diffusion Plant	**Flat, slightly sloping terrain; valley fill deposits; near 2 active seismic zones; slight hazard from soil erosion; Seismic Risk Zone 3**
MO	Weldon Spg. Site Remedial Action Project	**Site on a subtle ridge; soils exhibit moderate shrink/swell and are easily eroded; 5-18 m of clay; Seismic Risk Zone 2**
NV	Nevada Test Site	**Various types of topography; volcanic zones; Seismic Risk Zone 3**
NM	Los Alamos National Laboratory	**Mesas and deep canyons; potential headward erosion into inter-canyon plateaus; wind erosion; future volcanism and seismic events can be expected; Seismic Risk Zone 2**
	Sandia National Laboratory-NM/ITRI	**Generally flat; thick sedimentary sequence; potential for headward erosion of canyons; Seismic Risk Zone 2**
NY	Brookhaven National Laboratory	**More than 300 m of unconsolidated sands, clays, and gravels; gently rolling hills; adjacent areas designated Prime Farmland; Seismic Risk Zone 1**

Table 2-7. GEOLOGY

	SITE:	
NY	Knolls Atomic Power Lab., Kesselring	**Thin glacial till over sedimentary rocks; old faults; little seismic activity; Seismic Risk Zone 1-2**
	Knolls Atomic Power Lab., Niskayuna	**On bluff and bench over river floodplain; up to 21 m till; inactive faults; Seismic Risk Zone 1-2**
	West Valley Demonstration Project	**Gently rolling; thick (24 m) glacial till sometimes overlain by alluvial deposits, potential for headward erosion of streams; possible liquefaction of alluvial deposits; Seismic Risk Zone 1**
OH	Fernald Environmental Mgmt. Project	**Gently rolling; thin till overlies thick glacial valley fill sediments; poorly drained; seismically stable; Seismic Risk Zone 1-2**
	Mound Plant	**Gently rolling with some steep (20%) slopes; high erosion potential for soils; Seismic Risk Zone 1-2**
	Portsmouth Gaseous Diffusion Plant	**Relatively level; thick sedimentary sequence; well drained upland silty loams; Seismic Risk Zone 1**
PA	Bettis Atomic Power Laboratory	**Highly fractured sedimentary rocks; non-developed area is landslide prone with steep slopes (10-20%); previous coal mining; Seismic Risk Zone 1**
SC	Savannah River Site	**Thick sands and clays; good drainage; seismically inactive deep faults; Seismic Risk Zone 2-3**
TN	Oak Ridge Reservation	**Alluvial deposits overlying sedimentary rock; trough and ridge topography; karst features; thrust faults (inactive); Seismic Risk Zone 2**
TX	Pantex Plant	**Rolling grassy plains; playa basins; Seismic Risk Zone 1**
WA	Hanford Site	**Semiarid Pasco Basin; relatively flat alluvial plain on volcanics; minor wind erosion; volcanic hazards (ash fall); Seismic risk Zone 2**

Table 2-8. HYDROLOGY (Surface Water and Groundwater)

SITE:		
CA	Energy Technology Engineering Center	Small streams drain site; little or no flooding hazard; nearest water supply well is 16 km away
	General Atomics	Limited surface runoff to creek during heavy rains; above floodplain; depth to groundwater 73 m
	General Electric Vallecitos	Surface runoff to Vallecitos Creek; little or no flooding hazard; limited domestic use of water; depth to groundwater 15-22 m
	Lawrence Livermore Nat'l Lab Site 300	Intermittent streams flow only during wet season; groundwater is used for domestic and municipal water supply; high dissolved solids; depth to groundwater 7-45 m
CO	Rocky Flats Environmental Technology Site	Above flood plain; surface water to seeps or diverted to holding ponds; groundwater confined and isolated from surface; municipal water generally supplied from surface water but some groundwater used; high infiltration rates; depth to groundwater 20-40 ft
FL	Pinellas Plant	Seminole Lake to west near Gulf; poorly drained with groundwater almost at surface; above highest recorded storm surge; 2 aquifers used for domestic or municipal water supply
ID	Idaho National Eng. Lab/ANL-West	Limited surface runoff; underlain by Snake River Aquifer; groundwater supplies all drinking water
IL	Argonne National Laboratory-East	Drained by small streams that feed the Des Plaines River; little flooding hazard; groundwater supply is primarily from Niagaran Aquifer at about 30 m; municipal groundwater use
	Site A/Plot M	Ponds and intermittent streams; sparse groundwater usage from hand pumped wells; depths to dolomite aquifer 34 m
KY	Paducah Gaseous Diffusion Plant	Discharge of surface water from site is to Ohio River; underlying Regional Gravel Aquifer at 12-15 m below surface supplies nearby residences and towns; groundwater quality is good
MO	Weldon Spg. Site Remedial Action Project	Surface water drainage to Mississippi or Missouri R.; small portion of site in 100 yr floodplain of local creek; 3 aquifers under site; contaminated groundwater from site activities not used but almost all domestic and municipal water from groundwater
NV	Nevada Test Site	Surface water flows only as result of significant storm events; groundwater is deep at 250 m; limited local groundwater use
NM	Los Alamos National Laboratory	Surface water intermittent in deeply eroded canyons to Rio Grande; groundwater at 250-350 m (west to east); water quality good and deep groundwater used for lab and municipal water supply
	Sandia National Laboratory-NM/ITRI	Intermittent surface water to Rio Grande; 2 undeveloped arroyos in 100 yr floodplain; groundwater at 50-150 m depth used for Albuquerque water supply
NY	Brookhaven National Laboratory	Freshwater marshes; some of site in 100 yr floodplain; poorly drained glacial deposits; flow to Peconic river and to Atlantic Ocean; recharge zone of sole-source aquifer; groundwater used for water supply

Table 2-8. HYDROLOGY (Surface Water and Groundwater)

	SITE:	
	Knolls Atomic Power Lab., Kesselring	No history of flooding; drained by small streams (one Class C trout stream); drain to Saratoga Lake; groundwater system poor for water supply; surrounding dwellings/municipalities use combination of wells and surface water; depth to groundwater 1-2.5 m
	Knolls Atomic Power Lab., Niskayuna	Site drains to Mohawk River through intermittent streams; water supply from river with nearest municipal intake 8 km downstream; principal source of water for other supplies is Schenectady/Niskayuna aquifer to north and west
	West Valley Demonstration Project	Surface drainage to Lake Erie; Most water supply from surface water or shallow wells; high infiltration rates with spring runoffs; depth to groundwater 0-6 m in south to 2-170 m in north; deeper Cattaraugas Creek Basin Aquifer not used in immediate area
OH	Fernald Environmental Mgmt. Project	Above floodplain of Great Miami River; site drains to Paddys Run which flows to Great Miami; minor aquifers in glacial till; primary aquifer Buried Valley Aquifer which supplies several million people and major industries; depth to groundwater 25 m
	Mound Plant	Rapid runoff to Great Miami River; underlain by Buried Valley Aquifer (Class II Aquifer); depth to groundwater 208-212 m
	Portsmouth Gaseous Diffusion Plant	Drained of storm water by tributaries to Scioto River; groundwater recharged from Scioto River and used for water supply; river water of poor quality and not recommended for contact sports; depth to groundwater 5 m
PA	Bettis Atomic Power Laboratory	Surface water from site flows by way of Bull Run Cr. to Monongahela R; above floodplain; river used for recreation and water supply; groundwater from Monongahela sediments buy not an important water supply; depth to groundwater 6.1 m
SC	Savannah River Site	Site drainage to Savannah R; river used for water supply purposes; most municipal and industrial water used in surrounding counties from unconsolidated sediments under the site
TN	Oak Ridge Reservation	Surface water from ORR to the Clinch River; water for City of Oak Ridge and for ORR from Clinch River upstream from ORR; limited groundwater usage for some domestic wells; depth to groundwater 0-20.3 m
TX	Pantex Plant	All surface water drains into 6 playa lakes; overlies 2 aquifers (Ogallala and Dockum); Ogallala supplies water to Amarillo; Dockum supplies domestic and livestock wells near the site
WA	Hanford Site	Limited flow off site to Columbia R by ephemeral streams; unconfined aquifer at 50-100 m; deeper confined aquifers in basalts; water supply for industrial processes and for drinking almost totally from Columbia R (after treatment)

Table 2-9. SIGNIFICANT GROUNDWATER RESOURCES (Sole Source Aquifer)

	SITE:	
CA	Energy Technology Engineering Center	
	General Atomics	
	General Electric Vallecitos	
	Lawrence Livermore Nat'l Lab Site 300	
CO	Rocky Flats Environmental Technology Site	
FL	Pinellas Plant	Floridan Aquifer - Primary Water Supply
ID	Idaho National Eng. Lab/ANL-West	Snake River Plain Aquifer - Designated Sole Source Aquifer
IL	Argonne National Laboratory-East	
	Site A/Plot M	
KY	Paducah Gaseous Diffusion Plant	
MO	Weldon Spg. Site Remedial Action Project	
NV	Nevada Test Site	
NM	Los Alamos National Laboratory	Puye Formation - Primary Water Supply
	Sandia National Laboratory-NM/ITRI	Santa Fe Aquifer - Primary Water Supply
NY	Brookhaven National Laboratory	Lower and Upper Glacial Aquifers - Designated Sole Source Aquifer
	Knolls Atomic Power Lab., Kesselring	Schenectady Niskayuna Aquifer is just south - Designated Sole Source Aquifer
	Knolls Atomic Power Lab., Niskayuna	Schenectady Niskayuna Aquifer is north and west - Designated Sole Source Aquifer
	West Valley Demonstration Project	Cattaraugus Creek Basin Aquifer - Designated Sole Source Aquifer
OH	Fernald Environmental Mgmt. Project	Great Miami Aquifer - Designated Sole Source Aquifer
	Mound Plant	Buried Valley Aquifer - Designated Sole Source Aquifer
	Portsmouth Gaseous Diffusion Plant	
PA	Bettis Atomic Power Laboratory	
SC	Savannah River Site	
TN	Oak Ridge Reservation	
TX	Pantex Plant	Ogallala - Primary Water Supply
WA	Hanford Site	

Table 2-10. SENSITIVE ENVIRONMENT

	SITE:	
CA	Energy Technology Engineering Center	2 protected plant species; Chumash Indian caves nearby
	General Atomics	Nearby natural landmark; State Park and 2 wildlife reserves; wetland nearby
	General Electric Vallecitos	Provides potential habitat for 4 endangered, threatened, or rare species
	Lawrence Livermore Nat'l Lab Site 300	29 archeological sites; 2 endangered and 1 threatened species; wetlands
CO	Rocky Flats Environmental Technology Site	1 endangered species
FL	Pinellas Plant	1 species of special concern; 2 wetlands
ID	Idaho National Eng. Lab/ANL-West	National Historic Landmark; 1506 Archaeological resources; 2 Resource Areas; Near Indian reservation; numerous study areas and wildlife areas; 2 endangered species; numerous wetlands; National Environmental Research Park
IL	Argonne National Laboratory-East	26 archaeological sites; recreational sites nearby; waterfall; Glen Forest Preserve surrounds site; 2 endangered species; wetlands
	Site A/Plot M	Site is in Palos Forest Preserve; refuge for wildlife
KY	Paducah Gaseous Diffusion Plant	Potential prehistoric sites; wildlife management area surrounds site; 4 endangered species; wetlands
MO	Weldon Spg. Site Remedial Action Project	2 wildlife areas (recreational) nearby
NV	Nevada Test Site	1 endangered and 1 threatened species; wetlands; evidence of pre-Indian culture
NM	Los Alamos National Laboratory	Numerous archeological sites; National Forest borders; Indian reservation borders; 2 candidate species; wetlands
	Sandia National Laboratory-NM/ITRI	Several archeological sites are close; 3 endangered cacti; 5 endangered species; National Forest; Indian reservation
NY	Brookhaven National Laboratory	Potentially historic sites; scenic river; 10% of site is wetlands; endangered state species and 1 species of special concern; refuge for wildlife; nearby parks; Indian reservation nearby
	Knolls Atomic Power Lab., Kesselring	13 wetlands; several state multiple use areas nearby
	Knolls Atomic Power Lab., Niskayuna	
	West Valley Demonstration Project	Potential historic place; wetlands; critical habitat for white tail deer
OH	Fernald Environmental Mgmt. Project	3 historic places are nearby; many archeological sites; threatened crayfish; wetlands
	Mound Plant	Historic Indian mound landmark; wetlands
	Portsmouth Gaseous Diffusion Plant	Wayne National Forest borders the site; potential for endangered species; wetlands; church and cemetery on site
PA	Bettis Atomic Power Laboratory	
SC	Savannah River Site	6 endangered species; National Environmental Research Park
TN	Oak Ridge Reservation	Historic sites; several threatened or endangered species; wetlands; Tennessee Wildlife Management area; National Environmental Research Park; on site public areas and park
TX	Pantex Plant	50 prehistoric Indian/3 historic farmsteads; possible wetlands
WA	Hanford Site	9 archeological sites; several proposed historic sites; ecology reserve/wildlife refuge/recreational area as buffer zones

Site Fact Sheet
Energy Technology Engineering Center
California

Site Description

The Energy Technology Engineering Center (ETEC) at Rockwell's Santa Susana Field Laboratory is located in the Simi Hills, a rural area in the southeasterly region of Ventura County, California (Figure ETEC-1). This location is bounded on the east by the San Fernando Valley (City and County of Los Angeles), on the south by the Santa Monica Mountains (Cities of Calabasas and Agoura Hills, Los Angeles County), on the west by the Conejo Valley (City of Thousand Oaks, Ventura County) and on the north by the Simi Valley (City of Simi Valley, Ventura County).

A population of 5,000-10,000 is reported within 10 km (6.2 mi) of the site. A 50 km (31 mi) radius includes the county of Los Angeles, which has a population of 10 million.

The majority of the ETEC facilities are located within an approximate 0.4 km^2 (90 acre) parcel in Area IV of Rocketdyne's 10.9 km^2 (2,700 acre) Santa Susana Field Laboratory (Figure ETEC-2). One ETEC facility, the Steam Accumulator Blowdown Evaluation Rig, is located in the Bowl Area (Area I) of the Field Laboratory.

ETEC's primary mission is applied engineering development of emerging energy technologies including conservation and environmental issues and solar, geothermal, fossil, fusion, and fission energy. ETEC's primary function was the design, analysis, development, and testing of systems and components developed or proposed for use in energy, power conversion, liquid metal development, space, and defense programs. Nuclear Energy programs were terminated at the end of FY93 and shutdown operations at ETEC are ongoing through FY94 with facility transfer to EM-60. Employment at ETEC is approximately 150.

Institutional Factors

Ownership

ETEC facilities are owned by DOE on property leased from Rockwell International and operated for DOE by its Rocketdyne Division. Although DOE has provided funding to ETEC to conduct research activities, DOE does not have control over land use decisions at the site.

No LLW or MLLW disposal facility is located on the ETEC site. A radioactive waste disposal facility has never been in operation on site, and such facility is not planned for the future.

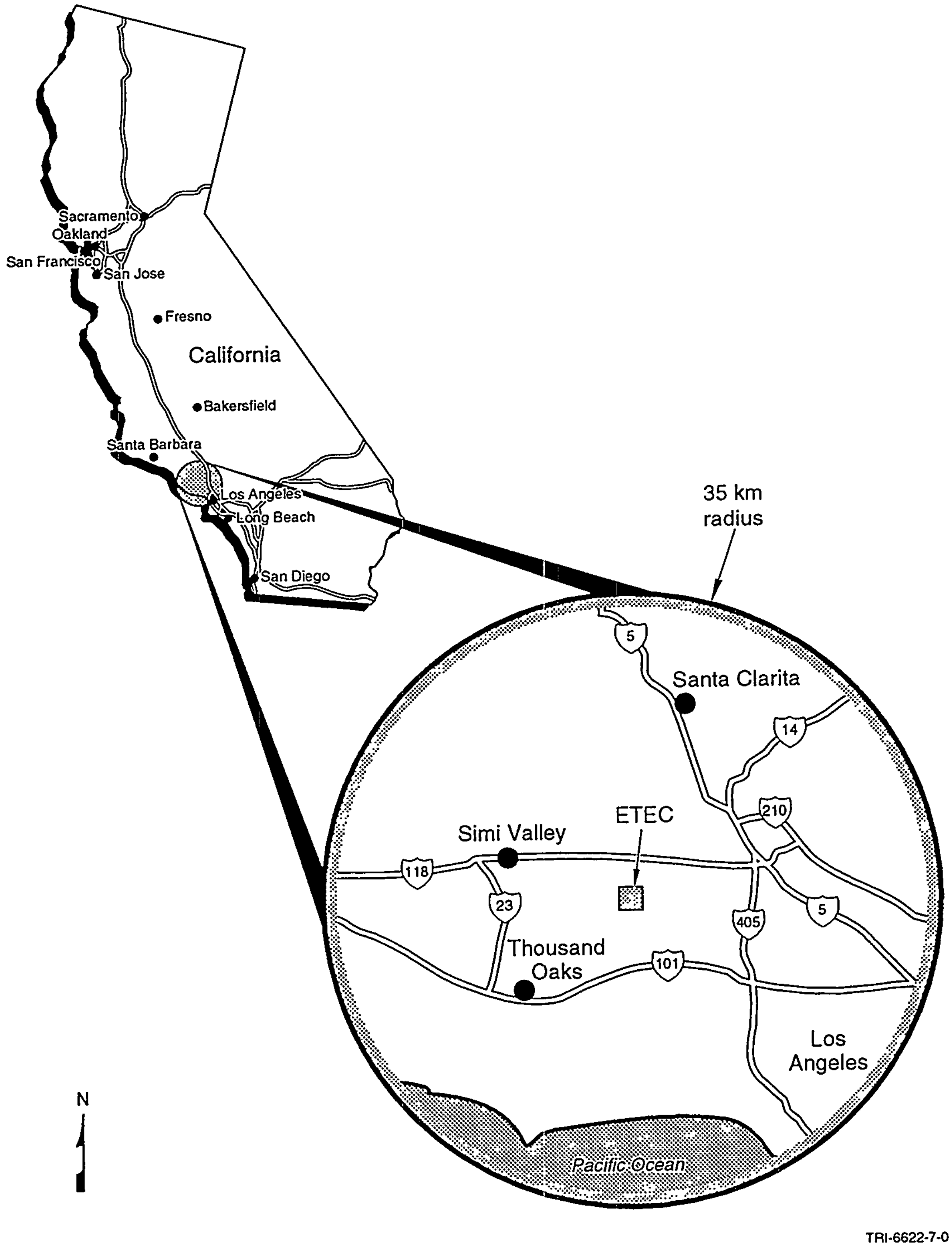

Figure ETEC-1. Location Map for Energy Technology Engineering Center

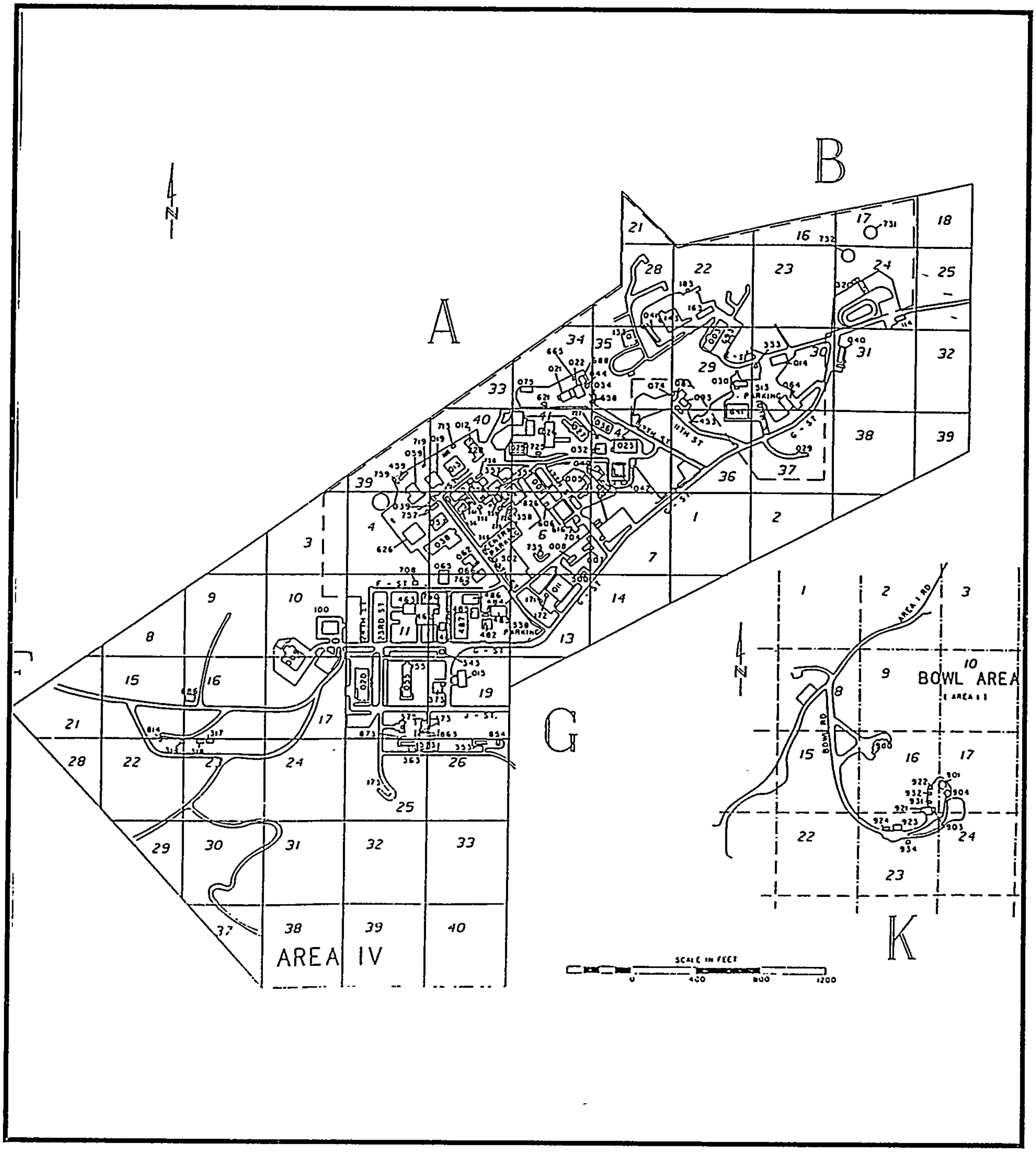

Figure ETEC-2. Site Map for Energy Technology Engineering Center

MLLW Storage and Generation
The estimated volume of MLLW inventory at ETEC is reported to be 656.6 m^3, with an additional 600 m^3 of waste anticipated to be generated through 1997.*

Regulatory Considerations
No records of decision, tri-party agreements, or facility compliance agreements are in place for ETEC.

No aquifers in the area are EPA designated sole source aquifers.

Technical Factors

Climate
This area is part of the Southern California Coastal Region, which implies temperature and precipitation regimes in which more than 90% of the annual precipitation falls between November and April and monthly mean temperature ranges from near 10° C (50° F) for the coldest months to the lower 20°s C (upper 70°s F) in the warmest ones. Temperatures at ETEC tend to be less extreme on given days than in either adjacent valley, with summertime maxima usually 2-4° C (4-8° F) lower than the regional average and wintertime minima 2-3° C (4-6° F) higher than the regional average. Average annual precipitation is 45 cm (18 in) and varies from a trace in July to 10 cm (4 in) in November. Average annual evaporation from shallow lakes in the area could be as much as 117 cm (46 in). During the fair-weather months from April to October, winds occur as an almost daily sea breeze from the northwest, 7 to 14 km/h (4.4 to 8.7 mph), that persists from shortly after noon to an hour or so after sunset. From November to March a similar pattern is seen, but the northwest wind speeds tend to be less than 8.3 km/h (5.2 mph).

Geology
ETEC is underlain by a massive-bedded, generally well-cemented sandstone known as the Chatsworth Formation. The formation is more than 66 million years old and has an overall thickness of approximately 1830 m (6,000 ft). The beds dip to the north from 20 to 35°, and trend 15 to 30° north of due east. The Chatsworth comprises generally uniform rock types, with the well-cemented coarse sandstone predominant and occasional beds of fine sandstone and thin beds of shale.

Alluvium deposited within the past two million years overlies the Chatsworth Formation in various areas of the Santa Susana Field Laboratory, most notably in the Burro Flats area and along major ephemeral drainages. The alluvium consists of mixtures of unconsolidated gravel, sand, silt, and clay of variable thicknesses, usually less than 6 m (20 ft).

Field examination and photogeologic surveys disclose numerous evidences of faults crisscrossing the property, with the fault planes extending in an east-west and northeast-southwest direction. All faults in the area are considered potentially active. The massive, hard Chatsworth sandstone

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*1994 *Mixed Waste Inventory Report*

develops a distinctive principal fracture pattern, generally parallel to the direction of the dip. These fractures appear to be much more abundant in the area adjacent to the faults than in the unfaulted areas.

The site is located in Seismic Risk Zone 3, which means that major damage could occur from earthquakes.

No known mined or drilled natural resources are on or near the site.

Hydrology

ETEC is located on a divide between the Santa Clara and Los Angeles river basins. A few small tributaries drain the site. ETEC is about 183 m (600 ft) above the highest 100-year flood level. Only a few towns withdraw water from the Los Angeles River and Calleguas Creek downstream from the site. Four reservoirs providing domestic water to the greater Los Angeles area are located within 50 km of ETEC. The closest is more than 10 km from the site.

There are two groundwater systems at the Field Laboratory: a shallow, unconfined system in the Quaternary alluvium of the Burro Flats area and along major drainages; and a deeper groundwater system in the fractured Chatsworth Formation. Water levels in the alluvium are not well known; some areas are completely unsaturated while other areas are partially saturated. The alluvium may form perched, discontinuous water-bearing zones which overlie the less permeable Chatsworth Formation. The Chatsworth Formation as a whole is a very poor aquifer or water-producing formation.

Groundwater accumulation in the area occurs in four ways: along fault planes where movement has caused fracturing of sandstone; along joints and fractures; on bedding planes where there is a change in rock type; and in limited poorly-cemented permeable zones within the sediments. Water levels respond to recharge resulting from surface flow and may vary considerably between dry and wet periods.

Geologic barriers in the form of impervious shale members and faulting have isolated the ground water underlying the Santa Susana facility from the Simi Valley to the north and the San Fernando Valley to the south. This isolation is borne out by well data that show the static water levels at ETEC to be 183 to 244 m (600 to 800 ft) above the adjacent valleys.

Hydraulic conductivity of the alluvium is estimated to range from 10^0 to 10^4 liters per day per square meter. The overall effective porosity through the formation is probably less than 1%.

The towns of Oxnard and Moorpark withdraw local groundwater for municipal use. The nearest groundwater well used for municipal water supplies is north of Moorpark, more than 16 km from the site.

Sensitive Environment
No national monuments or historic sites listed in the National Register of Historic Places are within or near the site.

Chumash Indian Caves are located in Area II of the Santa Susana Field Laboratory.

No national or state parks, forests, monuments, or preserves are near the site. Two protected plant species are located on the site.

No wetlands are reported on the site.

Sources

Technical Site Information--Energy Technology Engineering Center (ETEC), GEN-AT-0027, Rev. B., August 1993.

Site Fact Sheet
General Atomics
California

Site Description

The main General Atomics (GA) site is 13 miles north of downtown San Diego, and just southwest of the convergence of Interstates 5 and 805 (Figure GA-1). The site is on Torrey Pines Mesa about one mile east of the Pacific Ocean at an elevation of 90 m (300 ft) above sea level and extends into the adjacent Sorrento Valley. Land uses surrounding the GA site include scientific research and development parks to the north and east across Interstate 5, undeveloped land in Torrey Pines State Park, research and development parks and a hospital to the west, and the University of California at San Diego to the south.

GA comprises two contiguous sites of about 0.2 km^2 (60 acres) each (Figure GA-2). The only land not occupied by buildings is not only steeply sloped, but consists of relatively narrow strips less than 200 m wide.

The population within 10 km (6.2 mi) of the site is estimated to be 4,860. Within 50 km (31 mi) of the site, the estimated population is 2,056,000; cities with populations greater than 10,000 include San Diego, Oceanside, Carlsbad, San Marcos, Escondido, Ramona, Encinitas, Solana Beach, Poway, Lakeside, Spring Valley, Lemon Grove, National City, Chula Vista, and Imperial Beach.

GA carries out the largest fusion program in private industry. In recent years, GA scientists and engineers have pursued technical development programs such as nuclear space power, kinetic energy, directed energy systems, aerospace materials, and demilitarization of obsolete weapons. GA is engaged in a broad scope of research and development including product development of advanced power generation systems, energy conservation, and military applications. GA employs approximately 1,300 people.

Institutional Factors

<u>Ownership</u>
General Atomics is a privately owned and operated facility. Although DOE has provided funding to GA to conduct research activities, DOE does not have any control over land use decisions at the site. GA has emphatically expressed its opposition to hosting a MLLW disposal facility at the site.

No LLW or MLLW disposal facility is operating on the GA site. No radioactive waste disposal facility has ever been in operation onsite, and such a facility is not planned for the future.

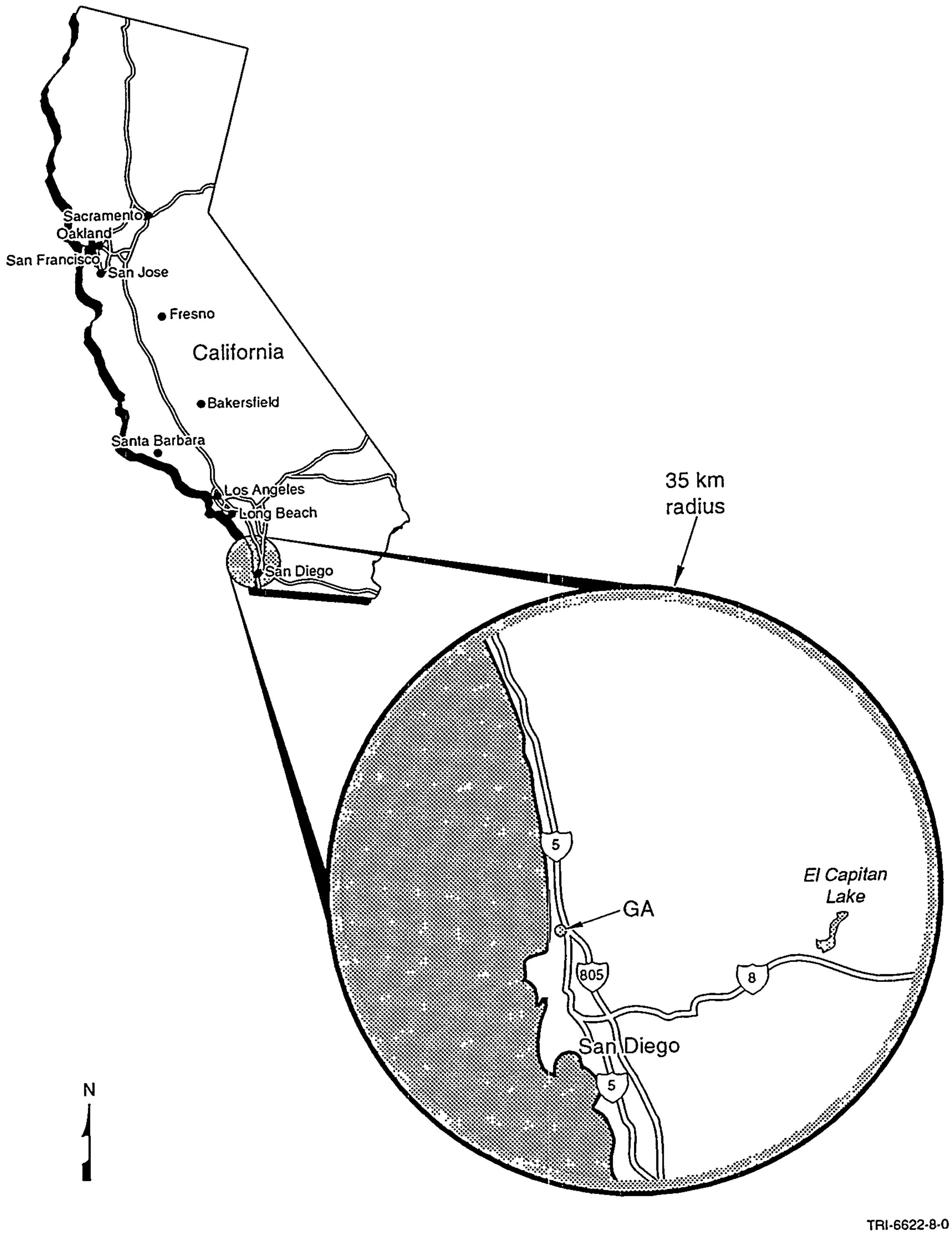

Figure GA-1. Location Map for General Atomics

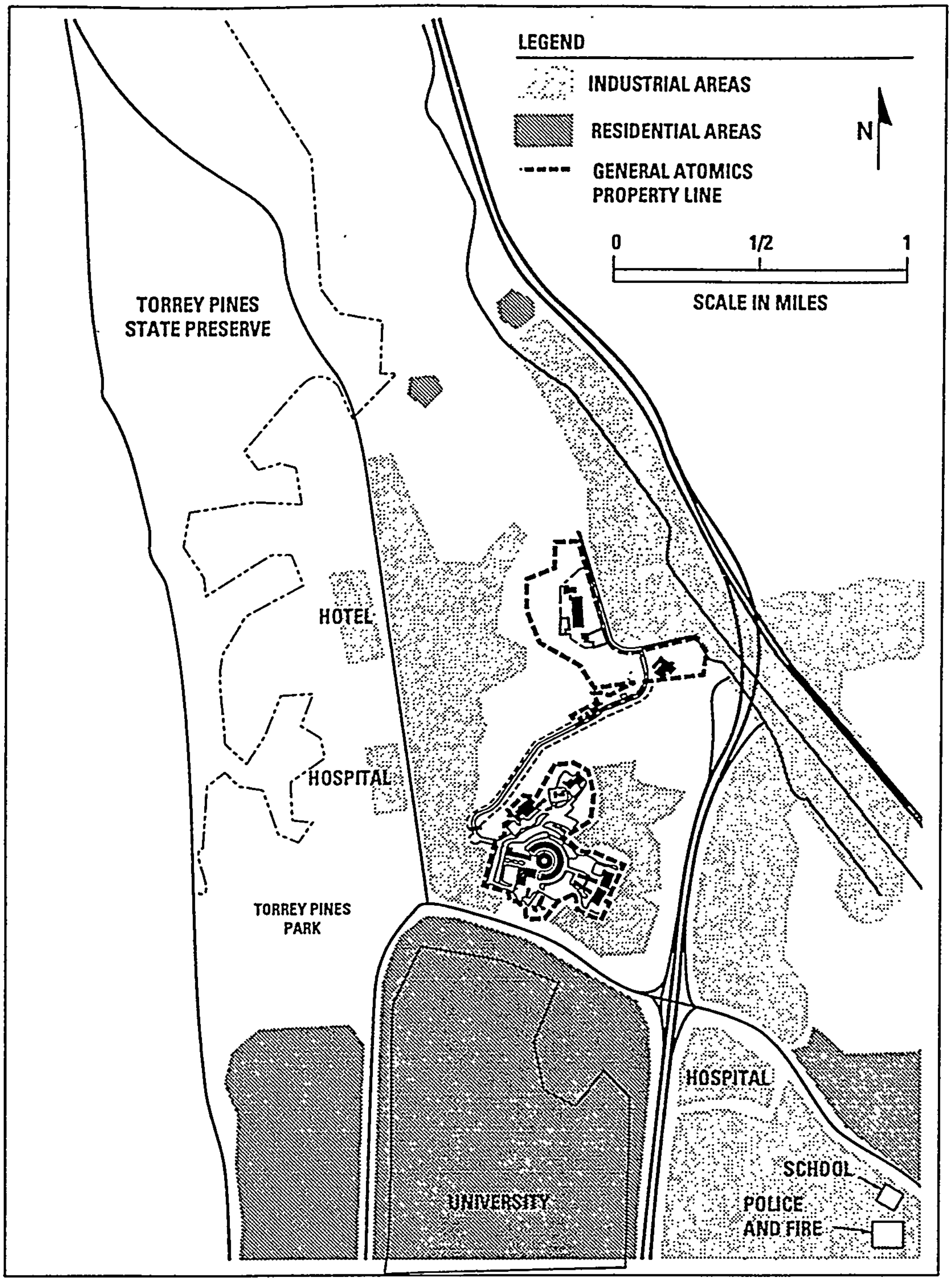

Figure GA-2. Site Map for General Atomics

MLLW Storage and Generation
The estimated volume of MLLW inventory at GA is 42.9 m^3, with an additional 0.4 km^3 of waste projected to be generated through 1997.*

Regulatory Considerations
No records of decision, Tri-party Agreements, Facility Compliance Agreements, or other agreements are in place. The use of General Atomics' site for LLW or MLLW disposal would be in direct violation of local land use zoning restrictions and would require the approvals of the State of California Department of Health Services, the State of California Department of Toxic Substances Control, California Environmental Protection Agency, the California Coastal Commission, and the City of San Diego.

No EPA designated sole source aquifers are below the site.

Technical Factors

Climate
The Torrey Pines Mesa and Sorrento Valley, as with most of San Diego County coastal areas, has a semi-arid Mediterranean climate characterized by hot, dry summers and mild, wet winters. The mean annual temperature in the project vicinity is 16° C (61° F), with summer high temperatures in the low 30°s C (90°s F) and winter lows near 0° C (middle 30°s F). Precipitation in the vicinity of the study area averages 28 cm (11 in) annually, the majority of which falls between October and April. Average annual evaporation from shallow lakes in the area could be as much as 122 cm (48 in). The prevailing wind direction is westerly and ranges from 10 to 15 km/h (6 to 9 mph). However, easterly winds are almost as common in the winter months, but are less intense, ranging from 1 to 11 km/h (1 to 7 mph). The predominant pattern is sometimes interrupted by Santa Ana conditions, when high pressure over the Nevada-Utah area overcomes the prevailing westerlies, sending strong, steady, hot, dry winds east over the mountains and out to sea.

Geology
The rocks in this area are part of a prism of sedimentary rocks deposited between 37 and 144 million years ago that thin to the east and are seldom found more than 16 km (10 mi) inland within the county. They lie upon crystalline rocks that make up the Peninsular Range in central and eastern San Diego County. In the site area, the sedimentary rocks are up to 300 m (1000 ft) thick. They consist of sandstones, siltstones, and shales. The sand blanket varies in thickness, with some of the region covered by marine terrace deposits up to 9 m (30 ft) in depth.

The project site is characterized by marine sedimentary formations that are capped by terrace deposits on the mesa tops. On site, four formations are found: the Baypoint Formation, the Lindavista Formation, the Scripps Formation, and the Ardath Shale.

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*1994 _Mixed Waste Inventory Report_

Site topography is typical of coastal San Diego County, with bluffs and mesas interspersed with cliffs and ravines. The topography of the site is characterized by steeply sloping canyons and relatively level mesa areas.

The only land on the site not occupied by buildings is on a grade of 20 to 25% and is only about 220 m wide, which would make construction of any facility difficult. All remaining unoccupied land occurs as narrow strips less than 200 m wide.

The presence of three small, local faults has been confirmed by field reconnaissance of the GA property site. All of these faults are mapped as being overlain by formations which were deposited up to two million years ago, and which have not since been displaced by the faults.

The site is located in Seismic Risk Zone 3, which means that major damage could occur from earthquakes. However, San Diego County is one of the more moderate seismic risk regions in Southern California. The historical pattern of seismic activity has generally been characterized as a broad scattering of small-magnitude earthquakes, whereas the surrounding regions are characterized by a high rate of seismicity with many moderate- to large-magnitude earthquakes. The Rose Canyon, La Nacion, Elsinore, Newport-Inglewood, San Jacinto, and San Andreas fault zones represent seismic risk to the San Diego area.

Aside from the faults, no structural features of importance are known.

Facilities on the main site are located primarily on fine sandy loam. Slopes are moderate, runoff is slow to medium, and the erosion hazard is slight to moderate. Adjacent soils include a clay with steep slopes, rapid runoff, and high erosion hazard. Soils are primarily loamy sand, which is moderately sloping, with slow to medium runoff and slight to moderate erosion hazard.

No mined or drilled natural resources are on or near the site.

Hydrology

The site lies within the Los Penasquitos Creek drainage basin. Surface drainage from the site runs through the Soledad Valley into Los Penasquitos Creek, which flows to the northwest and empties into the Pacific Ocean. Water flows into the Soledad Valley only during occasional heavy rains.

Floods do not represent a danger to the site as it is situated approximately 15-107 m (50-350 ft) above the valley floor. Also, drainage downstream from the site to the Pacific Ocean is unrestricted. The site is not located within a 100-year flood zone.

The depth of the regional aquifer is in excess of 73 m (240 ft) below the site. According to published geologic maps, the site is underlain with Ardath Shale, which may act as a hydrologic barrier to downward movement of water. Excavations conducted at a nearby location during 1991 verified that groundwater was not present at depths to 5.8 m (19 ft).

Groundwater is found in the Sorrento Valley at a depth of 90 m (300 ft) below the mesa elevation. Direction of movement probably follows that of surface water, from the Soledad Valley toward Los Penasquitos Creek and into the Pacific Ocean.

Groundwater quality is reported to be marginal to inferior for agricultural use with salt-water intrusion being a problem toward the coast. Therefore, use of groundwater, although not reported, is not expected.

Sensitive Environment

No significant archeological or cultural resources have been found in surveys of the GA site. The National Register of Historic Places lists no historical structures or sites within the boundary of the plant. The Register does, however, list a natural landmark about five miles from the site. This landmark, Miramar Mounds, consists of 640 acres of geologically unusual land.

Torrey Pines State Park is located one mile northwest of the site. Two wildlife reserves, Torrey Pines State Reserve and Los Penasquitos Lagoon, are located west and northwest of the site along the coast.

Several mammal, bird, and reptile species were identified in surveys of the area, with the majority of these occurring in the brushland habitats. No species listed by the state or federal agencies as rare, threatened, or endangered were found.

Los Penaquitos Lagoon, designated by the California Department of Fish and Game as a wetland area critical to maintaining wildlife resources, receives runoff from Soledad Valley, Carmel Valley, and Los Penasquitos Creek.

No wildlife refuges are on the site.

Sources

"General Atomics and Its Mission," General Atomics, San Diego, CA.

Site Fact Sheet
General Electric Vallecitos Nuclear Center
California

Site Description

The General Electric Vallecitos Nuclear Center (GEVNC) is located in Alameda County, California, about 25 miles southeast of Oakland, near the intersection of Interstate 680 and State Road 84. Vallecitos Valley is rural, with no incorporated communities (Figure GEVNC-1). Land use near the site is agricultural, including orchards, vineyards, and pastures, although grazing is predominant. The facility comprises 6.4 km^2 (1,594 acres) (Figure GEVNC-2). The majority of the site is leased for grazing. Buildings are located in the southwest portion of the site.

The only population center within 10 km (6.2 mi) of the site is Pleasanton (51,000). Within a 50 km (31 mi) radius, the population is estimated to be 2,718,000. Included within this area are the cities of Oakland (372,000), Concord (111,000), Berkeley (103,000), Fremont (173,000), and San Jose (782,000).

In March 1956, GE began construction of radioactive handling facilities near Pleasanton, California. Operations at GEVNC support GE nuclear fuel programs through fuel specimen examination and evaluation. The GE facilities were used primarily on projects for the DOE and the Atomic Energy Commission. The activities performed in support of government programs contaminated the facilities.

Employment at GEVNC is approximately 225.

Institutional Factors

<u>Ownership</u>
GEVNC is a privately owned and operated facility and is not under the direct control of the DOE. DOE will decontaminate the GE facilities and certify them free of contamination and suitable for support of other activities. DOE has no continuing investment or interest in the facility-at-large, nor does it have control over land-use decisions at the site. GEVNC has emphatically expressed its unwillingness to consider hosting a MLLW disposal facility at the site.

No LLW disposal facilities are located on site, and construction of an LLW or MLLW facility is not planned.

<u>MLLW Storage and Generation</u>
GEVNC has no MLLW in inventory at the site and does not anticipate generating any new waste volume through 1997.*

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*1994 *Mixed Waste Inventory Report*

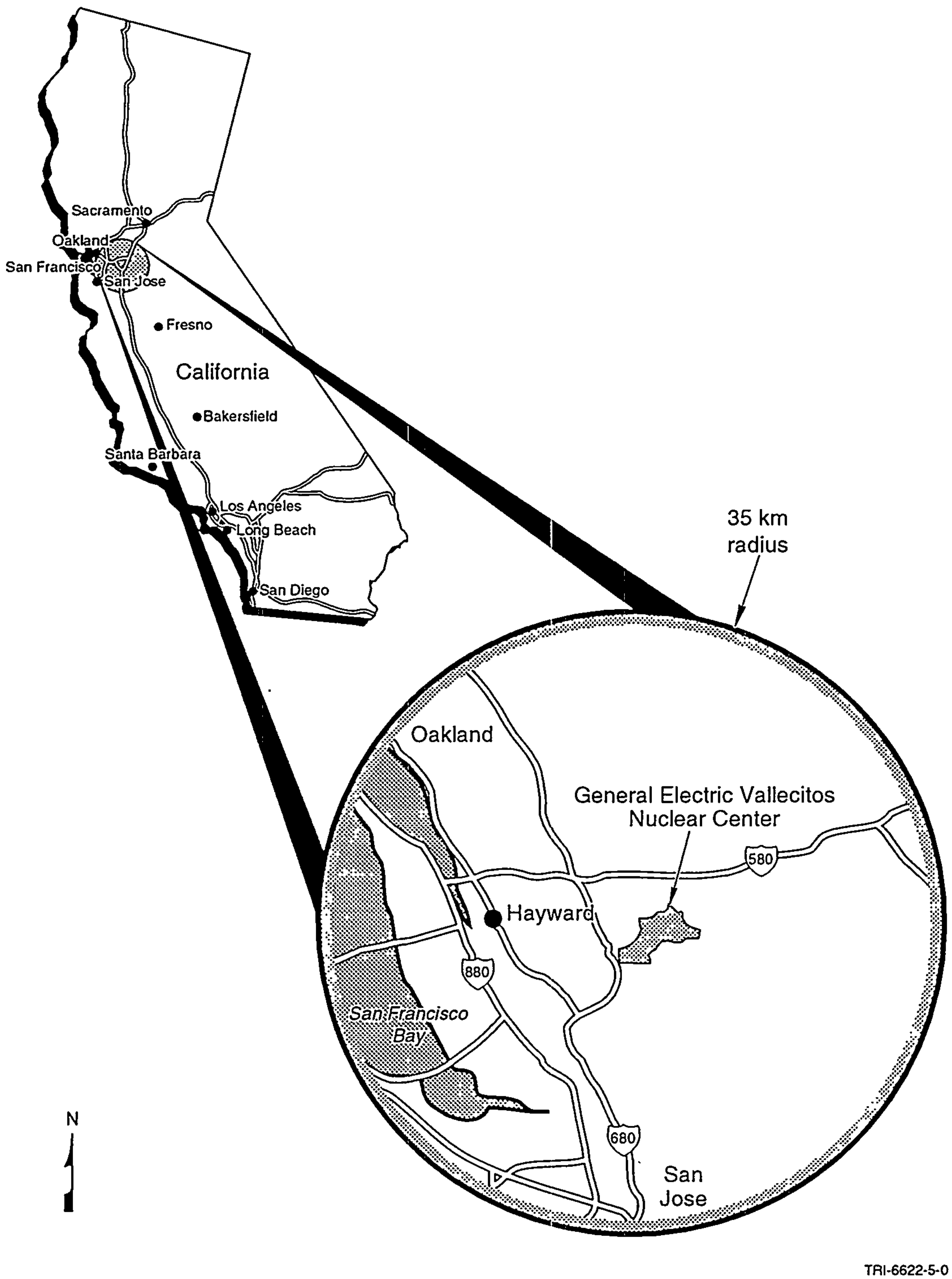

Figure GE-1. Location Map for General Electric Vallecitos Nuclear Center

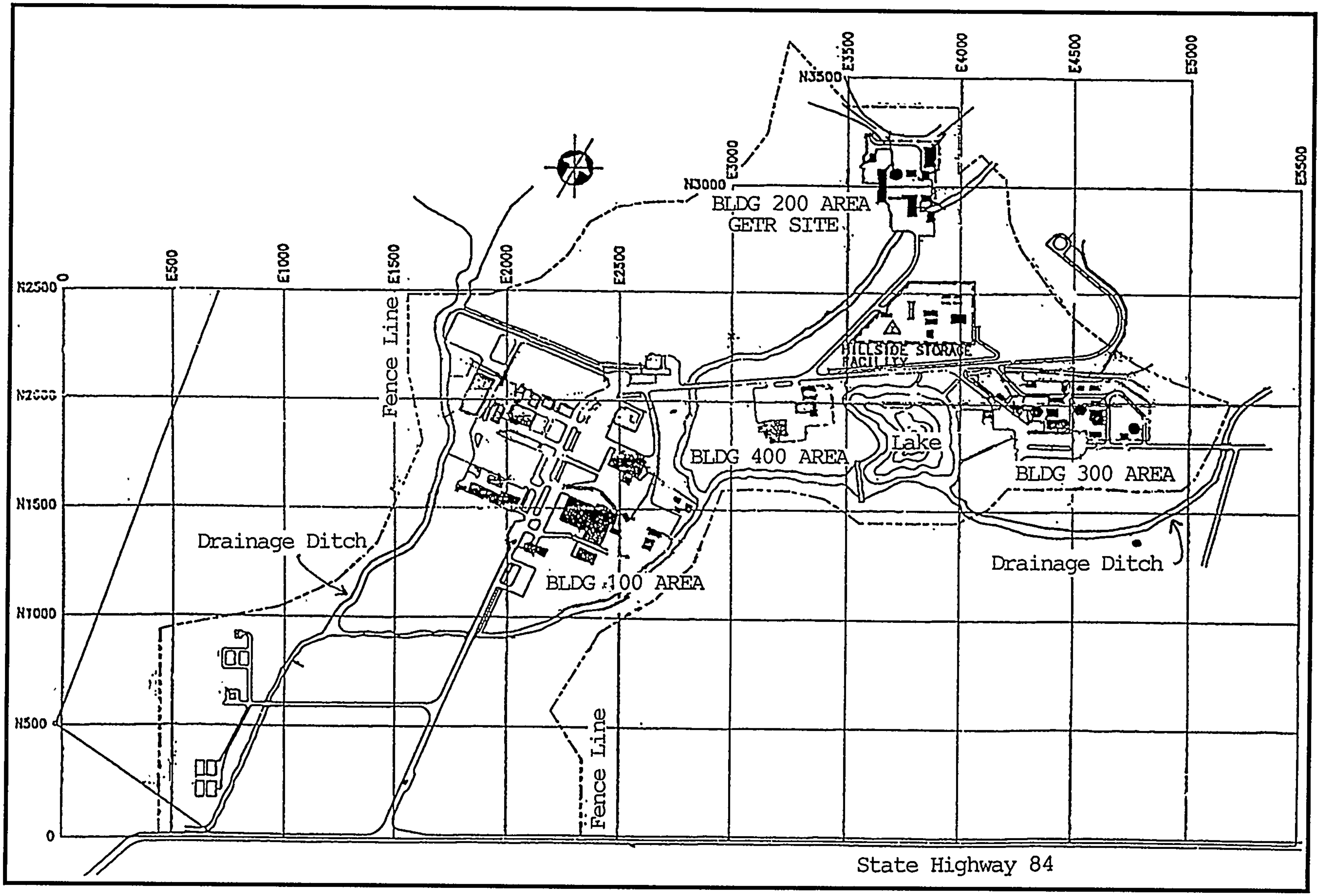

Figure GE-2. Site Map for General Electric Vallecitos Nuclear Center

Regulatory Considerations
No federal or cooperative agreements are in place regarding MLLW management or facility siting at GEVNC.

No EPA designated sole source aquifers are on or near the site.

Technical Factors

Climate
The climate of the valley is mild, with hot, dry summers and cool, moist winters. The average annual temperature is 15° C (59° F) with an average daily minimum of 8° C (46° F) occurring in January and an average daily maximum of 22° C (71° F) in July. The area receives about 51 cm (20 in) of precipitation annually, about 80 percent of which falls during the period from November through March. Average annual evaporation from shallow lakes in the area could be as much as 107 cm (42 in). The prevailing wind is from the southwest at an average of 12 km/h (7.8 mph).

Geology
GEVNC is located along the northern margin of the Vallecitos Valley, a broad valley within the Diablo Range in the eastern San Francisco Bay region. This region consists of several active strike-slip faults (e.g., San Andreas, Hayward, Calaveras, and Greenville), as well as many less well-known reverse faults. The Diablo Range is an uplifted block of rocks, deposited between 66 and 208 million years ago, mantled in part with a thick sequence of marine and nonmarine rocks more than two million years old, including sandstone, siltstone, shale, conglomerate, tuff, and minor coal seams, and up to 600 m (1970 ft) of Livermore Gravel deposited less than two million years ago. The poorly-sorted Livermore Gravel is composed of nonmarine, lenticular, poorly cemented gravel, sand, silt, and clay. The beds generally strike north to northwest and dip 10° to 30° east or northeast. The Livermore Gravel is exposed in the low hills around Vallecitos Valley and is overlain by thin alluvium on the valley floor.

The site is separated from the Livermore Valley to the north by the Pleasanton Hills. Except for its connection to the Livermore Valley and Niles Canyon, the site is almost totally surrounded by mountains, beginning with the Black Hills in the north, the Diablo Range from east to south, the Santa Cruz Mountains in the south, and the Sunul-Pleasanton Ridges from southwest to north. The site itself is located on relatively flat land near the floor of Vallecitos Valley.

The structural geology of the area is characterized by a series of northwest-trending folds and fault zones. The site is located in Seismic Risk Zone 3, which means that major damage could occur from earthquakes. Three faults which have been active within the past two million years lie in close proximity to Vallecitos Valley: the Calaveras, with the most recent earthquake occurring more than 130 years ago; the Las Positas, not currently zoned as active by the State of California; and the Verona, a thrust fault dipping northeast beneath a low range of hills adjacent to the GEVNC.

The low hills surrounding Vallecitos Valley exhibit numerous small, active or recently active landslides that are composed mostly of unconsolidated Quaternary material. Soils are well-drained and loamy, formed in alluvium from sedimentary rock. Runoff is slow to medium, and the subsoil has low permeability. The erosion hazard is slight to moderate; hillslopes left bare during rainy season may undergo severe erosion.

No mining activity occurs in Vallecitos Valley, although two large aggregate mines are present in the alluviated Sunol Valley, into which Vallecitos Creek flows approximately 3 km (1.9 mi) to the southwest of the GEVNC. Oil has been produced in the Livermore Valley, and coal, magnesite, and manganese have been mined locally.

Hydrology

Vallecitos Valley slopes gently from east to west and surface runoff is drained by Vallecitos Creek and its tributary streams. Vallecitos Creek flows westward through a narrow gap in the uplands to join Arroyo de la Laguna, a tributary of Alameda Creek. The low hills directly north of the GEVNC are drained southwestward by an unnamed stream tributary to Arroyo de la Laguna. Based on the small drainage area of Vallecitos Creek and the distance and height between the GEVNC and Vallecitos Creek, flooding hazard is small or nonexistent for the GEVNC. However, the unnamed tributary and other small gullies derived from minor basins in low hills directly north of the facility may generate locally significant runoff during high-intensity rainstorms.

The Hetca Hetchy aqueduct, a major regional water supply for San Francisco, passes within 5 km (3.1 mi) south of GEVNC.

The Vallecitos groundwater subbasin is coincident with the Vallecitos Valley surface-water drainage basin. The source of groundwater recharge in the study area is direct infiltration of precipitation and seepage along Vallecitos Creek; some seepage along a canal that is a part of the South Bay Aqueduct may be an additional recharge source. The semiconsolidated Livermore Gravel and overlying alluvium constitute the aquifers in Vallecitos Valley. The underlying consolidated sedimentary rocks are not water bearing, and act as a lower hydrologic boundary in the area. Within the Livermore Gravel and the alluvium, water-bearing beds of coarse-grained material (coarse sand, gravel, boulders) are interbedded with non-water-bearing beds of fine-grained materials (clay and silt). The alluvium is moderately permeable and contains water under water-table conditions. Small bodies of groundwater may be perched above fine-grained, impermeable material that occur as discontinuous beds in the alluvium.

Based on levels in three wells, the depth to groundwater in Vallecitos Valley ranges from 15 to 22 m (49 to 71 ft).

Groundwater flow likely occurs in a southwesterly direction toward Arroyo de la Laguna, similar to that of the surface drainage, at an average velocity of about 0.6 m/day (2 ft/day), with a range of 0.003 to 2.4 m/day (0.01 to 8 ft/day). A groundwater divide approximately coinciding with the surface-water drainage divide along the northern and eastern sides of the valley prevents groundwater from flowing between Vallecitos and Livermore Valleys on the north and northeast. The groundwater divide is created by the effects of topography and low average hydraulic conductivity of the Livermore Gravel. The groundwater gradient in the valley ranges from 9 m/km to 57 m/km (50 ft/mi to 300 ft/mi). The gradient is steepest at the northeast end of the valley, where Livermore Gravel is exposed, and flattens to the southwest along the valley floor, where alluvium is present. Values for hydraulic conductivity range from less than 0.3 to 24 m/day (< 1 to 80 ft/day). Surface water and groundwater from Vallecitos Valley reach Alameda Creek via Arroyo de la Laguna, upstream of a subsurface grout dam operated by the San Francisco Water Department. This dam integrates groundwater from the Sunol and Vallecitos Valleys into the drinking water supply for the City of San Francisco.

There are about 20 homes in the area, each with one or more wells to provide water for domestic use. Stock ponds provide water for most of the livestock raised on the few ranches in the area, but some water from wells is used to supplement surface-water supplies. Agricultural use of land in the valley is small, and the amount of water used for irrigation is minor. Water for GEVNC is supplied by the City of San Francisco. There are three wells on the site, two of which are unused, with the third being used for landscape irrigation.

Sensitive Environment

No areas of historic significance lie within the property boundary or adjacent to GEVNC, and no areas of archeological interest are on site.

The GEVNC vicinity provides potential or actual habitat for four species listed on the federal or state endangered, threatened, or rare species lists: the San Joaquin kit fox, the southern bald eagle, the American peregrine falcon, and the Alameda whipsnake.

Wetlands in the immediate vicinity are limited due to stream diversion by upstream dams and reservoirs, and by the severe lack of precipitation in this region.

No wildlife refuges are on site.

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Site Fact Sheet
Lawrence Livermore National Laboratory Site 300
California

Site Description

Lawrence Livermore National Laboratory (LLNL) Site 300 is located approximately 24 km (15 mi) southeast of Livermore (Figure LLNL-1) in the sparsely populated hills of the Diablo Range. The site covers approximately 28 km^2 (6920 acres) (Figure LLNL-2). Land use surrounding Site 300 is predominately agricultural, specifically cattle and sheep grazing. Southwest of the site is the Carnegie State Vehicular Recreation Area. South and east of the site, a corridor along Corral Hollow Road is designated as an ecological preserve. Two other smaller, privately operated defense-related research and testing facilities are located near Site 300.

The nearest urban area is the city of Tracy (population 42,000), approximately 12 km (8 mi) northeast of Site 300. Population within a 10 km (6.2 mi) radius of LLNL Site 300 is less than 1000; estimated population within a 50-km (31 mi) radius is 1.9 million.

LLNL was established at the location of a former naval air station. The University of California has managed and operated LLNL for DOE since 1952. The primary mission of LLNL has been weapons research and development, with additional work in energy, biomedical, and environmental programs. Site 300 was established in 1953 to provide a high explosives test site in support of laboratory activities. Additional activities at Site 300 include a large particle beam accelerator and environmental restoration operations. The site includes two remote firing areas and 25 magazines to store high explosives, supported by a chemistry processing area and an administrative complex.

Employees number approximately 8,000 at LLNL Livermore Site and approximately 300 at LLNL Site 300.

Institutional Factors

<u>Ownership</u>
Site 300 is owned by DOE. No LLW disposal facility is in operation at LLNL or at Site 300, and no future LLW or MLLW disposal units are currently planned. Historically, LLW has been disposed of at this site.

<u>MLLW Storage and Generation</u>
The estimated volume of MLLW inventory at LLNL is reported to be 215 m^3 with an additional 1075 m^3 anticipated to be generated through 1997.*

<u>Regulatory Considerations</u>
A Federal Facility Agreement is in place regarding MLLW management for Site 300 at LLNL.

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*1994 *Mixed Waste Inventory Report*

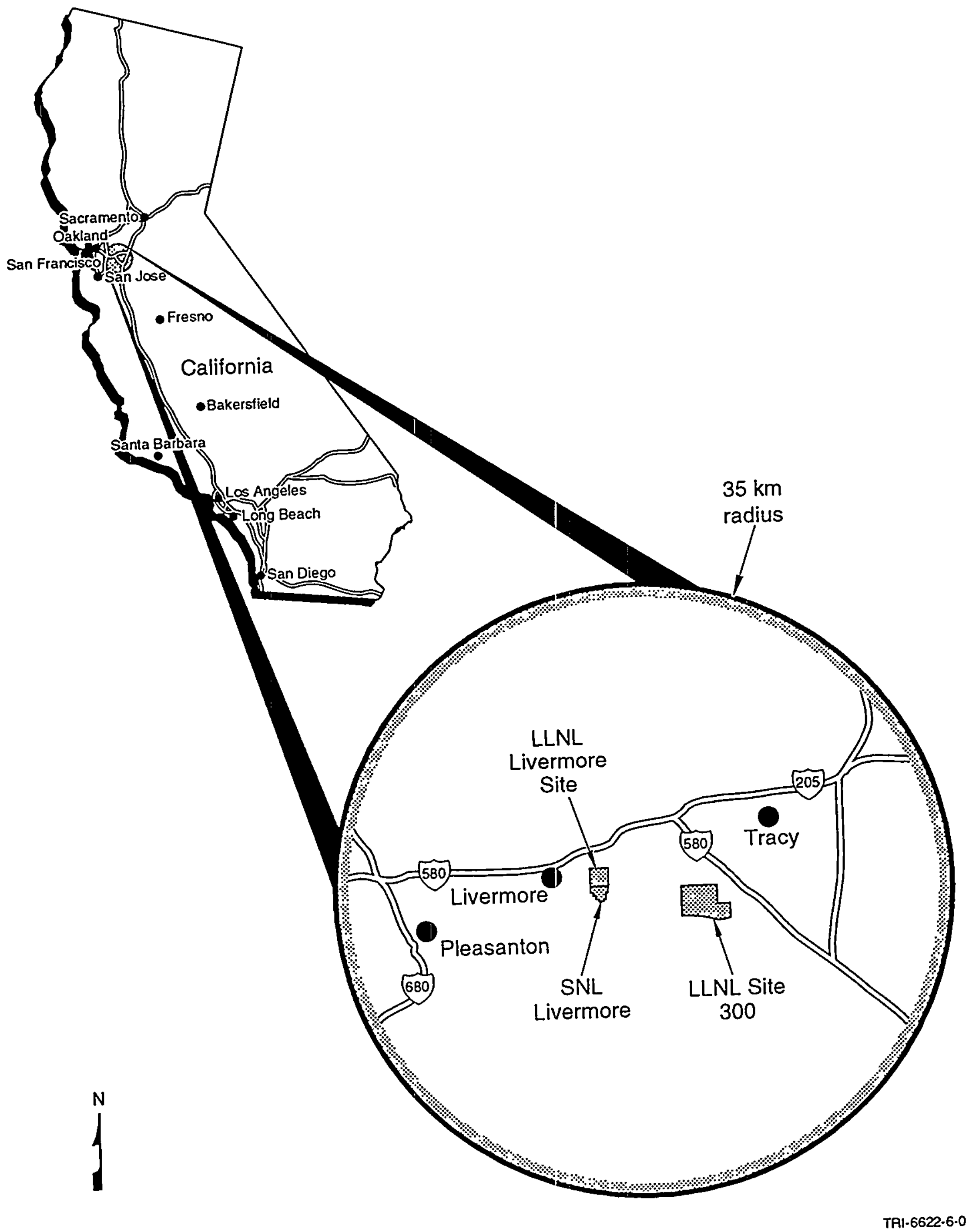

Figure LLNL-1. Location Map for Lawrence Livermore National Laboratory Site 300

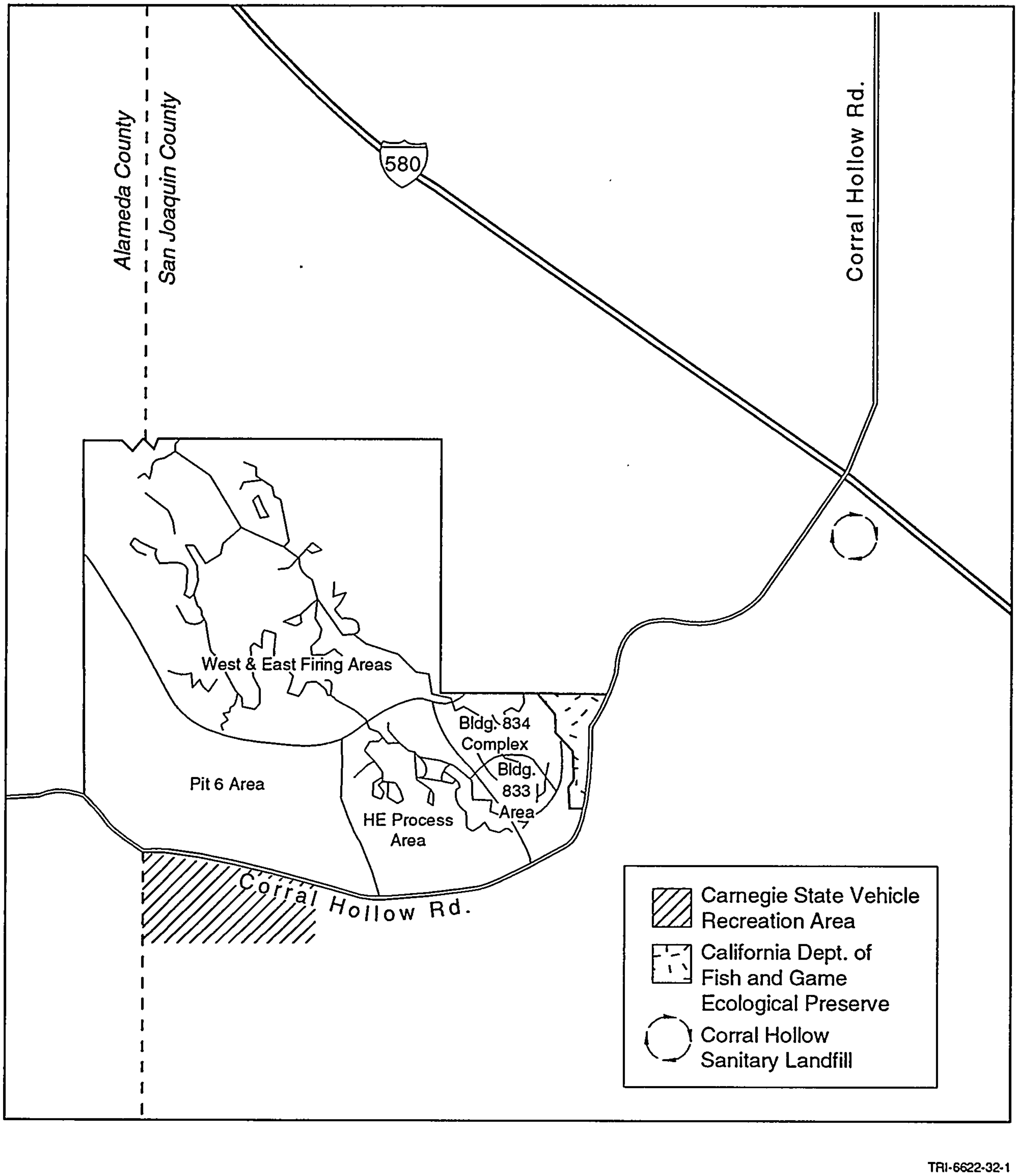

Figure LLNL-2. Site Map for Lawrence Livermore National Laboratory Site 300

Site 300 is on the Comprehensive Environmental Response, Compensation, and Liability Act National Priorities List (Superfund), and environmental restoration programs are currently being implemented.

No aquifers in this area are EPA designated sole-source aquifers.

Technical Factors

Climate
Mild winters and warm, dry summers characterize the climate of Site 300. The average annual temperature for the region ranges from 7.7° C (46° F) in January to 21.7° C (71° F) in July. The average annual rainfall at Site 300 is 25 cm (10 in). Evapotranspiration in the area is estimated at 85% of the annual rainfall or about 20 to 23 cm (8 to 9 in). However, potential evapotranspiration for the year is approximately 152 cm (60 in). For approximately 45% of the year, prevailing winds are from the west and southwest.

Geology
Site 300 is located in the California Coast Ranges geomorphic province, characterized by low rugged mountains and relatively narrow intervening valleys. Site 300 is located in the Altamont Hills, and includes steep ridges and canyons that decrease in elevation to the southeast. Site 300 ranges in elevation from 152 to 525 m (500 to 1,722 ft) above mean sea level. Slopes range from 3 degrees to greater than 45 degrees in the canyons.

Several bedrock formations underlie Site 300. These include the Panoche Formation, exposed in limited areas of the northwest and northeast corners of the site, and the Cierbo and Neroly Formations. The Miocene (24 to 5 million year old) Neroly Formation is exposed over the greatest areal extent. In addition, younger Quaternary (2 million years to recent) alluvial deposits are present onsite in limited areas.

Site 300 is located in Seismic Risk Zone 3, which means that major damage could occur from earthquakes. Three major fault systems are located in the area. Regional faults that could cause damaging ground motions within Site 300 include the San Andreas fault and its two principal branches: the Hayward and Calaveras faults. Strong earthquakes on local faults within the Altamont Hills and along the Coast Range-Central Valley margin could also cause damage at Site 300. These faults include the Greenville, Corral Hollow, Carnegie, Black Butte, San Joaquin, and Midway faults. Surface faulting could occur in areas adjacent to the Carnegie fault. The potential for damage from liquefaction is low in areas of consolidated bedrock.

The potential for slope instability in portions of Site 300 is considered moderate to high due to the presence of steep slopes and ancient landslides, the largest of which is 1.4 km^2 (0.54 mi^2) in area.

The Site 300 soils are classified as entisols. Entisols are young soils that have little or no development of the layers that make up more mature soils. Clay rich soils (vertisols) are also present and have been mapped as the Alo-Vaquero complex. Vertisols are characterized by their high clay content and display shrink-swell capability. The remaining soil types occur only in limited areas and include grassland mollisols and poorly developed inceptisols. All Site 300 soil types are potentially useful for agriculture but are constrained by location and slope. The loamy soils on site erode easily and the vertisols are subject to moderate erosion.

Potential mineral resources in the region include aggregate deposits and petroleum. Because aggregate deposits in the region are plentiful, any deposits at Site 300 are neither unique nor attractive. In addition, no commercially exploitable mineral deposits are known to exist within the Site 300 boundaries. Minor coal and gas deposits occur in the area; Tracy has numerous gas wells.

Hydrology

Surface water runoff from Site 300 occurs during the wet season with drainage largely toward the San Joaquin Valley, although a minor amount of drainage in the northwest portion may drain to Livermore Valley. Most site drainage occurs into several unnamed intermittent streams that flow through Site 300 during wet months and discharge to Corral Hollow Creek at the southern boundary of the site. Observations indicate that most water entering the stream channels infiltrates quickly. Historically, Corral Hollow Creek drained into the San Joaquin River; however, significant agricultural diversion now prevents creek water from reaching the river.

Two aquifers have been identified at Site 300. A local upper water table aquifer is present in the sandstones of the upper Neroly Formation, and a deeper confined regional aquifer is located in the Lower Neroly Formation sandstones and conglomerates just above the Neroly-Cierbo Formation contact. The deeper confined aquifer is present approximately 122 meters (400 feet) below ground surface beneath the southern part of the site within the lower Neroly Formation sandstones and conglomerates, and this aquifer provides the water supply for Site 300. Both aquifers contain permeable zones interlayered with lower permeability claystones, siltstones, and tuffs. Many of the sandstones are fine grained and silty and contain fractures. Groundwater flow occurs primarily through pores and some fractures. In addition, local perched aquifers containing small amounts of water occur in some deposits within the Neroly formation, the Pliocene non-marine sequence, and the Quaternary alluvium. These localized perched aquifers are not potential water supply sources. The groundwater table beneath Site 300 occurs at depths ranging from 7-45 m (22-150 ft).

Groundwater flow in the northern half of Site 300 is generally to the east-northeast. Flow in the southeastern quarter of the site is to the southeast, with flow in the southwestern quarter to the south. Estimated groundwater flow rates in the shallow Quaternary alluvial gravels in the southern portion range from 0.3 to 3 m/day (1 to 10 ft/day). The estimates of groundwater flow rates for bedrock aquifers at Site 300 range from about 0.002 to 1.2 m/day (0.007 to 4 ft/day).

Groundwater at Site 300 has a relatively high concentration of total dissolved solids, ranging from 400 to 4,000 ppm.

In Tracy, water for commercial, residential, and agricultural use is supplied by private wells, the California Aqueduct, and the Delta-Mendota canal. Water used at LLNL Site 300 is currently derived from two groundwater supply wells located in the southeastern part of the site. Shortly, Site 300 water will be imported from the Hetch-Hetchy aqueduct. Another potable water supply well is located off-site on State land near the south central border of LLNL Site 300. This well supplies water to the Carnegie Vehicle Recreation Park. Four off-site wells are located south of Site 300 on private rangeland. Two of the wells are inactive, one operates intermittently to supply the nearby Castle Rock Dept. of Forestry Fire Fighting Station, and the other pumps to nearby Connolly Ranch for livestock watering.

Sensitive Environment

Archaeological surveys conducted at Site 300 resulted in the location of 29 archaeological sites: 7 prehistoric, 21 historic, and 1 multicomponent site. Limited ethnographic and archaeological research conducted in this geographic region indicates that Site 300 is within the ethnohistoric tribal boundaries of two prehistoric California Native American groups. During the Hispanic and American historic periods (ca. 1750-1930), grazing and coal and clay mining were established in Corral Hollow Canyon. Three company towns were built in the Canyon to support the mines and factories. The residential portion of the largest town, Carnegie (population 2,500), was located inside the southern boundary of Site 300 and south of Corral Hollow Road. Currently, Site 300 archaeological sites are undergoing review and significant evaluation in order to determine eligibility for listing on the National Register of Historic Places.

Three paleontological sites are located on LLNL's Site 300. One site consists of a Pleistocene mastodon bone while the second site contains the fossilized fragmented remains of late Miocene mastodons, horses, bear-dogs, and camels. The third site, consisting of a deposit of mollusk fossils, has not yet been documented or investigated.

Three species on the Federal Endangered Species List (two endangered and one threatened), one proposed endangered species, and 12 candidate species have the potential to occur at LLNL Site 300. Operations at Site 300 are conducted with mitigation measures identified in environment impact statements.

At Site 300, wetlands total approximately 0.03 km^2 (6.8 acres). The 0.02 km^2 (5.0 acres) of natural wetlands consist of a number of small, widely dispersed wetlands that primarily occur at springs in the bottoms of some of the steep canyons onsite. The 0.007 km^2 (1.8 acres) of artificial wetlands are created by surface water runoff from four buildings and typically occur in drainage ditches along roads or on banks near the buildings.

South and east of the site, a corridor along Corral Hollow Road is owned by the state and is designated as a State Ecological Preserve. Southwest of the site is the Carnegie State Vehicular Recreation Area.

Sources

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Site Fact Sheet
Rocky Flats Environmental Technology Site
Colorado

Site Description

The Rocky Flats Environmental Technology Site (RFETS) is located in northern Jefferson County, Colorado (Figure RFETS-1), approximately 26 km (16 mi) northwest of Denver. Adjacent land use is a mixture of agriculture, open space, industry, and low-density residential housing.

The RFETS is located on approximately 26.3 km^2 (6,550 acres) (Figure RFETS-2). Primary facilities are located on approximately 1.6 km^2 (385 acres) near the center of the RFETS plant site within a fenced security area. The remaining plant area contains limited support facilities and serves as a buffer zone to former major production areas.

The largest towns in the area are Denver (population 468,000), about 26 km to the southeast and Boulder (population 83,500), about 20 km to the northwest. Westminster (population 74,500), Arvada, and Superior are the major residential centers within a 10 km (6.2 mi) radius. Estimated population within a 10-km radius of the RFETS is 76,000; estimated population within a 50 km (31 mi) radius is 1.8 million.

The historical mission of the Rocky Flats Environmental Technology Site has been to develop and fabricate nuclear weapons components from radioactive and nonradioactive materials. The plant was responsible for fabricating plutonium, uranium, beryllium, and stainless steel. This mission changed in January 1992 when certain planned weapons systems were cancelled. Rocky Flats is now in transition to a new mission focusing on environmental restoration, waste management, decontamination and decommissioning, and economic development. Employment at the RFETS is approximately 6830.

Institutional Factors

Ownership
The RFETS is owned by the DOE and operated by EG&G/Rocky Flats.

No LLW disposal facility is operating at the RFETS, but several inactive areas are under evaluation for remedial closure.

MLLW Storage and Generation
The current MLLW inventory is estimated to be 56,029.6 m^3. Future generation volumes through 1997 are anticipated to be 3,369 m^3.*

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*1994 *Mixed Waste Inventory Report*

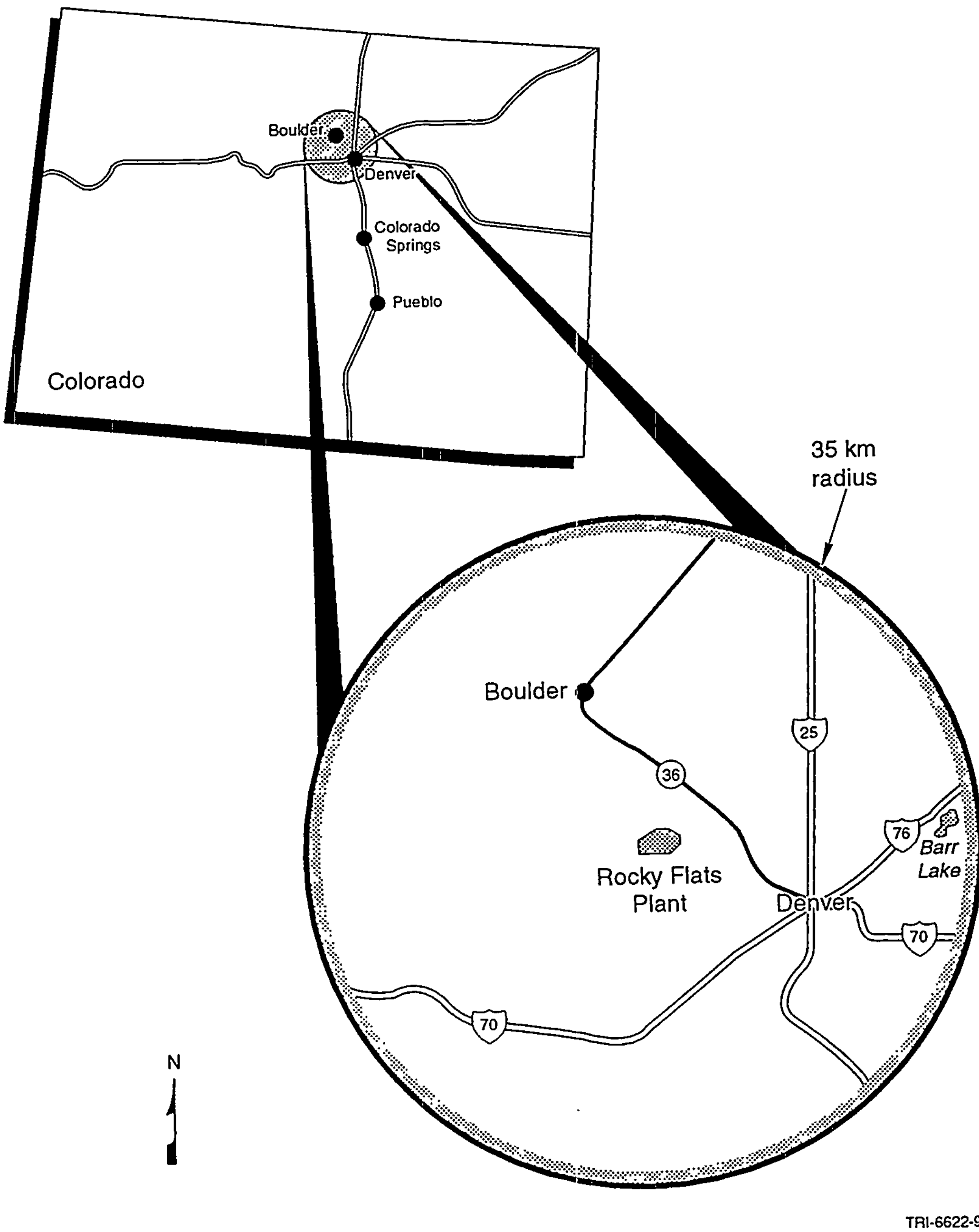

Figure RFETS-1. Location Map for Rocky Flats Environmental Technology Site

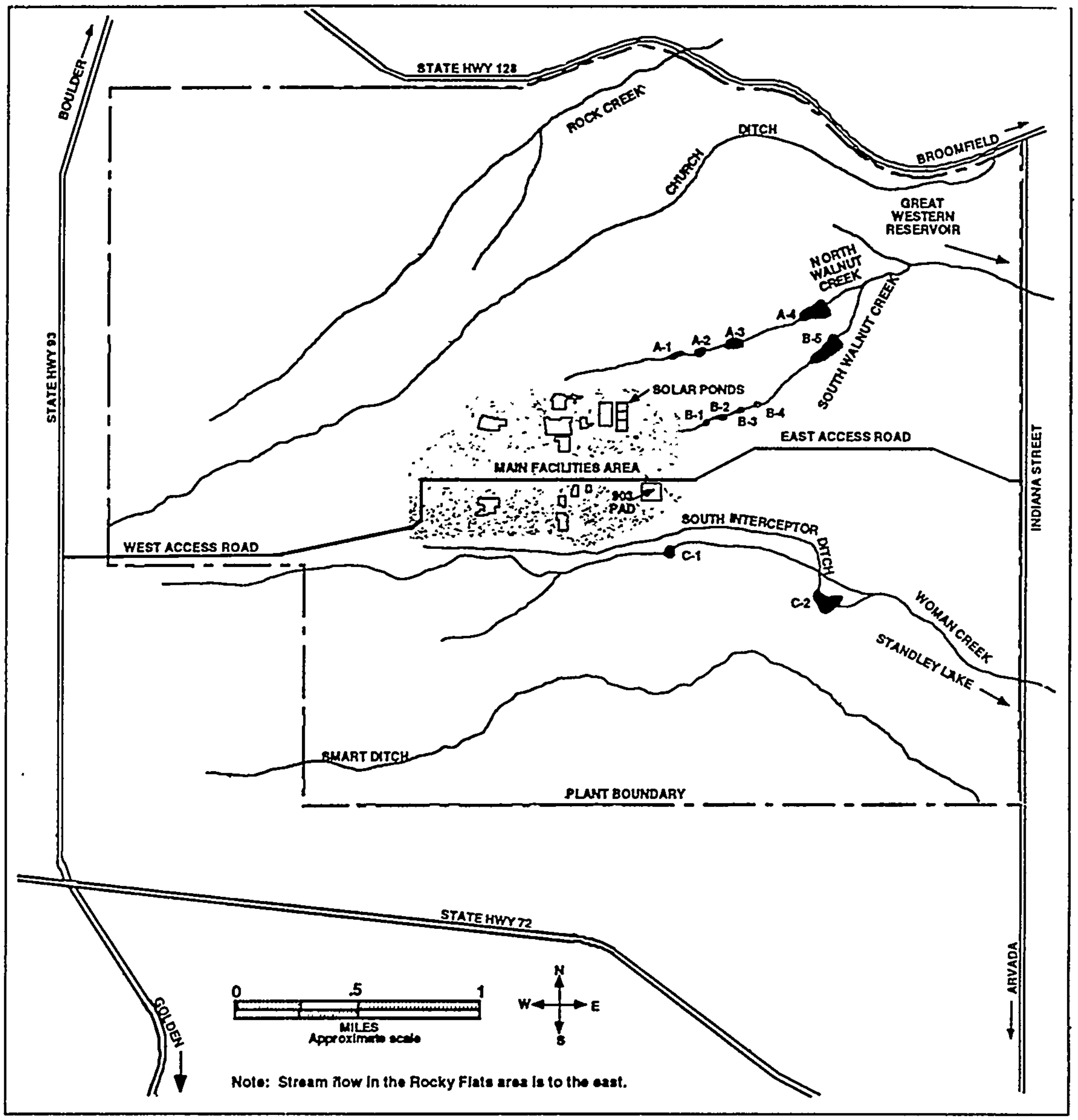

Figure RFETS-2. Site Map for Rocky Flats Environmental Technology Site

Regulatory Considerations
A Federal Facility Compliance Agreement II (FFCAII) was signed by DOE and EPA in May 1991. After expiration in May 1993, negotiations for FFCAIII continued. Pending the new agreement, Rocky Flats continues waste management in accordance with FFCAII. In April 1993, a Settlement Agreement and Compliance Order on Consent No. 93-04-23-01 was signed. Under the settlement agreement, DOE implements the Mixed Residue Reduction Program to process the backlog of mixed residues into a shippable or disposable form, and to remove mixed transuranic wastes as expeditiously as possible after a final offsite disposal facility becomes available. In January 1991, the Interagency Agreement for Environmental Restoration Activities at Rocky Flats was signed by DOE, EPA, and the State of Colorado, establishing time lines for study and cleanup of past contamination at Rocky Flats. This agreement is currently being renegotiated.

No aquifers in this area are EPA designated sole-source aquifers.

Technical Factors

Climate
The climate at RFETS is temperate and semiarid, characteristic of Colorado's Front Range. Elevation and major topographical features significantly influence climate and meteorological dispersion characteristics of the RFETS site. Maximum and minimum temperatures average 24°C (76° F) and -5° C (22° F), respectively. Annual average temperature is 9° C (48° F). Annual precipitation is nearly 41 cm (16 in), with more than 40% occurring from April through June. Evapotranspiration in the area is estimated at 60% of the annual rainfall or about 25 cm (10 in). Winds, although variable, are predominately west northwesterly toward Westminister, Arvada and Denver. Daytime winds at the RFETS frequently blow from the northeast and southeast; nighttime winds blow from the southwest and northwest.

Geology
The RFETS lies 6 km (4 mi) east of the Front Range section of the southern Rocky Mountains along the western edge of the Colorado Piedmont section of the Great Plains physiographic province.

The area is underlain by the Denver Basin, which contains more than 10,000 feet of sedimentary rocks deposited 310 million to 65 million years ago that have been locally folded and faulted. The sedimentary bedrock is overlain by alluvial gravels deposited during the last 1.8 million years that cap erosional surfaces of several distinct ages. The RFETS is situated on the Rocky Flats Alluvium, an alluvial fan deposit, that varies in thickness from approximately 31 m (103 ft) to less than 3 m (10 ft) and provides a gravel cover over the bedrock.

Located at an elevation of approximately 1830 m (6,000 ft), the RFETS is on the eastern edge of a geological bench known locally as Rocky Flats. This bench is approximately 8 km (5 mi) wide in an east-west direction. To the east, topography slopes gradually at an average downgrade of 18 m/km (95 ft/mi). Approximately 32 km (20 mi) to the west, the continental divide rises to elevations exceeding 4270 km (14,000 ft). The dominant surface deposit in the area is alluvium that has been locally dissected and reworked by stream processes. These processes have formed moderately steep hill slopes adjacent to intermittent streams that drain the area.

The region has a history of episodic structural deformation and stable sediment accumulation. Deformation from 75 million to 58 million years ago is responsible for most of the major structural elements in the region. The Denver Basin has a steeply inclined western flank that abuts the southern Front Range along a zone of related boundary (possibly reverse) faults. In northern Jefferson County, the trend of the western flank of the Denver Basin changes abruptly from north-northwest to nearly due north. The location of this shift is coincident with pre-existing structural trends, such as the northeast-trending Idaho Springs-Ralston Shear Zone. The site is located in Seismic Risk Zone 1, which means that minor damage could occur from earthquakes.

The surface soils at RFETS are chiefly moderately deep, well-drained clay, cobbly clay, and sandy loams, with moderate-to-low permeability. Soils with high shrink-swell potential are common in the areas near RFETS because of the high content of montmorillonitic clays. Soils that cover the largest areas of the RFETS buffer zone are categorized as montmorillonitic. Shrink-swell potential for most RFETS soils is categorized as moderate in the surface and high in the subsoil. Erosion potential is low for much of the western portion of the buffer zone, where the soils are flat lying and coarse fragments are very common at the surface. In the eastern portion of the buffer zone, soils have fewer coarse fragments and are steep (25% slopes). The erosion potential here is generally moderate, although substantial in some places.

Open pit gravel mining is currently conducted by a private company in the western portion of the RFETS buffer zone. Mining operations are conducted on approximately 0.9 km^2 (215 acres) of Rocky Flats property.

<u>Hydrology</u>
Surface drainage on the RFETS generally occurs west to east along intermittent streams. The industrial area of the plant is situated on an interfluve bounded on the north by the Walnut Creek drainage and on the south by the Woman Creek drainage. Most of the runoff from the plant area enters the Walnut Creek drainage and is captured in holding ponds. The Woman Creek drainage is isolated from the southern portion of the plant by an interceptor ditch, which diverts runoff to an off-line holding pond. The water in the holding ponds for both Walnut Creek and Woman Creek is tested and discharged to the Broomfield Diversion Ditch, which bypasses Great Western Reservoir, a municipal water supply. Woman Creek, isolated from plant runoff, flows offsite into Mower Reservoir. Occasionally during storm events or spring snow melt, Woman Creek flows will reach Standley Lake Reservoir, also a municipal water supply. Rock Creek drains the buffer zone to the north of Walnut Creek. Smart Ditch drains the buffer zone south of Woman Creek. Neither of these streams is considered to be impacted by plant operations. The elevation of the area is approximately 1,830 m (6,000 ft), well above the 500-year floodplain elevation.

Groundwater systems consist of a shallow, unconfined (20-40 feet below the surface) system in the Rocky Flats Alluvium and valley fill deposits, and a confined system in deeper sandstone units (130-200 feet below the surface) within the underlying bedrock. Infiltration rate of soils at RFETS is high and has been reported at rates of up to six inches per hour. When the field capacity of the soil has been reached, water moves downward toward the water table. The flow of groundwater in the Rocky Flats Alluvium is locally controlled by the topography and below-surface sandstone paleochannels; flow is generally eastward. Groundwater flows from the Rocky Flats Alluvium is to seeps and springs or into the valley fill alluvium, or is evapotranspired. The movement of groundwater to and from the valley fill alluvium varies along the length of the valleys. In the upper reaches, where the valley fill overlies the Rocky Flats Alluvium, water moves from the valley fill downward into the Rocky Flats Alluvium. Downstream, where the valley fill lies below the base of the Rocky Flats Alluvium, water from the Rocky Flats Alluvium recharges the valley fill. The valley fill alluvium is usually better sorted than the Rocky Flats Alluvium and is therefore more permeable. Pore velocities range from 4.5 to 7.5 m/day (15 to 25 ft/day), depending on hydraulic gradient. Sandstones of the Arapahoe Formation are recharged by downward movement of water from the overlying alluvia. Arapahoe sandstones are in hydraulic connection with the Rocky Flats Alluvium to the west of the plant site on the interfluve. Water movement on a regional basis is generally from west to east.

All water utilities in the area utilize surface water sources except for Brighton and the South Adams County Water and Sewer District, which use groundwater.

<u>Sensitive Environment</u>
No national historic sites have been designated at the RFETS. Archeological sites are not anticipated to be an impediment for site development at the RFETS.

Access to the RFETS site is strictly limited to authorized personnel. Therefore, recreational use of the area is precluded.

Bald eagles are found just off site, and RFETS is a suspect forage area for bald eagles.

The site is generally well drained with no designated wetlands. The RFETS does not include any wildlife refuges.

Sources

Rocky Flats Plant Site Environmental Report, 1991, EG&G Rocky Flats.

Site Fact Sheet
Pinellas Plant
Florida

Site Description

The Pinellas Plant is located near the center of Pinellas County, Florida (Figure PIN-1), between the cities of Clearwater and St. Petersburg in the unincorporated Greater Seminole Area, adjacent to the northwestern city limits of Pinellas Park. Pinellas County is the most densely populated county in Florida with over 850,000 people, and is located on a peninsula bordered by the Gulf of Mexico to the west and Tampa Bay to the east and south. Land use in the area is urban. Transportation facilities include the CSX Railroad, which passes the southwestern boundary of the site, US Route 19, just east of the facility, and Interstate Route 275, still further east. The site consists of approximately 0.4 km^2 (100 acres) with 24 buildings. Most of the buildings are located within an area of 0.22 km^2 (55 acres), while the remaining area is essentially open space (Figure PIN-2). A child care center is located adjacent to the plant.

The population within 10 km (6.2 mi) of the site is estimated to be 213,500, and includes Clearwater (98,800), Palm Harbor (50,500), Dunedin (34,000), Largo (65,700), Pinellas Park (43,500), and several towns with populations less than 20,000. Within 50 km (31 mi) of the site, the estimated population is 1,141,300. Included in this area are the cities of Tampa (280,000), Saint Petersburg (238,600), Bradenton (73,800), and Brandon (58,000).

Pinellas is operated by Martin Marietta Specialty Components, Inc., and its current mission involves small volume production of nonnuclear components for nuclear weapons. Employment at the Pinellas Plant is approximately 1,150.

Institutional Factors

Ownership
The Pinellas Plant is owned by the DOE. Under the Nonnuclear Consolidation Plan of DOE's Nuclear Weapons Reconfiguration Program, the Pinellas Plant is scheduled to cease Defense Programs operations in September 1994. The plant will transition to Environmental Management in October 1994 and has begun an Economics Development Program to convert its personnel and equipment to private sector use.

MLLW Storage and Generation
No MLLW is currently being stored at Pinellas.* A small amount of MLLW was generated at the Pinellas Plant. This waste was recently shipped to an off-site laboratory for a treatability study to determine the potential for future treatment options. The treatability study was successful and the material met the Land Disposal Restriction requirements, as all hazardous constituents were destroyed. The material is no longer considered a mixed waste. However,

*1994 *Mixed Waste Inventory Report*

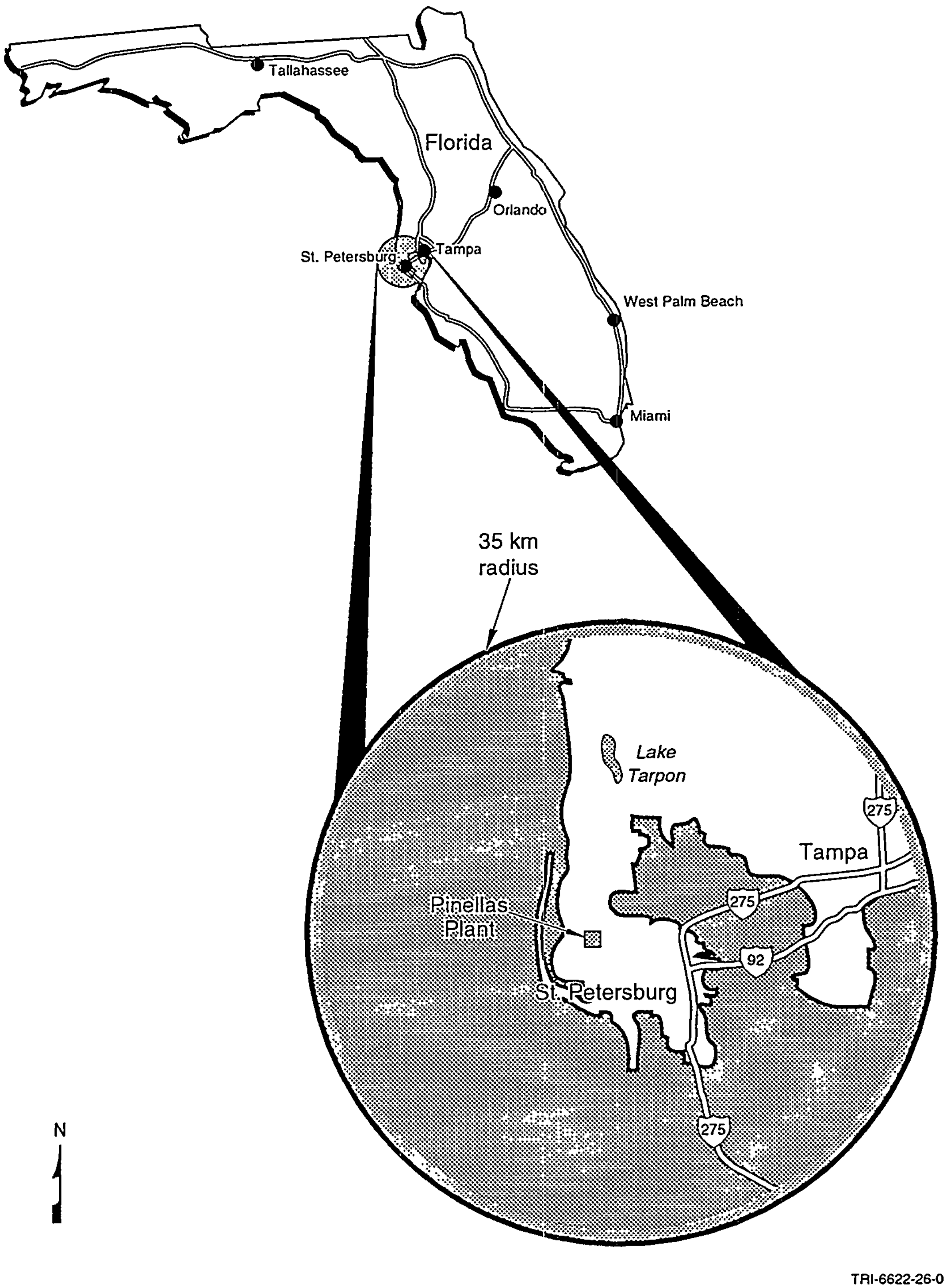

Figure PIN-1. Location Map for Pinellas Plant

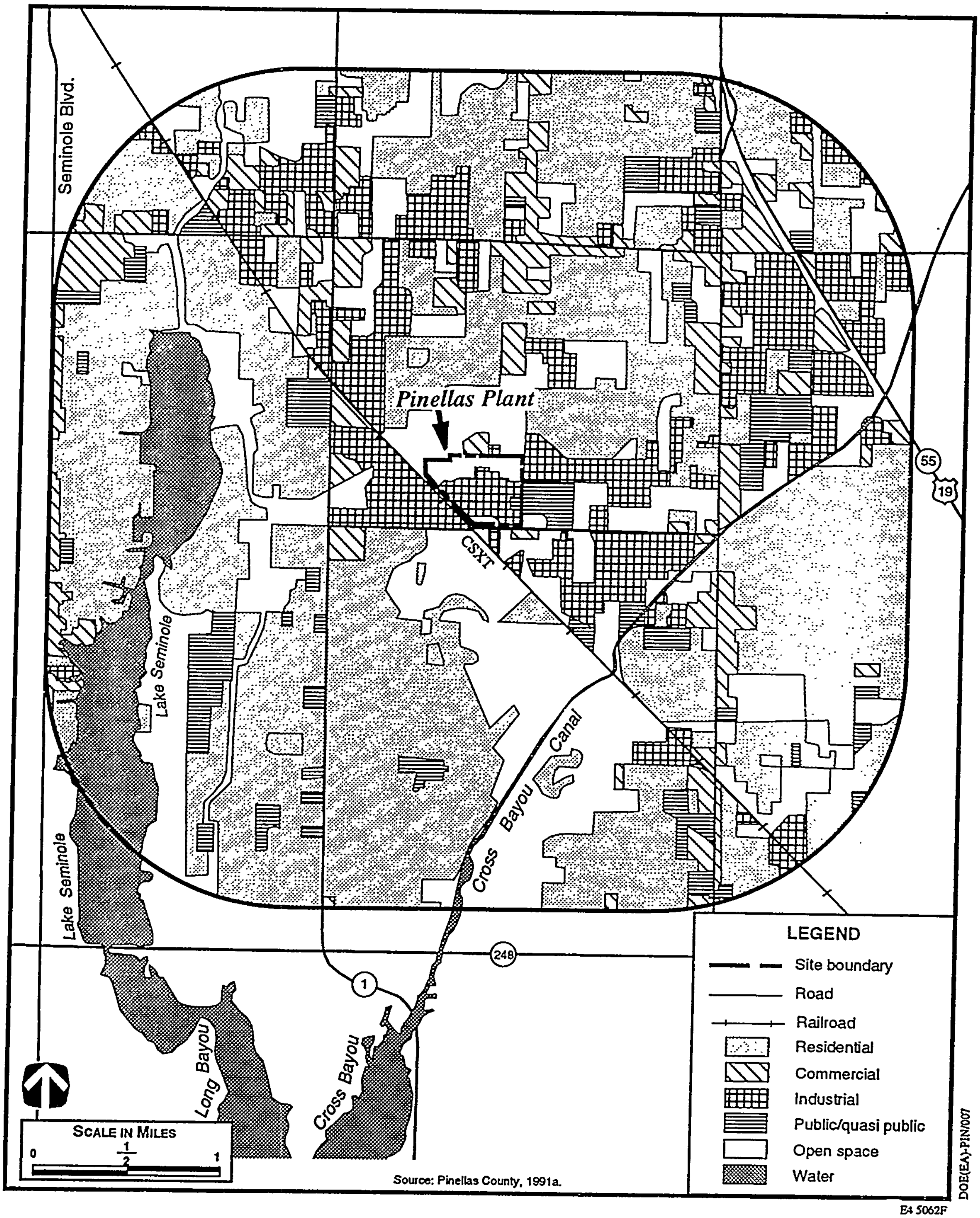

Figure PIN-2. Site Map for Pinellas Plant there is a potential for future MLLW generation from decontamination and decommissioning activities at the site.

Regulatory Considerations
There are no federal or cooperative agreements in place regarding MLLW management or facility siting at Pinellas.

No aquifers in this region are EPA designated sole-source aquifers.

Technical Factors

Climate
The climate at Pinellas and in the surrounding region is subtropical marine, characterized by long, humid summers and mild winters. The annual average temperature in the area is 22° C (72° F); temperatures vary from an average daily minimum of 9° C (49.5° F) in January to a maximum of 32° C (90° F) in August. Annual average precipitation is 119 cm (47 in), with most occurring between June and September. Evapotranspiration is estimated to be 75% of annual precipitation or about 89 cm (35 in). The prevailing wind is from the north and northeast in the winter and the east and south in the summer, averaging 15 km/h (9 mph). Hurricane and tornado watches can occur during the summer season, with the potential for severe weather.

Geology
Pinellas Plant lies on the Floridan Plateau of the Florida Peninsula. Deposited within the last 55 million years, rock types include limestone and dolomite interbedded with sands and clays. The site lies on a low relief surface north of St. Petersburg. No major geologic structural features are located in the area.

Pinellas is underlain by soils consisting of mixed sand, clay, and hard rock. Below that, the soils consist of poorly drained, fine sandy soils formed in thick beds of acid marine sands and beds of sandy and loamy sediments. Because of the low relief and relatively high water saturation of these soils, they are not subject to water or wind erosion. Sinkholes are not uncommon in Florida in areas where limestone layers are near the surface; however, the depth of the limestone layers below the water table and land surface renders sinkhole collapse unlikely at Pinellas.

The site is located in Seismic Risk Zone 0, which means that no damage is expected from earthquakes. The most severe earthquake within a 322 km (200 mi) radius occurred near St. Augustine in 1879, 260 km (160 mi) northeast of the plant, and had a magnitude of 4.

No mined or drilled natural resources are located on the site.

Hydrology
Pinellas is approximately 7 km (4.4 mi) west of Tampa Bay and 11.7 km (7.3 mi) east of the Gulf of Mexico. The nearest major water body is Lake Seminole (1.6 km to the west), which does not have open access to the Gulf or Tampa Bay. The land elevation at the plant is 5.5 m

(18 ft) above mean sea level, which is higher than the 100-yr floodplain and higher than the highest recorded storm surge in Pinellas County. Due to the distance and the number of natural barriers between Pinellas and the Gulf of Mexico and Tampa Bay, it is not likely that storm-generated wave activity could inundate the plant.

Aquifers underlying Pinellas include a surficial unit 1.5 to 11 m (5 to 35 ft) below the ground surface and the deeper Floridan Aquifer, 30 m (100 ft) below ground, separated by the Hawthorn Formation, a clay of low hydraulic conductivity. Infiltrating rainfall provides recharge to the surficial aquifer.

A groundwater divide crosses the site northeast to southwest. Groundwater flow in the surficial aquifer is from the divide toward discharge points along three surface channels. The water table of the surficial aquifer is found a few feet below the ground surface. The water table fluctuates 0.3 to 1.5 m (1 to 5 ft) seasonally.

The Floridan Aquifer is an extensive water-bearing carbonate unit throughout west-central Florida. It is the primary source of water supply in the Pinellas County area. Well fields are located in Pasco and Hillsborough counties that supply the various communities with domestic and industrial water. Both the surficial aquifer and the Floridan Aquifer are classified as Class IIa, defined as current sources of drinking water and waters having other beneficial uses.

Sensitive Environment

No historic or archeological resources have been identified at the site.

There are no federal, state, or county parks, monuments, or preserves on or adjacent to the site.

The Osprey, which has a nest on-site, is a federally designated species of special concern and is a state designated candidate protected species.

Two man-made ponds, the East Pond near the northeastern corner of the site and the West Pond near the northwestern corner of the site, are designated as wetlands.

A child care center is located adjacent to the plant.

Sources

Annual Site Environmental Report CY 92.

Non-Nuclear Consolidation Environmental Assessment, DOE/EA-0792, June 1993.

Pinellas Plant--Environmental Restoration Program Solid Waste Management Units Information Booklet.

Child Development Center Environmental Assessment.

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Site Fact Sheet
Idaho National Engineering Laboratory/
Argonne National Laboratory—West
Idaho

Site Description

Idaho National Engineering Laboratory (INEL) is located in two primary areas: the remote area known as "the Site" along the northwestern edge of the Eastern Snake River Plain in southeastern Idaho, and multiple locations east of the Site in the City of Idaho Falls (Figure INEL-1). Lying at the foot of the Lost River, Lemhi, and Bitterroot-Centennial Mountain ranges, the Site covers nearly 2300 km^2 (890 mi^2) (Figure INEL-2) of dry, cool desert. Most of the land withdrawn from public domain for use by the DOE is undeveloped. The facilities located in Idaho Falls include administrative, scientific support, and nonnuclear research laboratories.

The town nearest to INEL is Atomic City, which is less than 1.5 km (1 mi) from the southern boundary and has about 25 residents. Arco, 11 km (7 mi) to the west, is the largest boundary community with 1100 residents. The largest population centers near INEL are Blackfoot with 9700 residents, 37 km (23 mi) to the southeast; Idaho Falls with 44,000 residents, 35 km (21 mi) to the east; and Pocatello with 46,000 residents, 71 km (44 mi) to the south. Overall, approximately 121,000 people reside within an 80-km (50-mi) radius of the INEL operational center. Estimated population within a 10-km radius of Central Facilities Area (CFA) is less than 1000.

During World War II, the U.S. Navy and U.S. Army Air Corps used a portion of the present Site as a gunnery range. In 1949, the Site was formally established as the National Reactor Testing Station, where the Atomic Energy Commission built, tested, and operated various types of nuclear reactors. As of April 1991, 52 reactors had been built at INEL; of these, 13 were operating or operable.

INEL is a multiprogram laboratory and has provided innovative nuclear technologies, defense related support, and unique scientific and engineering capabilities to the nation. Current areas of primary emphasis include nuclear reactor technology research and development, waste management and environmental restoration, advanced energy production and utilization technology development, defense related support, technology transfer, and nonnuclear research and development projects. As of February 1994, employment at INEL was estimated to be 11,400, of which approximately 7300 employees are located at the Site.

Mission activities, including those associated with DOE's Environmental Restoration and Waste Management, occur primarily on nine major facility areas that were developed when the Site was established.

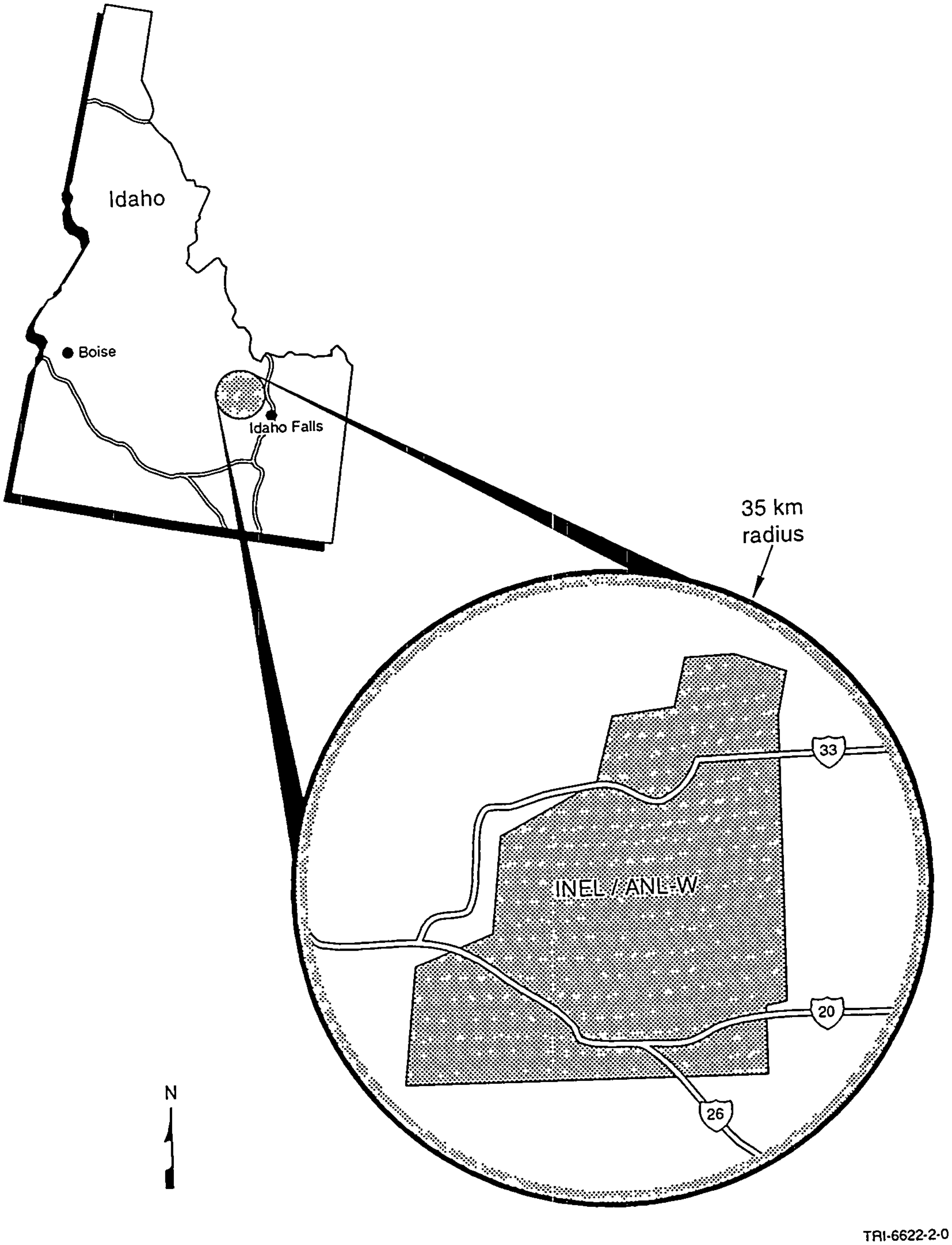

Figure INEL-1. Location Map for Idaho National Engineering Laboratory/ Argonne National Laboratory-West

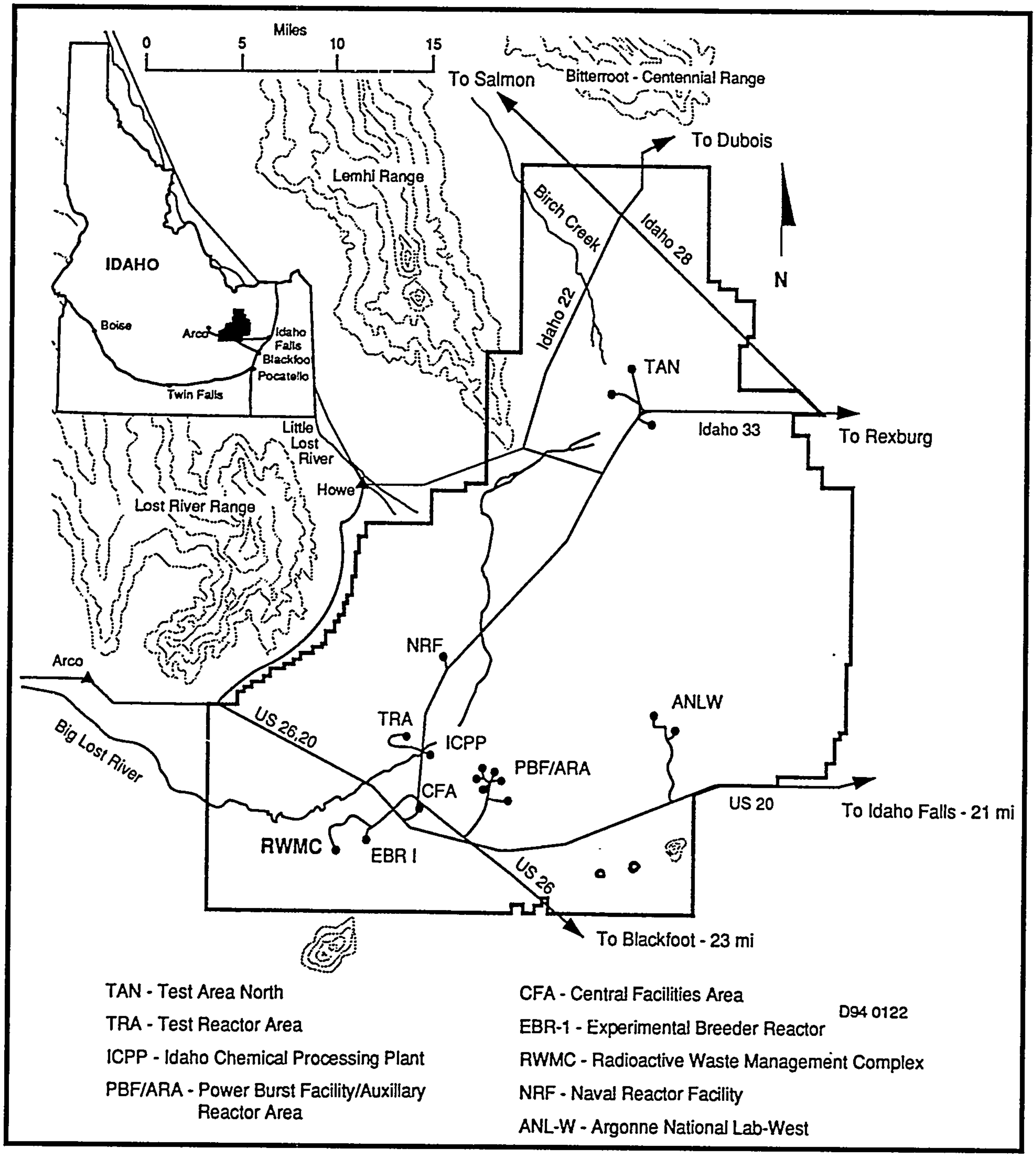

Figure INEL-2. Site Map for Idaho National Engineering Laboratory/ Argonne National Laboratory-West

Institutional Factors

Ownership

The INEL Site is located within the Medicine Lodge Resource Area (eastern and southern portions of the INEL Site) and the Big Butte Resource Area (central and western portions), both of which are administered by the Bureau of Land Management.

According to planning documents, energy research and waste minimization activities would continue in existing facilities and, in some instances, expand into currently undeveloped Site areas. Projected future land use scenarios for the next 25 to 30 years include outgrowth of current functional areas.

INEL is managed by DOE and administered by three DOE operations offices: the Idaho operations office; the Idaho branch office of Pittsburgh Naval Reactors; and the Chicago operations office.

At present, one LLW disposal facility is operating at INEL. The Radioactive Waste Management Complex was established in 1952 as a controlled area for disposal of defense wastes (mostly transuranic), solid low-level radioactive waste, and mixed waste generated at INEL. Since 1970, transuranic waste has been stored above ground in specially designed storage facilities, and no mixed waste has been disposed at the Radioactive Waste Management Complex since April 1984. The current purpose of the facility is to provide waste management, interim storage of transuranic waste, and disposal of low-level waste generated at INEL.

The Radioactive Waste Management Complex encompasses 0.5 km^2 (144 acres) and consists of two main disposal and storage areas: the Transuranic Storage Area and the Subsurface Disposal Area. Within these areas are smaller, specialized disposal and storage areas. INEL currently has no disposal facility available for MLLW.

MLLW Storage and Generation

Most of the MLLW currently stored at INEL is alpha MLLW shipped by off-site generators to INEL for storage and treatment. Currently, MLLW is accepted at INEL for storage and disposal from INEL contractors only. Approximately 25,495.3 m^3 of MLLW is stored at INEL, with approximately 2,460 m^3 of MLLW expected to be generated through 1997.*

MLLW at INEL is managed according to Resource Conservation and Recovery Act requirements. MLLW is generated at Test Area North, Test Reactor Area, Idaho Chemical Processing Plant, Central Facilities Area, Power Burst Facility, Radioactive Waste Management Complex, Naval Reactors Facility, Argonne National Laboratory-West, and the Idaho Falls Facility. Sources of MLLW include environmental restoration, decontamination and decommissioning, production operations, laboratory activities, construction maintenance, and research and development activities.

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*1994 *Mixed Waste Inventory Report*

Regulatory Considerations
A Federal Facility Agreement and Consent Order was signed in 1991 by the State of Idaho, EPA Region 10, and DOE. The order addresses environmental remediation activities in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and Recovery Act; and the Idaho Waste Management Act.

No on-site land use restrictions due to Native American treaty rights exist.

The groundwater underlying INEL is part of the Snake River Plain Aquifer, which in 1991 became an EPA-designated sole-source aquifer.

Technical Factors

Climate
The INEL climate is semiarid, with sagebrush-steppe characteristics. The temperature extremes recorded at INEL vary from -42°C (-43°F) in January to 39°C (102°F) in July. During the winter, the average temperature ranges from -16° to -3°C (3° to 27°F). For summer, the average temperature varies from 10° to 31°C (50° to 87°F).

The average annual precipitation at INEL is 22 cm (8.5 in). The highest annual amount of precipitation recorded was 36.6 cm (14.4 in), and the lowest amount was 11.4 cm (4.5 in). Snowfall ranges from 17 to 152 cm (6.7 to 59.8 in) per year, with an average of 70 cm (27.6 in). Average annual evaporation from shallow lakes in the area could be as much as 91 cm (36 in).

The potential annual evaporation from a saturated ground surface at INEL is approximately 91 cm (36 in), with 80% of evaporation occurring between May and October. For evaporation from surface water bodies (ponds), a pan evaporation rate of approximately 109 cm/yr (43 in/yr) has been established. Transpiration by the native vegetation of the Snake River Plain is estimated to be 15 to 23 cm/yr (5.9 to 9.1 in/yr).

INEL is in a belt of prevailing westerly winds that is channeled within the Eastern Snake River Plain. The record of average wind speed shows a minimum of 8 kph (5 mph) in December and a maximum of 14.5 km/h (9 mph) in April and May. The highest wind speed based on the maximum hourly average is 82 km/h (51 mph), measured at approximately the 6-m (20-ft) level from the west-southwest.

Geology
The Eastern Snake River Plain truncates basin and range structures on the northwest and southeast with approximately 1200 to 1400 m (4000 to 4600 ft) of relief between the ranges and relatively flat plain. The Eastern Snake River Plain contains a substantial volume of silicic and basaltic volcanic rocks with relatively minor sediments, except along its margins where drainages emerge from the neighboring highlands. The basalts have displaced the Snake River southward

to its present course. Although basalt covers three quarters of INEL's surface, rhyolite and ash flow tuffs beneath the basalt are more voluminous.

Little Lost River and Birch Creek descend southeast to the plain in a broad valley floored with alluvium, and Big Lost River, which enters INEL from the west, also descends on a broad alluvial-filled valley. The valleys trend northwest following the folding and faulting in the mountains. Faults showing late movement at the base of the mountains are common.

Most of INEL is located in Seismic Risk Zone 2B, which means that moderate damage could occur from earthquakes. A small portion of INEL is located in Zone 3, which means that major damage could occur from earthquakes. Three Quaternary (2 million years ago to recent) faults; Lost River, Lemhi, and Beaverhead, are located at the western boundary of INEL. The distribution of earthquakes at and near INEL from 1884 to 1989 clearly shows that the plain has a remarkably low rate of seismicity, whereas the surrounding basin has a fairly high rate of seismicity.

Volcanic hazards at INEL can come from sources inside or outside the Eastern Snake River Plain's boundaries. Most of the basalt volcanic activity occurred from 4 million to 2,100 years ago at the Craters of the Moon, 25 km (15 mi) southwest of INEL. The rhyolite domes along the Axial Volcanic Zone formed between 1.2 and 0.3 million years ago and have a recurrence interval of about 200,000 years. Therefore, the probability of future dome formation affecting INEL is very low.

Catastrophic Yellowstone eruptions have occurred three times in the past 2 million years, but INEL lies more than 112 km (70 mi) from the Yellowstone Caldera rim, and high-altitude winds would not disperse Yellowstone ash in the direction of INEL. For these reasons of infrequency, great distance, and unfavorable dispersal, pyroclastic flows or ash fallout from future eruptions are not expected to impact INEL.

The surface of much of the Eastern Snake River Plain is covered by waterborne and windborne soils derived primarily from Cenozoic (65 million years ago to recent) volcanic and Paleozoic (570 to 245 million years ago) sedimentary rocks from the surrounding mountain ranges (Lost River, Lemhi, and Bitterroot-Centennial). Underlying the plain are layers of interbedded volcanic and sedimentary rocks, principally basaltic lava with interbeds of sedimentary materials.

A typical soil association occurring on a lava flow consists of three to four soil series differentiated from one another largely on the basis of soil depth. INEL landscapes are covered with a thin to thick blanket of wind-borne sediments, which are deposited in episodes associated with climatic cycles. The thickness of these sediments on INEL is generally less than 2.1 m (7 ft) and commonly between 30 to 90 cm (1 to 3 ft). Quaternary geologic and Holocene (10,000 years ago or less) archaeologic data suggest the INEL area will continue its long-term history of regional subsidence and net accumulation of sedimentary and volcanic material, although sedimentation patterns on the Eastern Snake River Plain will change in response to future climate fluctuations.

The only potential natural resources other than water that might be explored beneath INEL are sand, gravel, pumice, silt, clay, aggregate for road construction and maintenance, and ornamental landscaping cinders.

Hydrology

Surface water on INEL comes from streams draining through intermountain valleys to the west and northwest, localized snowmelt, and rain. Streams entering INEL include the Big Lost River, Little Lost River, and Birch Creek. Flows from these streams are generally diverted for irrigation before reaching INEL. Thus, during dry years, water from these streams does not reach INEL. These three drainages are part of a closed basin with no outlet. The drainages terminate in four playas in the north-central part of INEL. As a result of the closed basin, when water does flow onto INEL, it either evaporates or infiltrates into the ground.

A diversion system has been installed on the Big Lost River shortly below where it enters INEL. This diversion system is designed as a protective system to allow redirection of any large flows that might occur on the Big Lost River. Water is routed to four large spreading areas in the southwest part of INEL. In this way, INEL facilities downstream from the diversion can be protected from possible extreme spring runoff events.

The vadose zone at INEL ranges in thickness from 61 m (200 ft) in the northern portion to over 274 m (900 ft) in the south. Infiltration estimates for undisturbed locations with natural vegetation are generally low, less than 1 cm/yr (0.4 in/yr). Estimates for disturbed locations are higher, up to 10 cm/yr (4 in/yr), and show a seasonal effect. The infiltration occurs primarily in the early spring as the accumulated snowpack melts during periods of low potential evapotranspiration. This infiltrating water passes through surface sediments, numerous basalt flows, and sedimentary interbeds where they occur. The thickness of individual basalt flows ranges from 3 to 30 m (10 to 100 ft). Because of extrusive emplacement with rapid cooling, the flows are strongly fractured and fissured. The primary controls on the movement of water within the vadose zone are thought to be the sedimentary interbeds. The fractures in the basalt are large enough (1 to 3 mm) that water movement in them likely occurs without attaining equilibrium with the much lower permeability basalt matrix. Therefore, water travel times through the vadose zone are likely longer in the northern part of INEL where sedimentary interbeds are thicker. The vadose zone provides partial protection to the underlying regional aquifer by filtering out many contaminants by adsorption, buffering dissolved chemical waste, and allowing decay during water transport.

Not all of the vadose zone at INEL is unsaturated. Perched water occurs when large amounts of infiltration occur during periods when the Big Lost River flows in its channel onto INEL. Perched water also occurs at several facilities where infiltration ponds have continuously supplied water at the surface. These perched water bodies can extend radially up to 600 m (2000 ft) within the vadose zone. Additionally, smaller isolated perched water zones are observed beneath the Radioactive Waste Management Complex and are thought to be due to either increased infiltration at the complex or preferential flow within the surficial sediments and fractured basalts, causing focused water movement.

The Snake River Plain Aquifer is a continuous body of groundwater that underlies nearly all of the Eastern Snake River Plain. Most of the permeable zones in the aquifer occur along the upper and lower densely fractured or rubbled edges of the basalt flows. Estimates of the permeable or effective thickness of the aquifer vary from 76 to 400 m (250 to 1300 ft). This effective thickness undoubtedly varies spatially beneath INEL. Water movement in the aquifer is generally from the northeast to the southwest. Similar to the effective thickness, the flow velocity varies spatially as well. Tracer studies at INEL indicated natural flow rates of 1.5 to 6.1 m (5 to 20 ft) per day, with an average near 3 m (10 ft) per day. However, these locally measured velocities are not necessarily representative throughout the aquifer.

Groundwater supplies all of the drinking water consumed within the Eastern Snake River Plain, and an alternative drinking water source or combination of sources is not available. The Snake River Plain Aquifer is a designated sole source aquifer.

Sensitive Environment

The Experimental Breeder Reactor-1 at INEL is a National Historic Landmark. To date, more than 100 cultural resource surveys have been conducted over approximately 4% of the area within the INEL site. During the course of these surveys, most of which have been conducted near major facility areas, 1506 archaeological resources have been identified, including 688 prehistoric sites, 38 historic sites, 753 prehistoric isolates, and 27 historic isolates. Geographically, INEL is included within a large territory once inhabited by and still of importance to the Shoshone-Bannock Tribes.

The Fort Hall Indian Reservation is located to the southeast of INEL. Recreational and tourist attractions located in the region surrounding INEL include the Craters of the Moon National Monument, Hell's Half Acre Wilderness Study Area, Black Canyon Wilderness Study Area, Camas National Wildlife Refuge, Market Lake State Wildlife Management Area, North Lake State Wildlife Management Area, and Snake River. The INEL Site is located within the Medicine Lodge Resource Area (approximately 568.2 km^2 [140,415 acres] of eastern and southern portions of the INEL Site) and the Big Butte Resource Area (1,742 km^2 [430,499 acres] of the central and western portions).

In 1975, INEL was designated as a National Environmental Research Park. All land within the INEL site boundary is protected as an outdoor laboratory to analyze the complex ecological relationship and impacts of technological research and development and agricultural use on this cool desert.

Two federal endangered species (bald eagle and peregrine falcon) and six federal category 2 candidate animal species were identified as potentially occurring on the INEL Site. No state-protected species occur on INEL.

The U.S. Fish and Wildlife Service National Wetlands Inventory maps show over 130 potential wetlands; these maps and subsequent surveys indicate that potential wetlands cover about 0.25% of the INEL Site. Over 70% of the potential wetlands are found near the Big Lost River and its spreading areas and playas, the Birch Creek Playa, and in an area north of and in the general vicinity of Argonne National Laboratory-West.

Sources

Idaho National Engineering Laboratory (INEL) Site Specific Plan for Fiscal Year 1994, DOE/ID-10253.

Department Of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Pre-decisional Draft (Rev 2) Environmental Impact Statement, DOE/EIS-0203, April 1994.

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Site Fact Sheet
Argonne National Laboratory East
Illinois

Site Description

The Argonne National Laboratory East (ANL-E) is located in DuPage County, Illinois, approximately 35 km (22 mi) southwest of downtown Chicago and 40 km (25 mi) west of Lake Michigan. It is north of the Des Plaines River Valley, south of Interstate Highway 55 (I-55), and west of Illinois Highway 83 (Figure ANLE-1).

The site is located within the western suburbs of Chicago, between the communities of Woodridge and Lemont. Approximately 7 million people reside within 50 km of the site and half a million people within 10 km of the center of the site.

Major geographic components in the region include both the Des Plaines River channel, which contains both the river and the Chicago Sanitary and Ship Canal, and Lake Michigan. Urban developments associated with high concentrations of commercial, industrial, and residential usage are located near ANL-E. Large oil refineries are located approximately 8 and 11 km (5 and 7 mi) southwest of ANL-E, and a large coal-burning electrical generating station is approximately 11 km (7 mi) to the southwest of ANL-E.

The site occupies the central 6.9 km^2 (1,700 acre) of a 15.1 km^2 (3,740 acre) tract (Figure ANLE-2). The 8.3 km^2 (2,040 acre) Waterfall Glen Forest Preserve surrounding the site is mostly former ANL-E property that was deeded to the DuPage County Forest Preserve District in 1973 for use as a public recreational area, nature preserve, and demonstration forest.

ANL-E is a multiprogram research and development laboratory that conducts basic and applied research on advanced fission reactors and in the physical, life and environmental sciences to support development of energy technologies. Employment at ANL-E is approximately 5,000.

Institutional Factors

Ownership
The ANL-E site is owned by DOE, and is operated by the University of Chicago. No LLW disposal facility is operating at the ANL-E, and no future LLW or MLLW disposal units are currently planned.

MLLW Storage and Generation
The estimated volume of MLLW inventory at ANL-E is 113.8 m^3. Roughly 2177 m^3 of MLLW is projected to be generated through the end of 1997.*

*1994 *Mixed Waste Inventory Report*

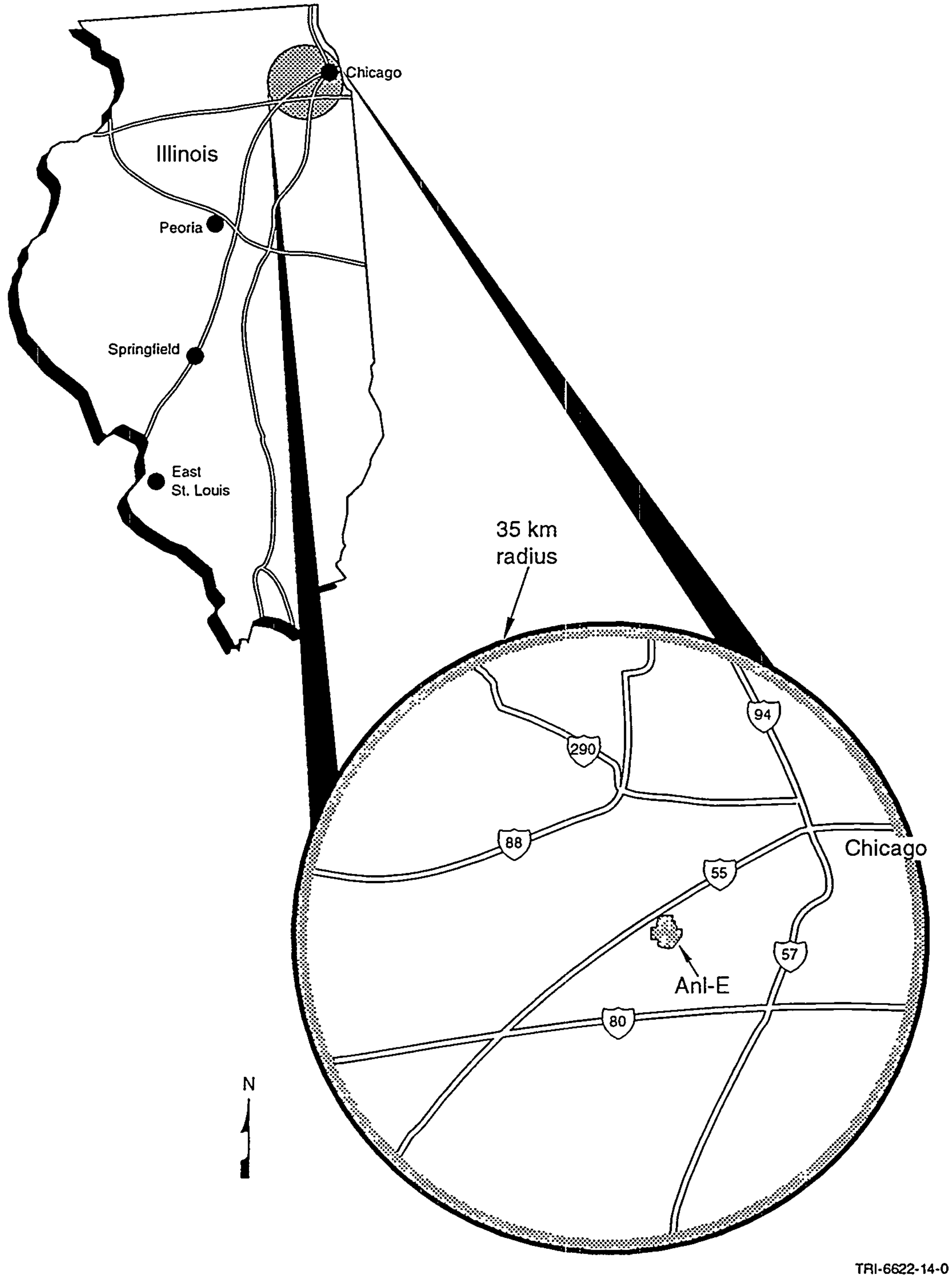


Figure ANLE-1. Location Map for Argonne National Laboratory East

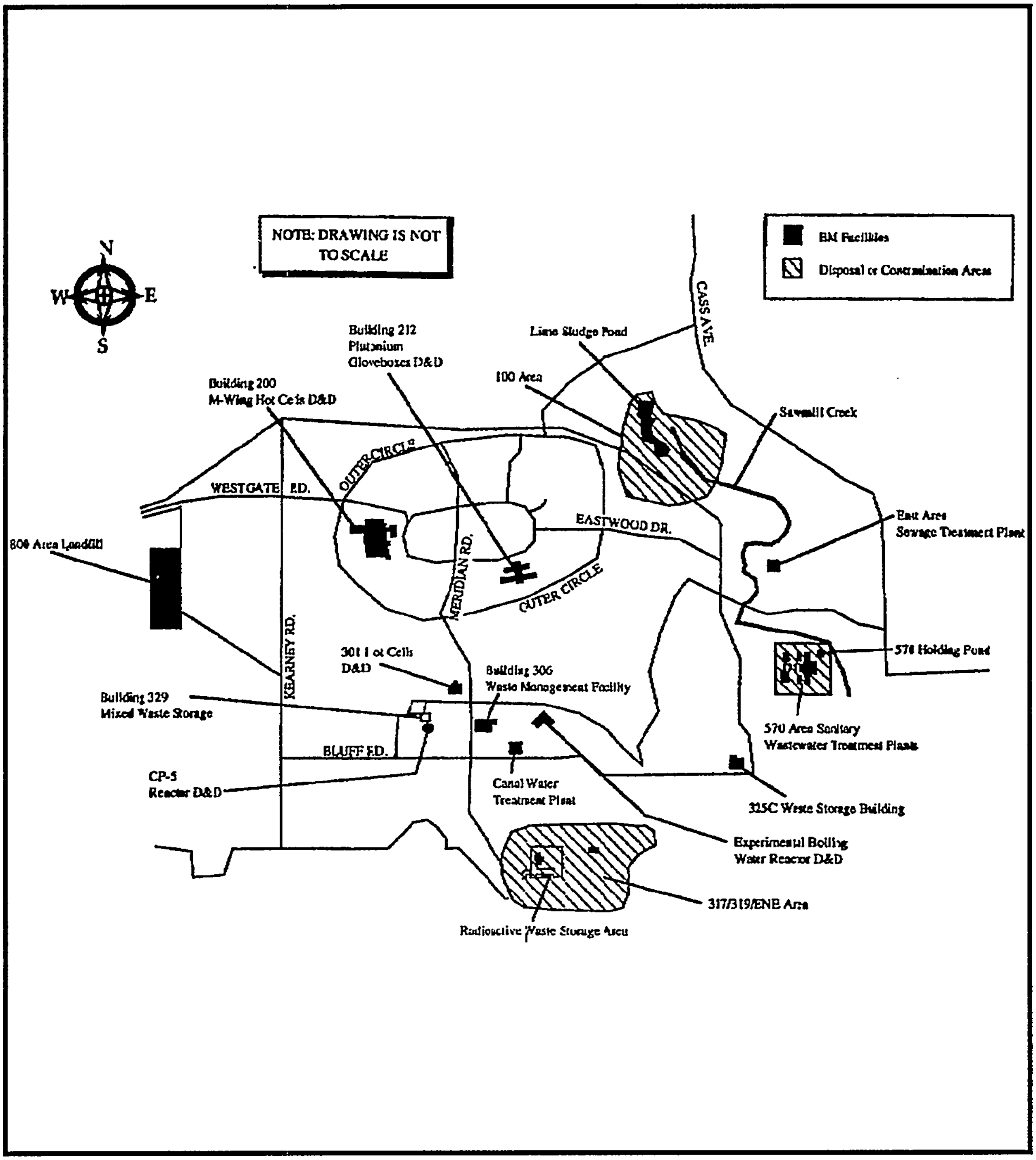


Figure ANLE-2. Site Map for Argonne National Laboratory East

Regulatory Considerations
No federal or cooperative agreements are in place regarding MLLW management or facility siting at the ANL-E site.

No aquifers in this area are EPA designated sole-source aquifers.

Technical Factors

Climate
The climate of the area is representative of the upper Mississippi Valley, as moderated by Lake Michigan, and is characterized by cold winters and hot summers. January is the coldest month with an average temperature of -6° C (21° F), and July is the warmest month with an average temperature of 21° C (70° F). Precipitation averages about 84 cm (33 in) annually, with the largest rainfalls occurring between April and September. Evapotranspiration in the area is estimated at 80% of the annual rainfall or about 67 cm (26 in). The annual average wind direction is generally variable, from the west to south, but with a significant northeast component.

Geology
The topography at the ANL-E site is generally gently rolling. The average elevation at the site is 221 m (725 ft) above sea level. Slopes of consequence are found only adjacent to streams and near the southeastern edge of the site, where the fall into the Des Plaines River valley begins.

The geology of the ANL-E area consists of about 30 m (100 ft) of glacial till on top of the bedrock, which is Niagaran and Alexandrian Dolomite of Silurian age, underlain by shale and older dolomites and sandstones of Ordovician and Cambrian age. Niagaran and Alexandrian Dolomite is about 60 m (200 ft) thick and widely used in DuPage County as a source of groundwater. The shale separating the upper dolomite aquifer from the underlying sandstone and dolomite aquifers retards hydraulic connection between them.

The glacial till provides a mix of soil characteristics, but the presence of silts and clays in some areas indicates that slope stability and foundation settlement could be sensitive for some site development needs. The soils on the site have derived from glacial till over the past 12,000 years, most of which are of the Morely series. Morely soils have a relatively low organic content in the surface layer, moderately slow subsoil permeability, and a large water capacity. The remaining soils along creeks, intermittent streams, bottomlands, and a few small upland areas are of the Sawmill, Ashkum, Peotone, and Beecher series, which are generally poorly drained.

The site is in Seismic Risk Zone 1, which means that minor damage could occur from earthquakes. No tectonic features within 100 km (62 mi) of ANL-E are known to be seismically active. Although a few minor earthquakes have occurred in northern Illinois, none has been positively associated with particular tectonic features. The potential for seismic activity that would cause building damage at ANL-E is remote.

No known mined or drilled natural resources occur on or near the site.

Hydrology

The Argonne National Laboratory-East is located in the Des Plaines River drainage basin 39 km (24 mi) west of Lake Michigan and on the northern margin of the Des Plaines River valley. The largest stream onsite is Sawmill Creek, which originates north of the laboratory and enters the Des Plaines River about 21 km (1.25 mi) southeast of the center of the site. Two small streams originate onsite and combine to form Freund Brook, which discharges into Sawmill Creek. Flow in Sawmill Creek upstream from the wastewater outfall averaged 0.18 m^3/sec (6.3 ft^3/sec) in 1992. Along the southern margin of the laboratory, the terrain is dissected by ravines containing intermittent streams that discharge some site drainage into the Des Plaines River valley. In addition to the streams, various ponds and cattail marshes are present on the site. A network of ditches and culverts transports surface runoff toward the smaller streams. The Des Plaines River flows southwest about 48 km (30 mi) until it joins with the Kankakee River to form the Illinois River.

Flow in the Des Plaines River near the laboratory is approximately 25.5 m^3/sec (900 ft^3/sec). The laboratory is located approximately 46 m (150 ft) above the Des Plaines River and thus is not subject to major flooding. In addition, facilities at Argonne National Laboratory-East are not in the 500-year floodplain for the site. The floodplain areas are largely confined to areas within 61 m (200 ft) of the surface streams.

Two principal aquifers are used as water supplies in the vicinity of the laboratory. The upper aquifer is the Niagaran and Alexandrian Dolomite, which is about 61 m (200 ft) thick and has a potentiometric surface between 152 and 30 m (500 and 100 ft) below ground. Water flows through this unit at the rate of 24 m/yr (78 ft/yr) in a southerly direction. Wells in this aquifer yield up to 3,028 liters (800 gallons) per minute. The lower aquifer is in the Galesville Sandstone, which lies between 152 and 457 m (500 and 1,500 ft) below the surface. Water flows through this unit at the rate of 240 m/yr (780 ft/yr) in a southerly direction. The lower aquifer does not appear to be affected by pumpage from the upper aquifer. The Maquoketa shale separates the upper dolomite aquifer from the underlying sandstone aquifer, and retards hydraulic connection between the two.

Most groundwater supplies in the ANL-E area are derived from the Niagaran, and to some extent, the Alexandrian Dolomite bedrock. Because the cones of depression on ANL-E wells do not extend beyond the site and adjacent forest preserve, ANL-E water use does not affect neighboring communities. However, continued commercial and residential development in the area has increased demand on the aquifer, necessitating deeper wells.

The four domestic water supply wells now in use on the ANL-E site are drilled about 90 m (300 ft) deep, terminating in the Niagaran Dolomite. A well drilled in the Galesville Sandstone 490 m (1,600 ft) deep has been taken out of service. The water level in the Niagaran Dolomite has remained reasonably stable under ANL-E pumping, dropping about 3.7 m (12 ft) between 1960 and 1980. The aquifer appears to be adequate for future ANL-E use, but this groundwater source is used throughout the area. Several small capacity water wells used for laboratory experiments, fire protection, and sanitary facilities also exist on the site, primarily in the ANL-E area and meteorology complex. Within an area approximating a 10 mile radius of ANL-E, there are more than 9,000 water supply wells; 150 of the 9,000 wells are public water supply wells and more than 8,800 are domestic drinking water wells.

Sensitive Environment

ANL-E, located in the Illinois and Michigan Canal National Heritage Corridor, is situated in an area known to have a long and complex cultural history. All periods listed in the cultural chronology of Illinois, with the exception of the earliest period (Paleo-Indian), have been documented in the ANL-E area by either professional cultural resource investigation or by interviews of ANL-E staff with local collectors. A variety of site types, including mounds, quarries, lithic workshops, and habitation sites, have been report by amateurs within a 25-km (16-mi) radius of ANL-E. Twenty-six sites have been recorded including prehistoric chart quarries, special purpose camps, base camps, and historical farmsteads. The range of human occupation spans several time periods (Early Archaic through Mississippian Prehistoric to Historical). To date, one site may be eligible for the National Register of Historic Places.

The principal recreational area near ANL-E is Waterfall Glen Forest Preserve, which surrounds the site. The area is used for hiking, skiing, and equestrian sports. Several large forest preserves of the Forest Preserve District of Cook County are located east and southeast of ANL-E and the Des Plaines River. The preserves include the McGinnis and Saganashkee sloughs, as well as other, smaller lakes. These areas are used for picnicking, boating, fishing, and hiking. A small park located in the eastern portion of the ANL-E site is for ANL-E and DOE employees only. Sawmill Creek and the Des Plaines River above Joliet, about 21 km (13 mi) southwest of ANL-E, receive little recreational or industrial use. A few people fish in these waters downstream of ANL-E and some duck hunting takes place on the Des Plaines River.

Although the geographic ranges of several federally listed animal species include the northern Illinois region, no suitable habitat for these species is present on the site, with the possible exception of the Indiana bat. The black-crowned night heron and hairy marsh yellow cress are both listed as endangered by the state and have been documented on the ANL-E site. The hairy marsh yellow cress and the blackcrowned night heron occur within wetland areas of the site. No other species on the state list are known to occur at ANL-E.

Wetlands include a cattail marsh and wooded swamp habitat of 0.014 km^3 (3.5 acres) and three small cattail marshes that provide year-round habitat for species such as muskrat and waterfowl. Adjacent wetlands in the Waterfall Glen Nature Preserve may be connected hydrologically to ANL-E.

Sources

Golchert, N. W., and R. G. Kolzow. "Argonne National Laboratory-East Site Environmental Report for Calendar Year 1992." ANL-93/5.

Site Fact Sheet
Site A/Plot M (Palos Forest Preserve)
Illinois

Site Description

Site A and Plot M are two distinct areas of the Palos Forest Preserve where the United States government leased 4.1 km^2 (1025 acres) of land from the Forest Preserve District of Cook County, Illinois, and operated two early research reactors as part of the Manhattan Project. The Palos Forest Preserve is approximately 5 km (3 mi) east of Argonne National Laboratory, and 32 km (20 mi) southwest of downtown Chicago (Figure A/M-1). The site began operation when the world's first nuclear reactor was moved to the site from the University of Chicago in 1945, and was decommissioned in 1956. The federal government has begun a more extensive characterization program to evaluate environmental conditions and the waste inventory at the site and to sample for hazardous contaminants in addition to radionuclides.

The site is located within the western suburbs of Chicago, just northeast of the community of Lemont. Approximately 7 million people reside within 50 km of the site; within 10 km of the center of the site, the population is estimated to be 150,000.

Site A is the 0.07 km^2 (19 acre) site where the two research reactors and associated research activities were located; Plot M is a 0.004 km^2 (one acre) site about 300 m (1000 ft) to the north where researchers disposed of radioactive and hazardous waste generated from the experimental research (Figure A/M-2). Waste was buried in six-foot deep trenches and covered with soil until 1948, when buried materials were placed in steel bins. In 1949, the steel bins were retrieved and sent to another DOE facility, the remaining trench waste was capped, and the site was returned to the Forest Preserve District of Cook County, the land-owner.

DOE's objective for these sites is to complete the site characterization effort and identify any additional actions that are appropriate. No permanent employees are associated with the two site areas, which have been closed for more than 35 years.

Institutional Factors

<u>Ownership</u>
Both sites are owned by the Forest Preserve District of Cook County, which manages the Palos Forest Preserve as a public recreational area for local residents to walk, hike, mountain bike, and picnic. The DOE monitors the sites. The sites were originally leased to the United States government as a 4.1 km^2 (1025 acre) parcel but in 1947 4 km^2 (1000 acres) were returned to the Forest Preserve.

In 1956, the federal government decontaminated and decommissioned Site A, and put an inverted concrete box over and around Plot M. The box comprises a 0.3 m (1 ft) thick slab over the top

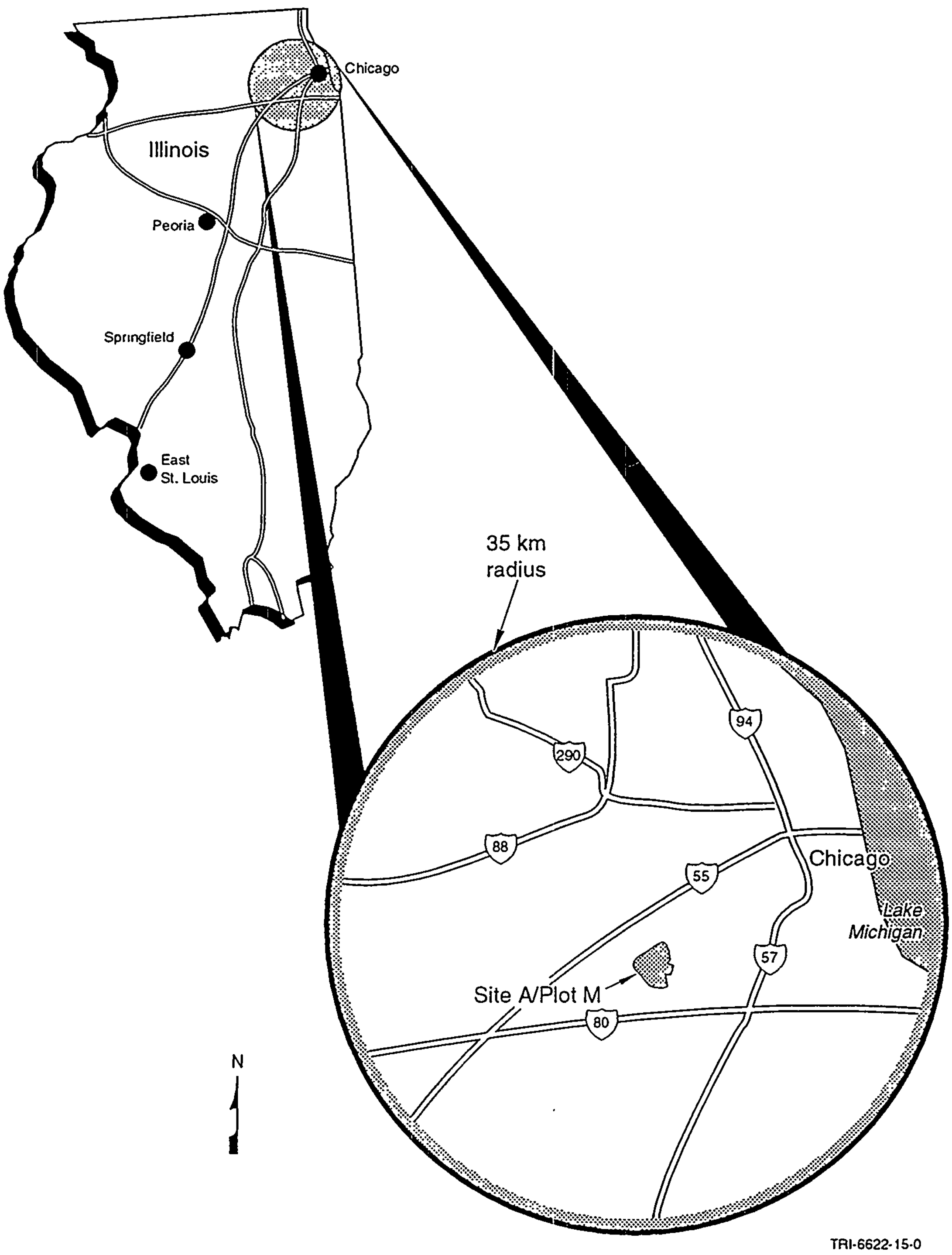
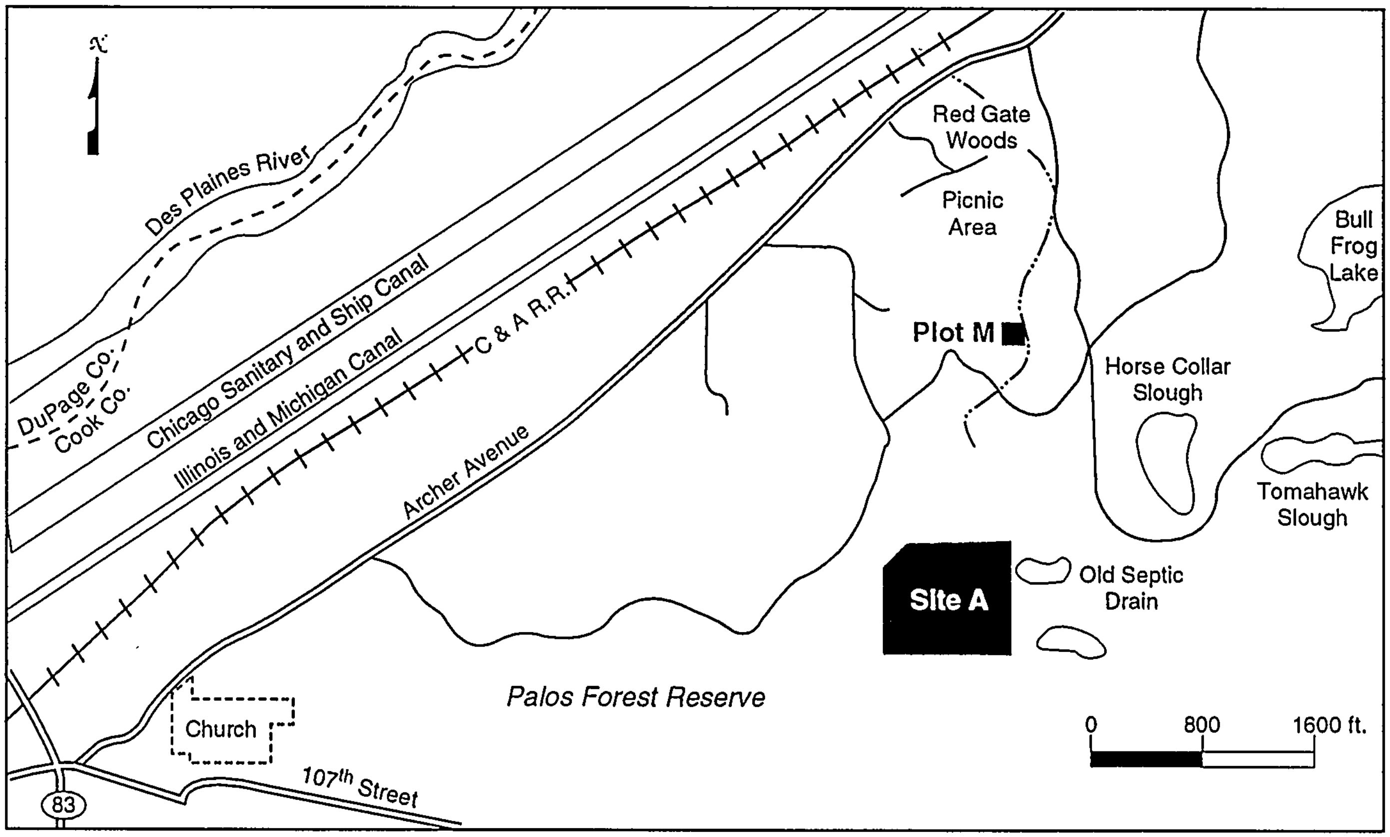


Figure A/M-1. Location Map for Site A/Plot M



TRI-6622-29-0

Figure A/M-2. Site Map for Site A/Plot M with 2.4 m (8 ft) thick side walls. The lease was terminated and the land was returned to the Forest Preserve District. The concrete slab was covered with soil, seeded with grass, and identified with a permanent granite marker. Site A and several suspect areas around it are currently fenced while the site is being characterized to prevent public access to survey grid markings and groundwater wells; the property owner also requested that the site be fenced. Plot M is not fenced at this time, but the subsurface concrete cap isolates the site.

MLLW Storage and Generation
No MLLW is reported in inventory at either site, and DOE does not anticipate that any MLLW will be generated through 1997* unless it is generated because of clean up actions in 1995 and 1996 to assure site safety.

Regulatory Considerations
No records of decision, Tri-party agreements, Facility Compliance Agreements, or other agreements are in place. The site is being characterized on a voluntary basis by DOE.

No aquifers in this area are EPA designated sole-source aquifers.

Technical Factors

Climate
The climate is that of the upper Mississippi Valley, as moderated by Lake Michigan, and is characterized by cold winters and hot summers. Precipitation averages about 84 cm (33 in) annually. The largest rainfalls occur between April and September. Average annual evaporation from shallow lakes is about 81 cm (32 in). The average monthly temperature ranges from -6° C (21° F) in January to 23° C (73° F) in July. The annual wind direction is generally variable from west to south, but with a significant northeast component.

Geology
Plot M is located on a moraine upland that is dissected by two valleys. The upland is characterized by rolling terrain with poorly developed drainage. The site is underlain by glacial till or drift, dolomite, and other sedimentary rocks. Glacial till at the site is about 40 m (130 ft) thick, and is underlain by 60 m (200 ft) of dolomite bedrock more than 400 million years old.

The topography of the Palos Forest Preserve is generally rolling terrain with hills and horizontal swales. The 0.08 m^2 and 0.004 m^2 (19 and 1 acre) areas of former government activity are at the tops of hills, with intermittent streams running beside and below Plot M.

The site is located in Seismic Risk Zone 1, which means that minor damage could occur from earthquakes.

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*1994 *Mixed Waste Inventory Report*

The glacial till provides a mix of soil characteristics, but the presence of silts and clays in some areas indicates that slope stability and foundation settlement could be sensitive for some site development needs.

No mined or drilled natural resources have been reported on or near the site.

Hydrology
The surface water consists of ponds and intermittent streams. When sufficient water is available, an intermittent stream flows from the highest point near Site A, past Plot M, then continues near the Red Gate Woods picnic well, and finally discharges into the Illinois and Michigan Canal.

The groundwater in the glacial till and dolomite forms two distinct flow systems. The flow in the till is controlled principally by topography. The flow in the dolomite, which is recharged by groundwater from the glacial till, is controlled by two discharge areas, the Des Plaines River to the north and the Calumet Sag Canal to the south.

Groundwater flows north from both sites toward the Illinois and Michigan Canal. Depths to water vary over the sites, ranging from 2.5 m (8 ft) to perched aquifers, to 34 m (111 ft) to the dolomite aquifer. Annual fluctuations at boreholes are a few feet or less.

Water use in the area is confined to hand-pumped picnic wells, which are open to the dolomite and are used primarily in the warmer seasons by visitors to the Park District. Within an area approximating a 10 mile radius of Site A/Plot M, there are in excess of 8,000 water supply wells; about 90 of the 8,000 wells are public water supply wells and more than 7,800 are domestic drinking water wells.

Sensitive Environment
The Palos Forest Preserve in which Site A and Plot M are located is managed by the Cook County Forest Preserve and is used by local residents for walking and picnicking. A number of hand operated wells have been installed in the area ("picnic wells"). The Red Gate Woods picnic area is about 30 m (100 ft) north of Plot M, and more remote areas of the preserve are often used by individuals for recreation.

No archeological sites have been identified in the immediate area. While the site is significant for its role during the Manhattan Project, the area is not a designated historic site. No federal or state listed endangered or threatened species use this area of the Forest Preserve District.

The Palos Forest Preserve is generally well drained and is not considered a wetland area, but it does serve as a refuge for much local wildlife.

Sources

U.S. Department of Energy Fact Sheet, February 1992.

U.S. Department of Energy Fact Sheet, April 1993.

U.S. Department of Energy Fact Sheet, September 1990.

Golchert, N.W., "Surveillance of Site A and Plot M - Report for 1992", *ANL-93/4*, May 1993.

US DOE Interim Mixed Waste Inventory Report: Waste Streams, Treatment Capacities, and Technologies, DOE/NBM-1100, April 1993.

Biang, R. P. et. al., "Environmental Review for Site A/Plot M, Palos Forest Preserve, Cook County, Illinois", ANL/EAIS/TM-99, June 1993.

Site Fact Sheet
Paducah Gaseous Diffusion Plant
Kentucky

Site Description

The Paducah Gaseous Diffusion Plant (PGDP) is located in western Kentucky, approximately 16 km (10 mi) west of the city of Paducah (Figure PGDP-1). The facility is within a few miles of Interstate 24, and US Route 60 runs south of the PGDP. The Illinois Central and Paducah & Louisville railroads operate within the region. Most of the land ownership around the PGDP is public. The area contiguous to the PGDP consists of predominantly undeveloped open space and the Ohio River. The West Kentucky Wildlife Management Area is situated predominantly to the west and south of the PGDP. The Tennessee Valley Authority Shawnee Plant and Metropolis Lake are located northeast of the PGDP, with the Ohio River north and east of the site. Regional land use consists primarily of agricultural land and forested land.

The PGDP is located on a 13.9 km^2 (3425 acre) site, with the PGDP itself within an "L" shaped, fenced tract of 3.0 km^2 (750 acres) (Figure PGDP-2).

The two largest towns in the area are Metropolis, Illinois (population 6800), slightly over 10 km to the north, and Paducah (population 27,500), about 15 km east of the PGDP. Estimated population within a 10 km (6.2 mi) radius of the PGDP is 2000; estimated population within a 50 km (31 mi) radius is 106,500.

The PGDP was completed in 1954 to operate in conjunction with the Oak Ridge and Portsmouth Gaseous Diffusion Plant. The Energy Policy Act of 1992 established the U.S. Enrichment Corporation (USEC) and gave it the responsibility of operating the gaseous diffusion plant at Paducah. The mission of the USEC at PGDP is the separation of uranium isotopes using a gaseous diffusion process, producing enriched uranium for nuclear fuel. The DOE mission at the PGDP is conducting investigations for identification and remediation of environmental contamination stemming from prior operations. Employment at the PGDP is approximately 1850.

Institutional Factors

Ownership
The 13.9 km^2 (3,425 acre) site is owned by DOE. About 95% of the property within the security fence is leased to USEC. No LLW disposal facility is operating at the PGDP, and no future LLW or MLLW disposal units are currently planned. Historically, LLW has been disposed of at the site.

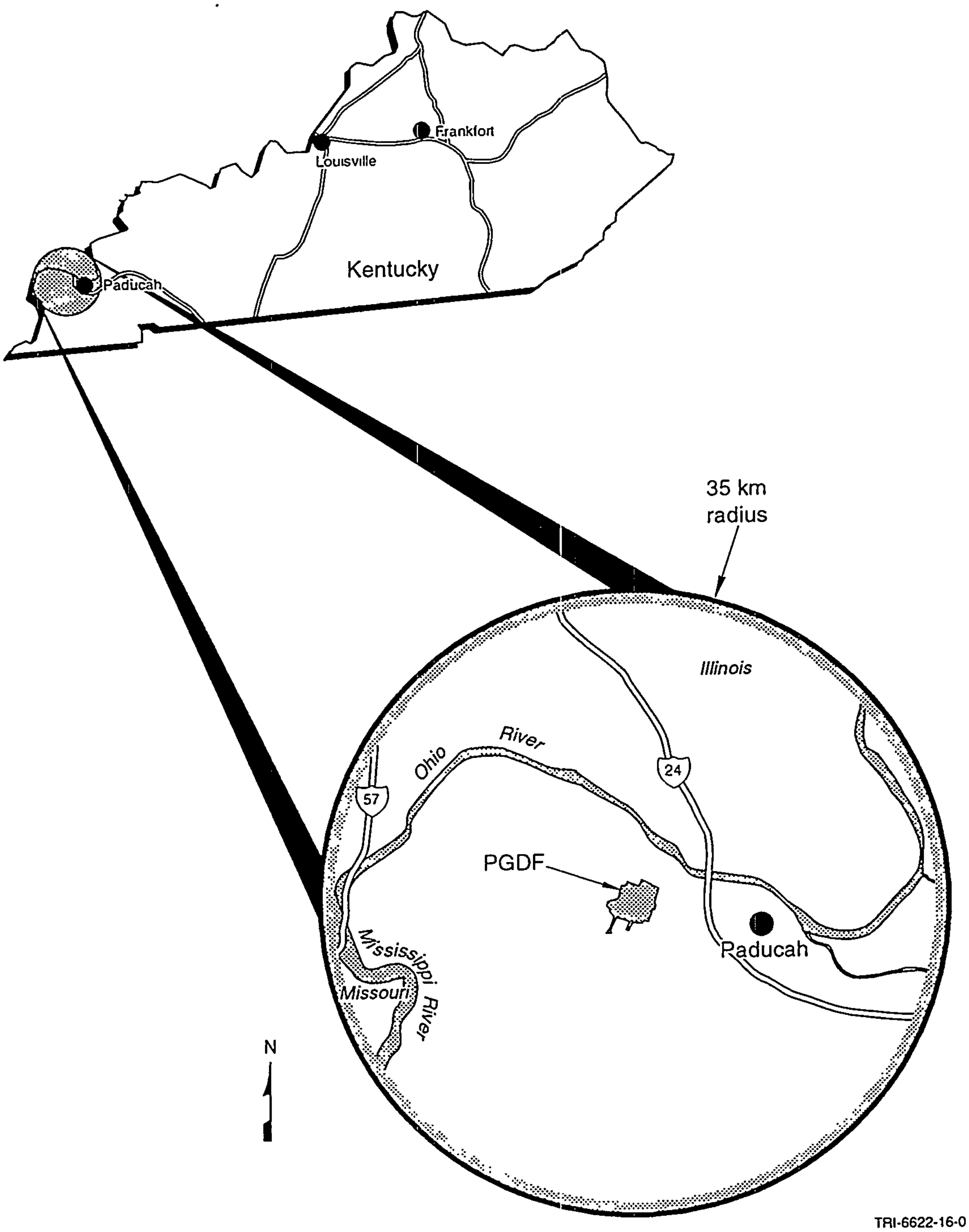

Figure PGDP-1. Location Map for Paducah Gaseous Diffusion Plant

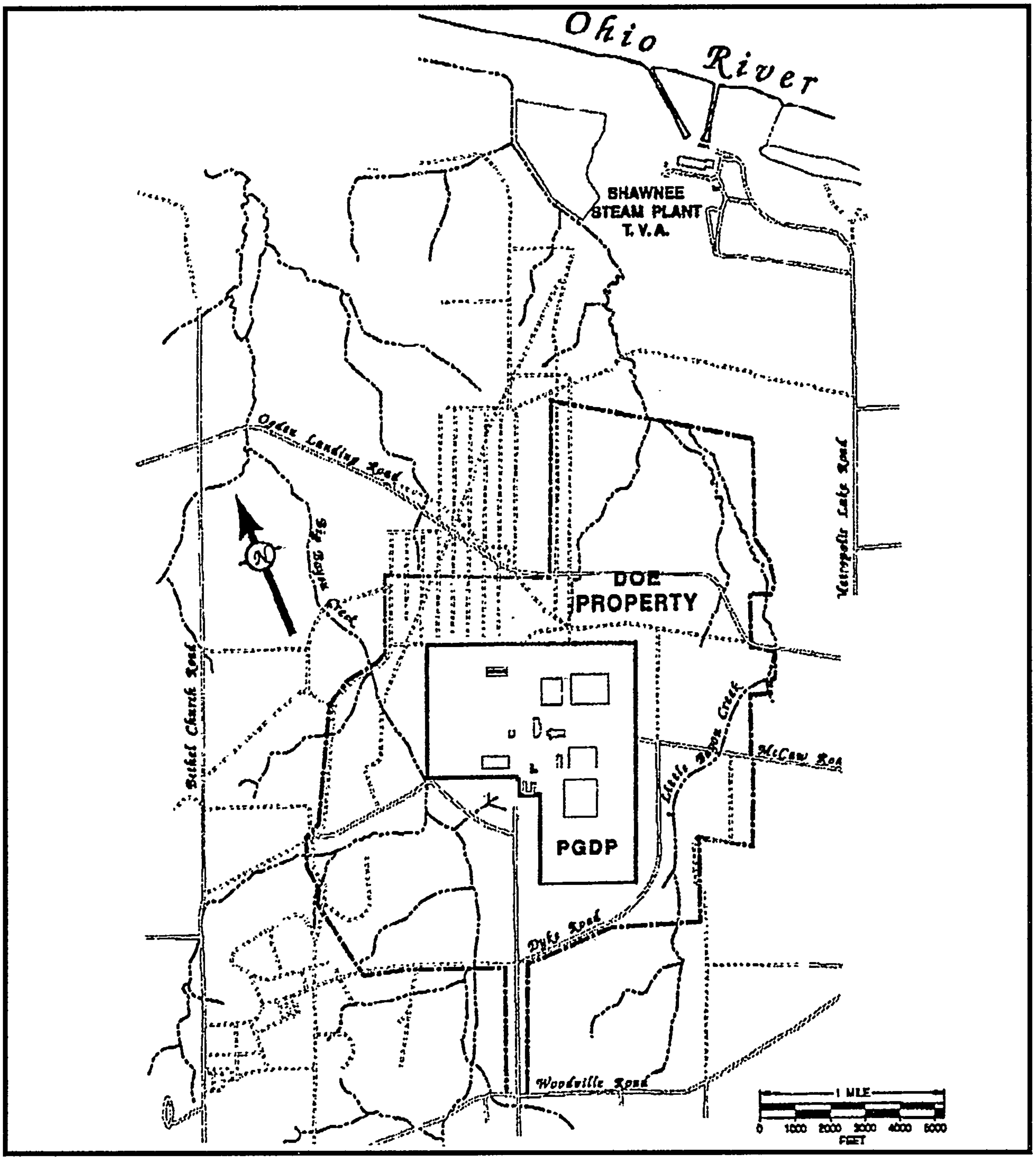

Figure PGDP-2. Site Map for Paducah Gaseous Diffusion Plant

MLLW Storage and Generation
The estimated volume of MLLW inventory at the PGDP is 596.5 m^3, with no additional waste anticipated to be generated through 1997.*

Regulatory Considerations
PGDP entered into a Federal Facilities Compliance Agreement with EPA on June 30, 1992. Also, PGDP was placed on EPA's National Priority List on May 31, 1994.

No aquifers in this area are EPA designated sole-source aquifers.

Technical Factors

Climate
The climate of Paducah is characteristic of the humid continental zone in which it is located. January is the coldest month with an average temperature of 1.5° C (35° F), and July is the warmest month with an average temperature of 26° C (78° F). Precipitation is well distributed throughout the year with an average of approximately 68.6 cm (47 in). Average annual evaporation from shallow lakes in the area is 91 cm (36 in). The prevailing wind direction is from south to southwest. Average high wind speed is between 13 to 18.5 km/h (8.1 to 11.5 mph).

Geology
The PGDP is located within the northern tip of the Mississippi Embayment portion of the Gulf Coastal Plain Province. The embayment is a large sedimentary trough that received sediments between approximately 135 million and 2 million years ago.

In the PGDP area, basement rock is overlain by the sedimentary Tuscaloosa, McNairy, and Porters Creek Formations and by continental deposits. A layer of loess (wind blown sediment) overlies the continental deposits. Stream systems have eroded their valleys, reworking the continental deposits. A thick sequence of valley fill deposits underlies most of the site and extends northward to the Ohio River. Both the loess and the valley fill were deposited between 2 million and 10,000 years ago.

The topography around the site is relatively flat, sloping slightly north- and eastward toward the Ohio River.

The site is located in Seismic Risk Zone 3, which means that major damage could occur from earthquakes. Two active seismic zones are near the PGDP. The New Madrid rift zone is located 25 miles west of the PGDP, and the Wabash Valley fault zone is located 15 miles north of the PGDP.

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*1994 *Mixed Waste Inventory Report*

Generally, the soils at the site present a slight hazard from erosion and have a low shrink-swell potential. In areas where a hardpan is present, a perched water table may be created during wet periods.

Potential mineral resources at the PGDP include deposits of sand, gravel, stone, or clay.

Hydrology

The major surface waters in the region are the Ohio, Cumberland, and Tennessee Rivers. The confluence of the Ohio River with the Tennessee River is approximately 24 km (15 mi) upstream of the site, and the confluence of the Ohio River with the Mississippi River is approximately 56 km (35 mi) downstream. The PGDP is located within the drainage areas of Big Bayou and Little Bayou creeks, which meet about 4.8 km (3 mi) north of the site and discharge into the Ohio River. Other nearby surface water bodies include Metropolis Lake (2.4 km northeast), Crawford Lake (6.4 km northwest), and approximately 35 small ponds in the adjacent West Kentucky Wildlife Management Area.

Surface drainage from the PGDP is to Big Bayou Creek on the west and Little Bayou Creek on the east. The flow in the onsite creeks is closely tied to precipitation, although during dry periods, natural runoff makes up a small portion of flow. Effluents from the PGDP constitute 85% of the normal flow in Big Bayou Creek and 100% of the normal flow in Little Bayou Creek.

Groundwater recharge generally occurs to the south with discharge occurring to the north. The Regional Gravel Aquifer is the primary aquifer that supplies the drinking water for nearby private residences and towns. The aquifer consists of sand and gravel units of the lower continental deposits and alluvium found adjacent to the Ohio River. These deposits have an average thickness of 9.1 m (30 ft). The water levels of the aquifer typically are on the order of 12 to 15 m (40 to 50 ft) below the ground surface. The mean flow velocities of this unit range from 0.036 to 0.76 m/day (0.12 to 2.5 ft/day). The Upper Continental Recharge System, located 3-5 meters below ground surface, overlies the Regional Gravel Aquifer and consists of predominantly clayey silt with interbedded sand and gravel of the upper continental deposits. Groundwater flow in the Upper Continental Recharge System is mainly downward to recharge the Regional Gravel Aquifer. Groundwater quality in these shallow aquifers is generally good with low levels of calcium and sodium, and pH near neutral.

Sensitive Environment

No national historic sites have been designated or archeological sites identified on the PGDP site, although evidence of pre-Indian cultures have been found and potential historic sites identified in the region.

In 1953, a 8.4 km^2 (2080-acre) parcel surrounding the PGDP was transformed into a wildlife management area. This area is leased to the Kentucky Department of Natural Resources and Environmental Protection as part of the West Kentucky Wildlife Management Area and is managed by the Kentucky Department of Fish and Wildlife. The West Kentucky Wildlife

Management Area is used for many recreational activities including hunting, fishing, hiking, horseback riding, and dog trials. Metropolis Lake, located 2.4 km from PGDP, is a dedicated Kentucky Nature Reserve.

A Kentucky threatened or endangered species located on the facility is the *Silphiam lacinianum* (compass plant). A survey at the West Kentucky Wildlife Management Area indicated one federal-listed endangered species and three state-listed wildlife species.

Several sites of the West Kentucky Wildlife Management Area have been identified as wetlands. One of these areas, a tupelo swamp, has been designated an area of ecological concern by the Kentucky Nature Preserves Commission.

Sources

U.S. Department of Energy. "Final Environmental Impact Assessment of the Paducah Gaseous Diffusion Plant Site". DOE/EA-0155, August 1982.

Martin Marietta Energy Systems, Inc. "Paducah Gaseous Diffusion Plant Environmental Report for 1992". ES/ESH-36, September, 1993.

Site Fact Sheet
Weldon Spring Site
Missouri

Site Description

The Weldon Spring Site (WSS) is located approximately 48 km (30 mi) west of St. Louis in western St. Charles County, Missouri (Figure WSS-1). The site consists of two geographically distinct areas: the 0.9 km^2 (217-acre) chemical plant area, which is about 3.2 km (2 mi) southwest of the junction of State Route 94 and U.S. Route 40/61, and a 0.04 km^2 (9-acre) limestone quarry, which is about 6.4 km (4 mi) south-southwest of the chemical plant area (Figure WSS-2).

Site features include about 40 buildings (currently being dismantled), four raffinate pits, two ponds, and two former dump areas. Soils in the two dump areas and at scattered locations throughout the chemical plant are radioactively contaminated; the raffinate pits are heavily contaminated.

From 1941 to 1945, the U.S. Department of the Army operated the Weldon Spring Ordnance Works, constructed on the land that is now the WSS, for production of TNT and DNT explosives. The facility was closed in 1949, and the U.S. Atomic Energy Commission acquired part of the land to construct a uranium processing plant, which subsequently became the chemical plant. The Army reacquired the chemical plant property in 1967 and used the quarry for disposal of rubble contaminated with TNT. The property was eventually returned to the DOE in 1985, and the DOE established a project office at the site in 1986 to support cleanup activities. The remediation effort is currently underway at the site.

The three largest towns within a 50 km radius are St. Louis (population 397,000), St. Charles (population 55,000), about 30 km northwest of the site, and St. Peters (population 46,000), about 25 km north-northwest. The nearest communities, Weldon Spring and Weldon Spring Heights, are located about 3.2 km (2 mi) northeast of the site and have populations of 750 and 100, respectively. The Francis Howell High School is located approximately 0.8 km (0.5 mi) north of the site on State Route 94. Estimated population within a 10 km (6.2 mi) radius of the site is less than 1,000; estimated population within a 50 km radius is 667,000.

Institutional Factors

Ownership

The WSS is owned by the DOE. No LLW disposal facility is operating at the WSS, and no future MLLW disposal units are currently planned. The CERCLA Record of Decision indicates that an LLW disposal unit will be built for on-site waste. The disposal cell configuration footprint area, including the required buffer zone, will cover 40% of the chemical plant area.

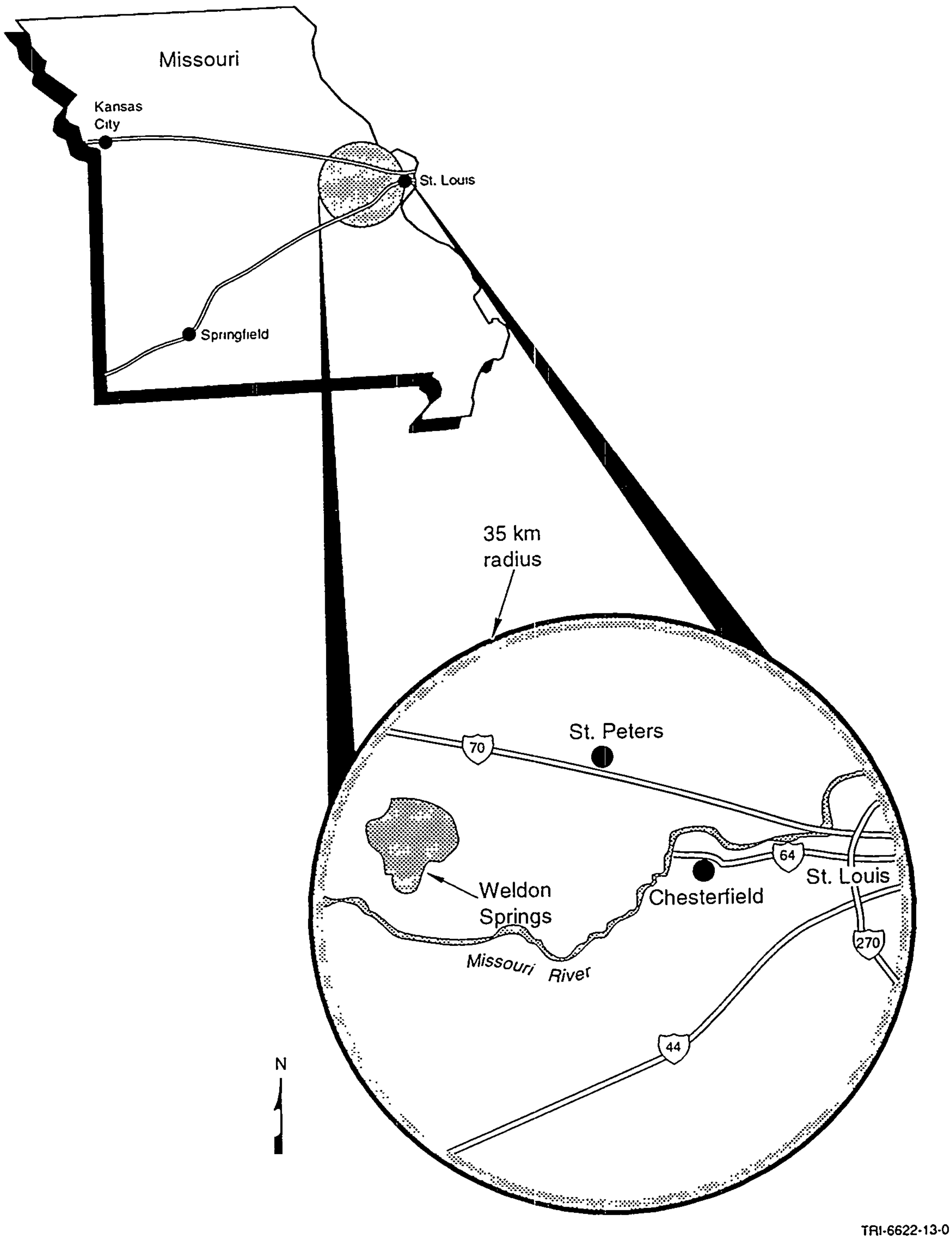

Figure WSS-1. Location Map for Weldon Spring Site

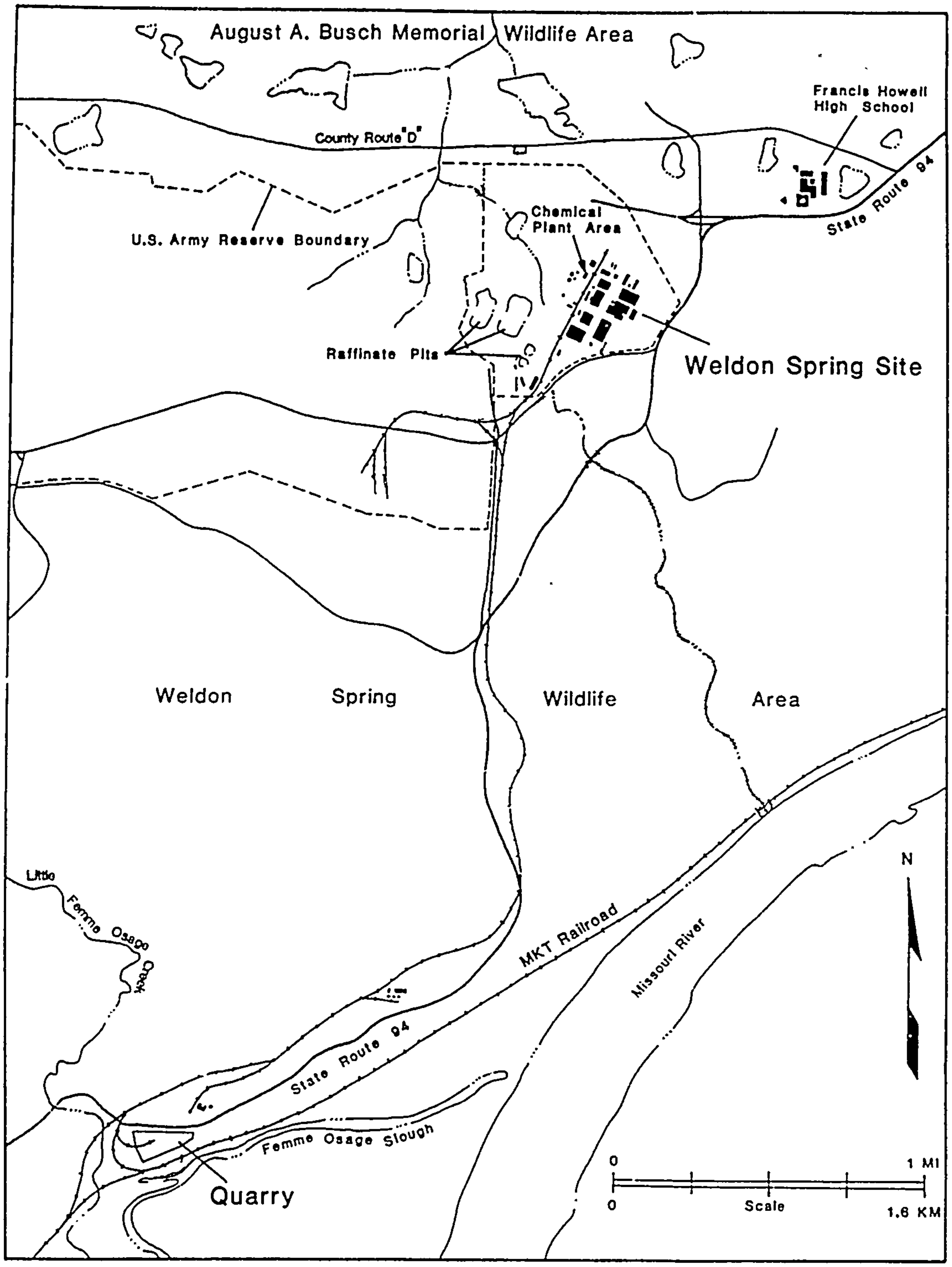

Figure WSS-2. Site Map for Weldon Spring Site

MLLW Storage and Generation

The estimated MLLW inventory at WSS is 1,678.8 m^3, with no additional MLLW anticipated to be generated through 1997.*

Regulatory Considerations

The quarry at the WSS was listed on EPA's National Priority List in 1987, and the chemical plant was added to the list in 1989. A Record of Decision for remediation action at the chemical plant area of the WSS was issued in September 1993. As stated, no off-site wastes will be accepted for disposal at the WSS.

No EPA-designated sole source aquifers are located in the area.

Technical Factors

Climate

The climate in the area is continental, with moderately cold winters and warm summers. Average monthly temperatures near the WSS range from -1.8° C (28.6° F) in January to 25.7° C (78.3° F) in July. Average annual rainfall is 94 cm (37 in) per year. On the average, more than half of the precipitation falls between March and July. Data compiled from 1956 through 1980 indicate the annual average free water surface evaporation in the region is close to annual average total precipitation. Prevailing winds are from the south during the summer and fall and from the northwest and west-northwest during the winter and early spring. The average wind speed is about 13.5 km/h (8.5 mph) for May through November and about 16 km/h (10 mph) for December through April.

Between 1916 and 1958, 446 tornadoes were reported in Missouri, an average of about 10 per year. During the most recent 40-year period of records for the St. Louis area, there have been four tornadoes that produced extensive damage and loss of life.

Geology

The WSS is in the southeast corner and on the very southern edge of the Dissected Till Plains. The site lies on a subtle ridge that forms a surface drainage divide between the Missouri and Mississippi Rivers. South of the site, the topography changes dramatically as the gentle, rolling topography of the Dissected Till Plains changes to narrow ridges and valleys.

The geology beneath the site is characterized by 5 to 18 m (15 to 60 ft) of clayey overburden overlying an argillaceous, cherty limestone bedrock. The elevation of the bedrock surface is highest in the southeastern portion and lowest in the north/northwestern portion of the site. The upper unit is highly weathered at the top, exhibiting solution features.

The site is located in Seismic Risk Zone 2, which means that moderate damage could occur from earthquakes. A few scattered seismic events have been recorded throughout Missouri and Illinois, but these have been of small magnitude and do not define any currently active faults.

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*1994 *Mixed Waste Inventory Report*

The predominant soil type in the chemical plant area is composed primarily of silty loess materials that are moderately permeable and have a high water content. The soil exhibits moderate shrinking and swelling and is easily eroded.

Hydrology

A primary factor influencing surface water hydrology near the WSS is its location on the drainage divide between the Mississippi and Missouri River basins. The Missouri River is about 2.4 km (1.5 mi) southeast of the site, while the Mississippi River is approximately 22.4 km (14 mi) north of the site.

Streams in the immediate vicinity of the site include Schote Creek, a tributary of Dardenne Creek north of the site, and the southeast drainage, an unnamed tributary of the Missouri River south of the site. Surface runoff from the chemical plant areas ultimately flows to the Mississippi River.

Floods on the Missouri and Mississippi Rivers are most common in spring and summer. The site elevation is such that the potential for site flooding by the Missouri and Mississippi Rivers is negligible. However, the U.S. Department of Housing and Urban Development has identified approximately 0.005 km^2 (1.3 acres) of the Weldon Spring property as lying within the area identified as the 100-yr flood plain of Schote Creek.

The vadose zone generally varies in thickness from less than 10.6 m (35 ft) to more than 19.7 m (65 ft) near the site. The vadose zone is poorly drained, indicating the presence of low hydraulic conductivity layers within the overburden.

Three principal aquifer systems have been identified in the Weldon Spring area. These are the alluvial aquifers, the shallow bedrock aquifer system, and the deep bedrock aquifer system.

The alluvial aquifers include saturated sands, gravels, and silts in the alluvium of the Missouri and Mississippi Rivers and alluvium of tributary creeks, which can have significant groundwater yields.

The shallow bedrock system ranges regionally in thickness from 76 to 197 m (250 to 650 ft) and consists mostly of limestone and sandstone. Locally, limestone features include solution channels that allow conduit-type flow for groundwater to travel hundreds of meters per day. Within the shallow bedrock aquifer under the site is the regional groundwater divide, which corresponds roughly to the regional surface divide between the Mississippi and Missouri River drainages. North of the divide, groundwater moves to the north toward Dardenne Creek. South of the divide, groundwater moves to the southeast toward the Missouri River. The hydraulic conductivity in the bedrock at the site is highly variable; the mean hydraulic conductivity has been measured to be approximately 0.9×10^{-6} m (3×10^{-6} ft)/sec. This aquifer is believed to be both anisotropic and heterogeneous.

A leaky confining layer 120 m (400 ft) thick lies below the shallow bedrock aquifer and overlies a deep bedrock aquifer system. The deep bedrock aquifer is approximately 300 m (1000 ft) thick and is comprised of sandstone and dolomite.

No drinking water wells are completed in the contaminated aquifer either on site or in the immediate vicinity. The deep, production aquifer groundwater is not contaminated. A number of domestic wells are used in the vicinity of the site. Private wells in the vicinity are not being affected by the former uranium processing operations. Travel time for water originating at the chemical plant to reach public water supply wells in O'Fallon and Wentzville are determined to be about 2800 years. The St. Charles County well field, located about 8 km south of site, is a source of water for county residents. Public Water District #2, Missouri Cities Water Company, Francis Howell High School, the Army, and many outlying county residents rely on this well field for all or part of their water supply. Larger communities rely on their own water sources.

Sensitive Environment

Ongoing studies are being conducted to determine historical and archeological sites and wetland areas on site.

The Busch Wildlife Area is located on 28 km^2 (6920 acres) north of the raffinate pit and chemical plant areas, and the Weldon Spring Wildlife Area, on 29.1 km^2 (7,200 acres), is situated south of State Route 94. Both of these areas are park-like tracts administered by the Missouri Department of Conservation and are dedicated to various kinds of recreational uses. Most of the visitors to the wildlife centers are from the St. Louis metropolitan area. Annual visitation to these two areas is estimated to be 1,200,000 people. Bordering the site to the west is the 6.5 km^2 (1600 acre) U.S. Army Reserve Weldon Spring Training Area.

The National Heritage data base for the Missouri Department of Conservation lists 13 endangered and 15 rare species for St. Charles County. Four of these species are also federally listed, and eight are candidates for the federal endangered species list. At the WSS, no federal or state endangered species have been identified. Several federal and state endangered species are known to exist on or near the Busch/Weldon Spring area, including bald eagles.

Sources

Quarry Bulk Waste CERCLA Record of Decision, September 1990.

Chemical Plant CERCLA Record of Decision, September 1993.

1993 Annual Site Environmental Report, May 1994.

Site Fact Sheet
Nevada Test Site
Nevada

Site Description

The Nevada Test Site (NTS) is located in southern Nevada, approximately 100 km (65 mi) northwest of Las Vegas, Nevada (Figure NTS-1). NTS occupies an area of 3,500 km^2 (1,350 mi^2) in Nye County (Figure NTS-2).

The land contiguous to the NTS is a combination of undeveloped lands and federal lands. The site is bounded on three sides by the Nellis Air Force Base Bombing and Gunnery Range to the north, east, and west. Lands to the south and southwest are managed by the Bureau of Land Management and include some acreage that is privately owned. Devil's Hole and Death Valley National Monuments are located farther to the southwest. Regional land use consists of undeveloped areas, agriculture, mining, and recreational and wilderness areas.

The NTS is reached by U.S. 95. Other major transportation routes include U.S. 93 east of the NTS and Bombing and Gunnery Range, U.S. 6 north of the NTS and Tonopah Test Range, and Interstate 15 through Las Vegas. The Union Pacific Railroad services the city of Caliente to the east of the NTS, and Las Vegas.

No permanent population is within 10 km (6.2 mi) of the center of the site. Mercury is the main base camp at the NTS and serves as the administrative and logistical center. These facilities provide general support to other areas of the site. The Mercury base camp is located in the southeast corner of the site and has the capability of providing housing for approximately 1,200 workers. Nearby towns within 50 km (31 mi) include Beatty (population 1,600), Indian Springs (population 1,200), and Armagosa Valley (population 800), for an estimated population of 4,000. Pahrump is approximately 64 km (40 mi) south-southwest of the Mercury base camp and has a population of approximately 15,000.

The NTS has been the primary location for testing the nation's nuclear weapons and devices since 1951. Programmatic functions include the management and disposal of wastes generated by NTS activities and by other DOE-approved, defense-related facilities across the United States. Capabilities include the storage and disposal of low-level radioactive waste and storage of transuranic waste. Hazardous waste is collected and transported to a permitted, off-site facility for disposal. A proposed function is the development of an MLLW disposal facility. Other functions include environmental restoration efforts throughout the NTS, technology development projects, and operation of the Liquefied Gaseous Fuels Spill Test Facility. Employment at NTS is estimated to be 3,500.

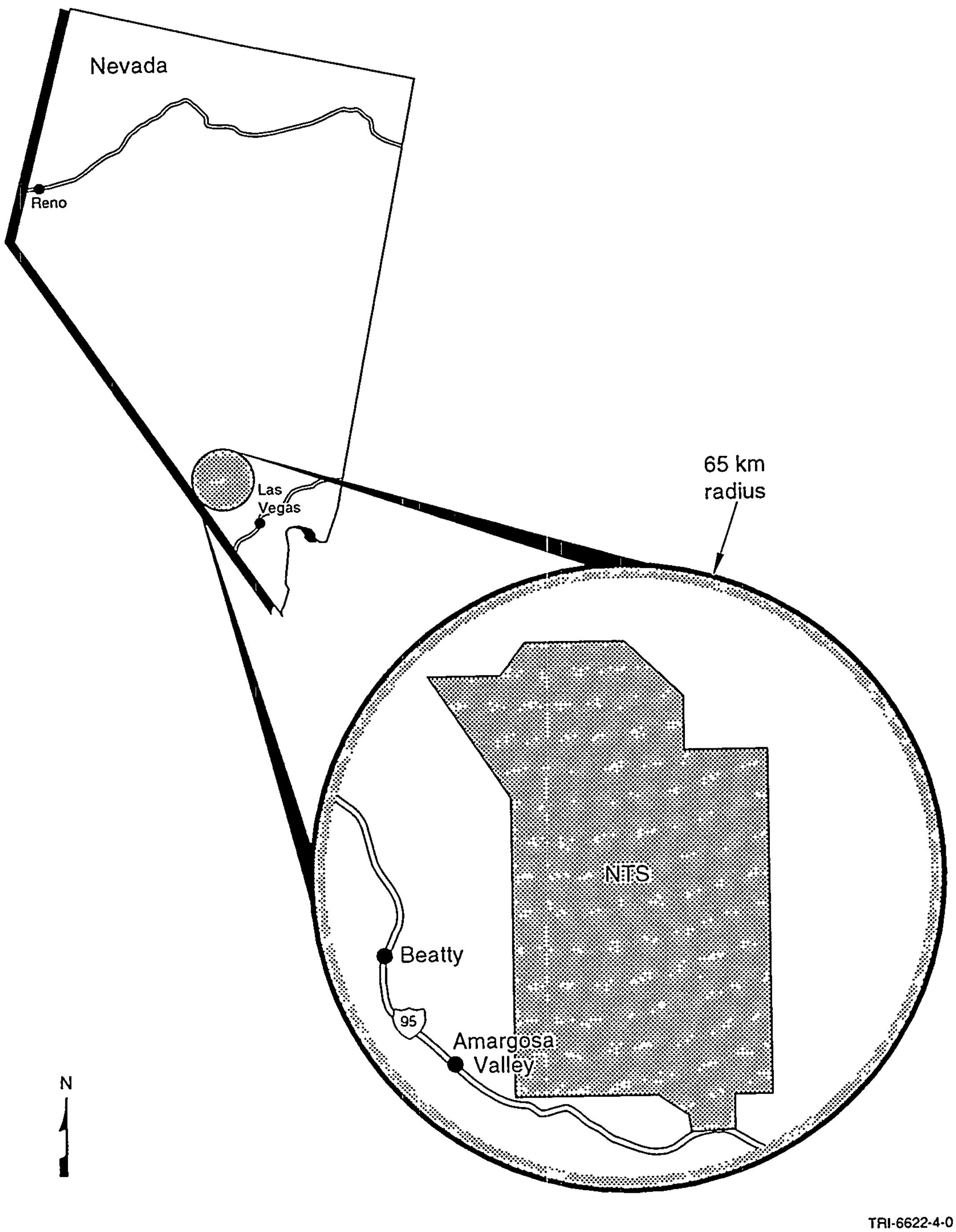

Figure NTS-1. Location Map for Nevada Test Site

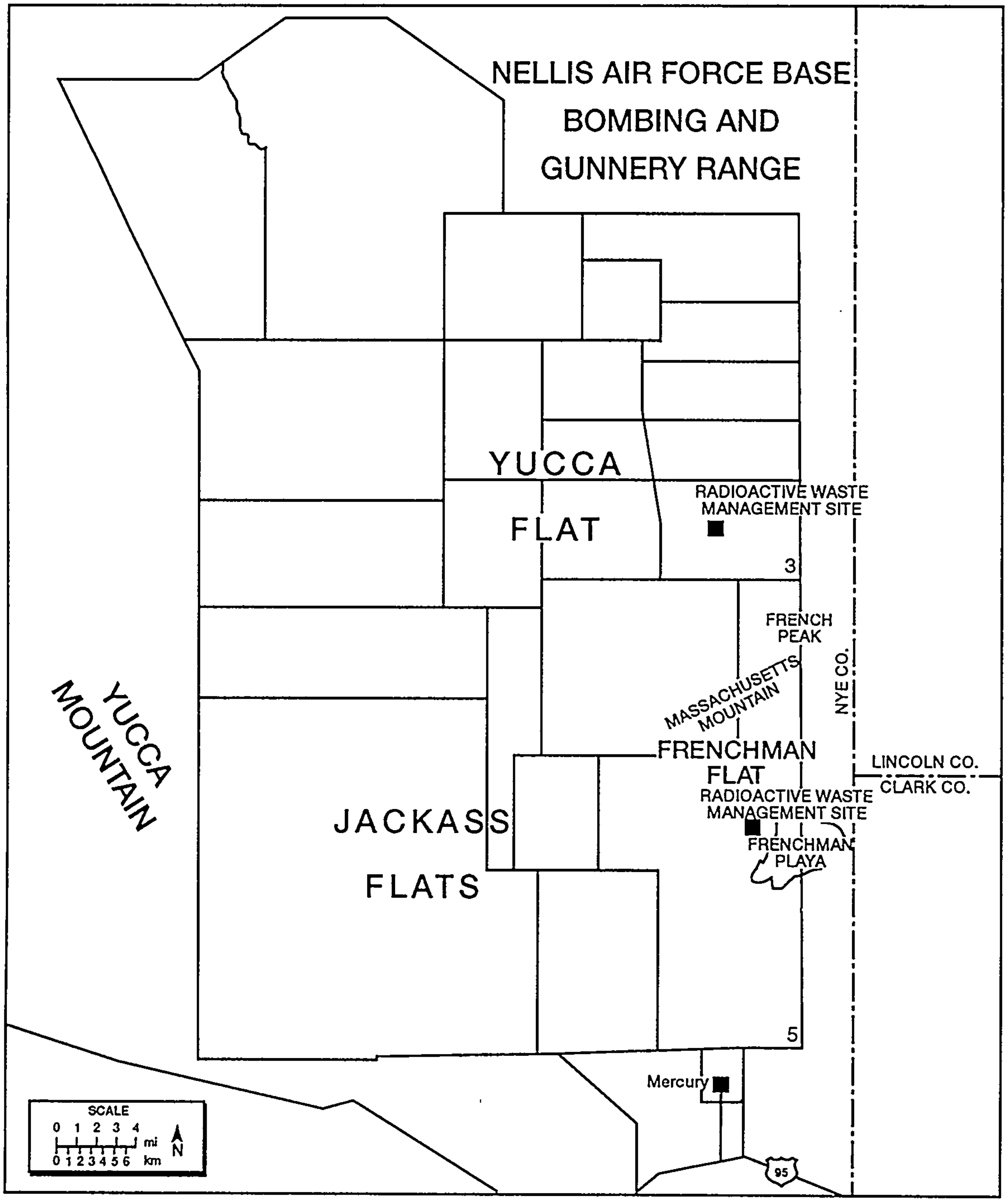

Figure NTS-2. Site Map for Nevada Test Site

Institutional Factors

Ownership

The 3,500 km^2 site is owned by DOE. Waste disposal facilities for DOE radioactive and mixed waste are located in Areas 3 and 5. The Area 3 Radioactive Waste Management Site covers an area of approximately 0.2 km^2 (50 acres). Contaminated debris from the nuclear weapons testing program and contaminated materials from other DOE sites are disposed of in subsidence craters. The Area 5 Radioactive Waste Management Site was formally established in 1978 for the disposal of unclassified and classified low-level radioactive waste generated by various NTS operations and by other DOE facilities. The Area 5 Radioactive Management Site consists of 0.37 km^2 (92 acres) with several closed trenches and open pits. A transuranic and mixed waste storage pad is also at the facility. In addition, a Mixed Waste Disposal Unit is currently proposed for location in Area 5. A RCRA Part B permit application is under review by the state of Nevada.

MLLW Storage and Generation

Approximately 0.4 m^3 of MLLW is stored at NTS, and an additional 0.2 m^3 is anticipated to be generated through 1997.*

Regulatory Considerations

An agreement is in place at NTS between DOE and the Nevada Division of Environmental Protection for the storage of transuranic and mixed waste in Area 5. Pit 3, located in Area 5, is currently operating under RCRA interim status, although the facility is not currently receiving mixed waste pending resolution of questions raised by the state of Nevada. A RCRA Part B permit application for the Mixed Waste Disposal Unit is under review by the state of Nevada.

No aquifers in this area are EPA designated sole-source aquifers.

Technical Factors

Climate

The climate of the NTS region is arid with extreme diurnal temperatures. Temperatures at NTS region range from an average daily minimum of 1° C (33° F) in January to an average daily maximum of 37° C (98° F) in July. Mean annual precipitation is 10 cm/yr (4 in/yr). The annual potential evapotranspiration is over 10 times higher than the annual precipitation, or about 100 cm (40 in).

The prevailing winds are northerly from 10 to 14 km/hr (6 to 9 mph) during the winter months, and are southerly from 17 to 35 km/hr (10 to 22 mph) during the warm summer months.

Geology

The geology and hydrology descriptions in this fact sheet will concentrate on Area 5 because the area is well characterized and already hosts the aforementioned disposal sites.

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*1994 *Mixed Waste Inventory Report*

The NTS is located in the Great Basin of the Basin and Range Geologic Province. This geologic province is characterized by large-scale north-south trending normal block faults and is topographically expressed by similarly trending mountain ranges and valleys. A typical Basin and Range valley is a gently sloping, alluvium-filled basin with a playa located in the bottom. The terrain at the NTS is extremely irregular, with elevations ranging from a high of 2,350 m (7,700 ft) on Rainier Mesa in the north to a low of approximately 945 m (3,100 ft) in Frenchman Flat in the southeast and 825 m (2,700 ft) in the extreme southwest corner on the edge of the Amargosa Desert. There is a general but frequently interrupted downward slope from north to south.

The geology at NTS consists of 3 major rock units: the Paleozoic age sedimentary rocks, the Tertiary age tuffs and lavas, and the Tertiary and Quaternary age alluvium. The Paleozoic age sedimentary rocks are overlain in many places by the volcanic tuffs and lavas. In the valleys, these rocks are covered by the alluvium.

The Paleozoic age rocks are many thousands of feet thick and are composed of carbonates in the upper and lower parts, separated by a middle section of clastics. The volcanic rocks are predominantly tuffs and lavas that are mostly of rhyolitic composition. The aggregate thickness of the volcanic rocks is many thousands of feet, but in most places the thickness of the section is far less because of erosion or nondeposition. The alluvium is derived from erosion of the nearby hills of Tertiary and Paleozoic rocks. The alluvial sediments attain thicknesses of 600 to 900 m (2,000 to 3,000 ft) in the central portions of the valleys.

Area 5 is located in Frenchman Flat, a topographically closed basin. Frenchman Lake is the playa lake that occupies the central portion of the basin. The Frenchman Flat watershed extends into Nellis Air Force Range on the east and into other NTS operation areas on the north, west, and south. The Area 5 Radioactive Waste Management Site is situated on coalescing alluvial fans southeast of the Massachusetts Mountains and northwest of Frenchman Lake. The fan areas slope gently toward Frenchman Lake. The natural topography and drainage features within this area have been altered by construction and operation of the facilities in Area 5.

At the northern portion of Frenchman Flat, the alluvium is composed of gravel, sand, and silt of varying proportions. Although the alluvium may be quite permeable, due to the generally rapid rates of precipitation, runoff is somewhat enhanced in the desert environment. Any significant mass wasting or erosion is usually associated with stream channels.

The NTS is located in Seismic Risk Zone 3, which means that major damage could occur from earthquakes. Faults in the NTS region include the Cane Springs and Yucca Faults. Two volcanic areas are in the NTS region; however, the probability that a volcanic eruption would occur in the region in the near future is low.

The potential for subsidence is low for a large portion of NTS. Consolidated rock is present on the mesas. In areas underlain by alluvium, the older alluvium is commonly more consolidated and considered more stable than the younger alluvium.

No ecologically significant natural or mineral resources have been identified at NTS.

Hydrology

Frenchman Flat is a closed basin with surface runoff draining toward the playa. Runoff is usually the greatest during severe thunderstorms that may occur during the summer months and may produce localized flash floods. Little and only temporary surface water is stored in the playa, with no apparent connection with the groundwater beneath Frenchman Flat.

The alluvial aquifer system in and around Area 5 is overlain by a thick unsaturated zone. The aquifer system consists of three major hydrostratigraphic units: unconsolidated valley-fill; volcanic ash and lava flows; and carbonate basement rock. The volcanic and carbonate hydrostratigraphic units are subdivided into numerous stratigraphic units.

Pilot wells surrounding the Area 5 Radioactive Waste Management Site indicate that the water table is approximately 245 m (800 ft) below the ground surface and is relatively flat. Some reports indicate that the Frenchman Flat groundwater is virtually horizontal with little or no lateral movement. The underlying carbonate aquifer is thought to flow to the southwest and discharge to the surface about 48 m (30 mi) southwest of the NTS boundary. Around NTS, private and public supply wells use groundwater.

Sensitive Environment

No archeological sites have been identified at NTS, although evidence of pre-Indian cultures have been found. Historic sites consist of stone cabins and corrals, a natural cave containing miners' paraphernalia, and crude remains of early mining and smelting processes.

One federally listed endangered species of wildlife (American peregrine falcon) is known to occur on NTS and one threatened species (desert tortoise) is present on the site. An additional nine species of fauna and 21 species of flora are state listed or under federal review. Most nonrodent species of mammals at NTS are on the state protected list. Five other species are protected by other regulations.

Natural springs, surface reservoirs, containment ponds, and sewage lagoons occur in various isolated areas of the NTS, some of which support wetlands.

Sources

U.S. Department of Energy, "Nevada Field Office Annual Site Environmental Report-1991". DOE/NV/10630-33, September, 1992.

Desert Research Institute, University of Nevada System, "Economic Potential of Alternative Land and Natural Resource Uses at the Nevada Test Site, Nye County, Nevada," by Katherine Richard-Haggard, March 1983.

Raytheon Services of Nevada, "Summary of Natural Resources that Potentially Influence Human Intrusion at the Area 5 Radioactive Waste Management Site DOE/Nevada Test Site, Nye County, Nevada," by D. L. Gustafson, S E. Rawlinson, and J. J. Miller, August, 1993.

Reynolds Electrical and Engineering Co., Inc., "Site Book for Waste Management," May, 1994.

U.S. Department of Commerce, Environmental Science Services Administration Research Laboratories Technical Memorandum-ARL 7, "Climatological Data - Nevada Test Site and Nuclear Rocket Development Station" by Ralph F. Quiring, August, 1968.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Nevada Test Site, Weather Service Nuclear Support Office, "Climatological Summary, Desert Rock, Nevada, June 1978-May 1991," 1991.

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Site Fact Sheet
Los Alamos National Laboratory
New Mexico

Site Description

Los Alamos National Laboratory (LANL) is located in Los Alamos County in north-central New Mexico, approximately 97 km (60 mi) north-northeast of Albuquerque and 40 km (25 mi) northwest of Santa Fe (Figure LANL-1). LANL and the associated residential and commercial areas of Los Alamos County, which occupies an area of 283 km^2 (109 mi^2), lie on the Pajarito Plateau. The plateau consists of a series of finger-like mesas separated by deep east-west trending canyons.

LANL occupies an area of 112 km^2 (43 mi^2) (Figure LANL-2). Most laboratory and community developments are confined to the mesa tops. The surrounding area is largely undeveloped. Normally, limited access by the public is allowed in certain areas of the LANL reservation.

Los Alamos County had an estimated 1991 population of approximately 18,200. Two residential and related commercial areas exist in the county. The Los Alamos townsite (the original area of development, now including residential areas known as Eastern Area, Western Area, North Community, Barranca Mesa, and North Mesa) has an estimated population of 11,400. The White Rock area (including the residential areas of White Rock, La Senda, and Pajarito Acres) has about 6,800 residents. About 40% of the people employed in Los Alamos commute from other counties. Population estimates for 1991 indicate about 218,000 persons living within an 80-km (50-mi) radius of Los Alamos. Estimated population within a 10-km radius of the site is 18,500; estimated population within a 50-km radius is 102,500.

LANL is a multidisciplinary research and development institution of the DOE. LANL's mission is the application of science and technology to solve national problems including weapons development, energy supply, and conservation programs, while basic scientific research complements and strengthens its fundamental technical capabilities. As of April 1993, about 7300 permanent employees and 2300 temporary employees or visitors were located at LANL.

Institutional Factors

Ownership

The DOE has been the designated federal landlord agency for LANL since 1978. Previous agencies filling this function were the Atomic Energy Commission and the Energy Research and Development Administration. LANL has been managed by the University of California since 1943.

Two MLLW sites are described in this fact sheet. TA-54 Area G is an existing disposal site located on Mesita del Buey, a relatively narrow, gently sloping mesa bordered on the northeast

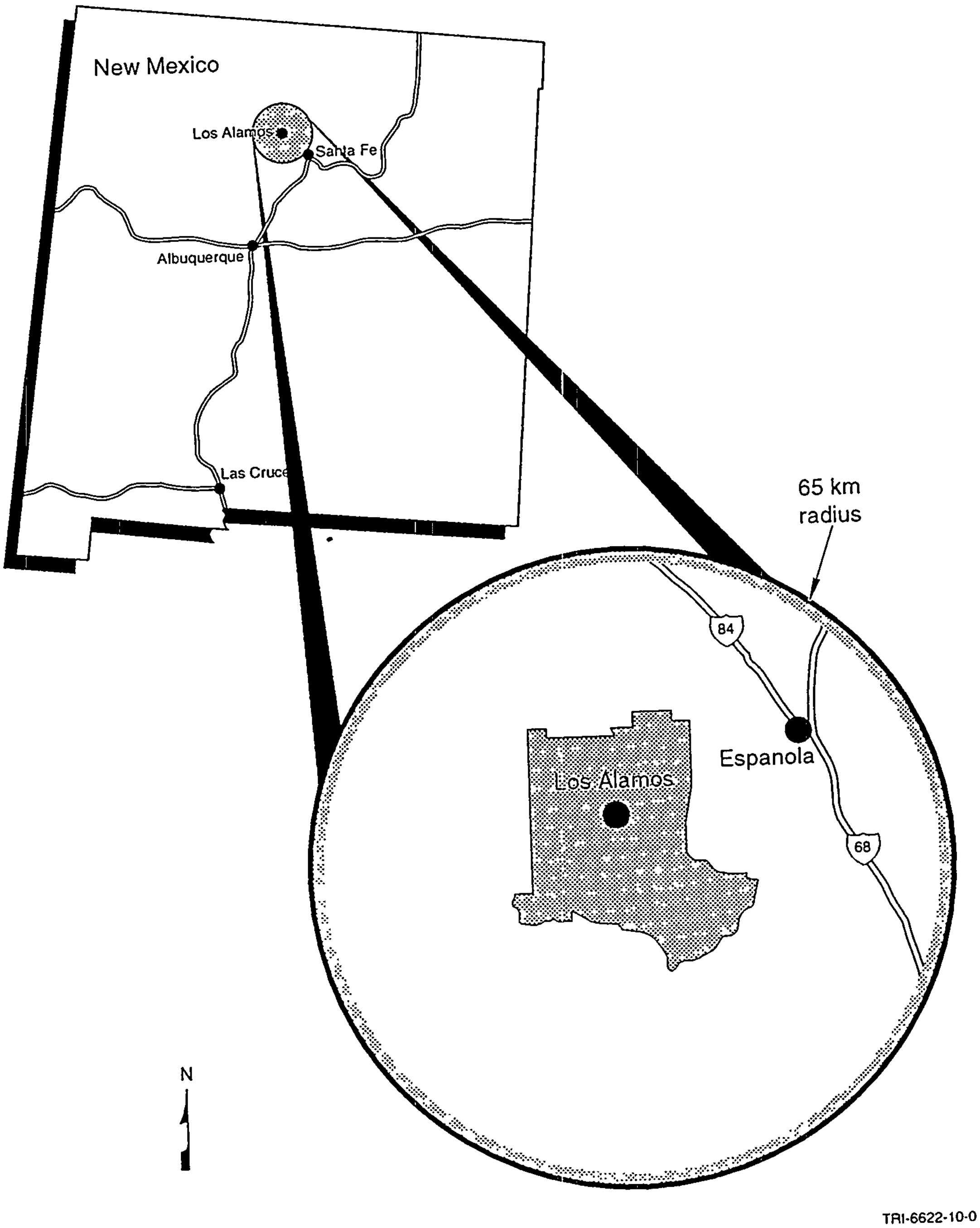

Figure LANL-1. Location Map for Los Alamos National Laboratory

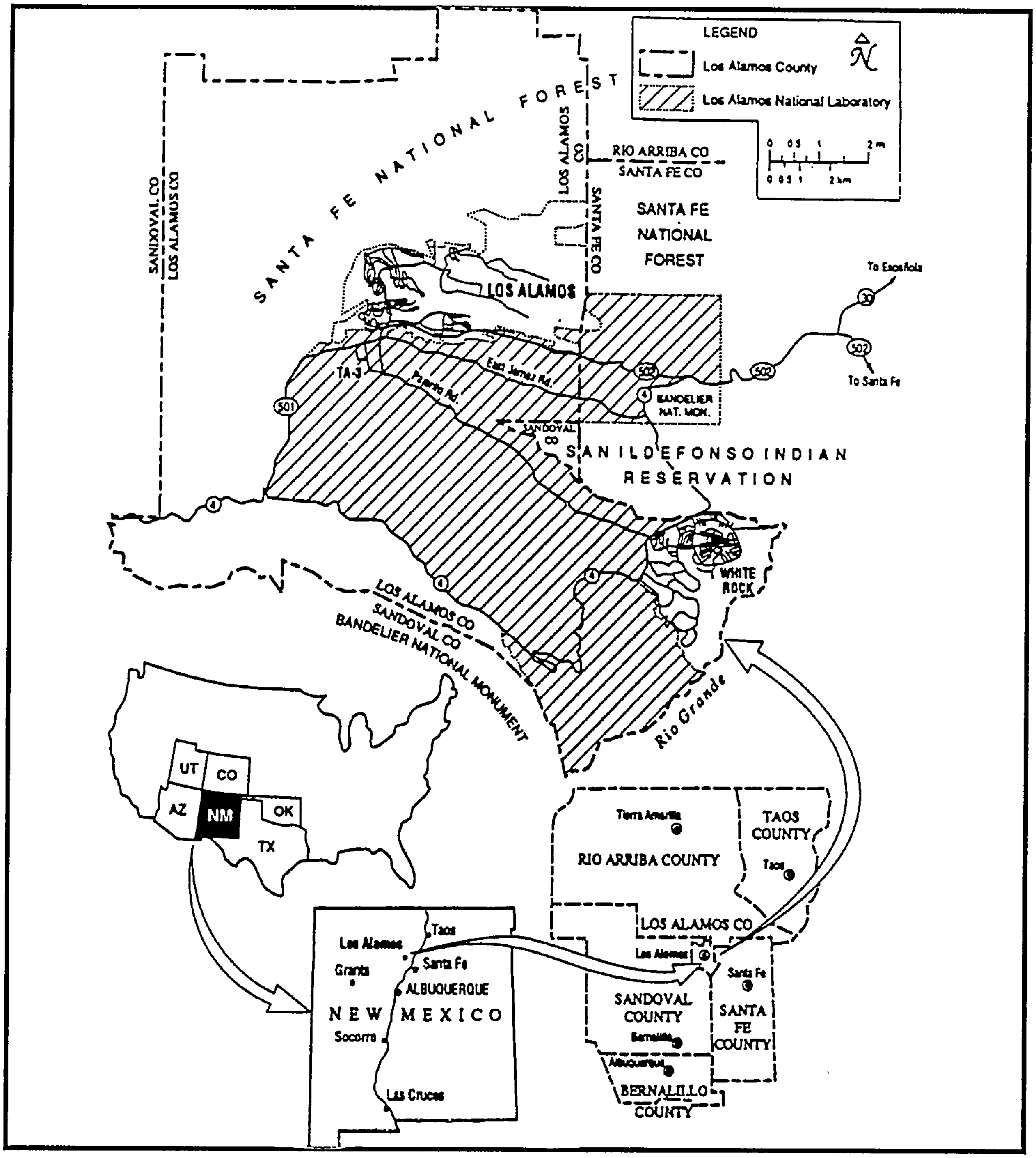

Figure LANL-2. Site Map for Los Alamos National Laboratory by Cañada del Buey and on the southwest by Pajarito Canyon. Mesita del Buey decreases in elevation from about 2140 m (7020 ft) in the west to about 2027 m (6650 ft) in the east. Mesita del Buey is approximately 305 to 396 m (1000 to 1300 ft) wide at TA-54 Area G. The south side of the mesa is deeply incised by multiple side drainages into Pajarito Canyon.

The Mixed Waste Disposal Facility is a proposed MLLW disposal site to be located at TA-67. TA-67 is located in the west-central portion of LANL on Pajarito Mesa and is bounded on the north by Pajarito Canyon and on the south by Three Mile Canyon. It lies at elevations between 2195 m (7200 ft) on the east and 2240 m (7350 ft) on the west side of the facility. The mesa has a relatively flat surface and steep walls of between 30 and 60 m (100 and 200 ft) deep dropping into the canyons.

Beginning in 1957, TA-54 Area G was used for radioactive operations waste disposal and also received waste that would now be classified as mixed waste (radioactive waste containing hazardous waste components regulated under the Resource Conservation and Recovery Act [RCRA]). In 1970, the Atomic Energy Commission directed its facilities to begin storing transuranic waste in such a way that it could eventually be retrieved. LANL then began segregating LLW from transuranic waste and dedicating specific areas within Area G for management of these wastes. Since 1986, operational MLLW has been segregated for storage at TA-54 Area G. Disposal of MLLW generated under the Environmental Restoration Program is projected to take place at the TA-67 Mixed Waste Disposal Facility. Historically, LLW has been disposed of at this site.

<u>MLLW/Storage and Generation</u>

The estimated MLLW disposal inventory is 665.4 m^3, with an additional 529 m^3 anticipated to be generated through 1997.*

<u>Regulatory Considerations</u>

No direct federal or cooperative agreements are in place regarding MLLW facility siting at LANL. LANL has negotiated a Federal Facilities Compliance Agreement with the EPA to develop a schedule to bring into compliance any MLLW currently not in compliance with storage prohibitions of the RCRA Land Disposal Restrictions. MLLW handling issues covered by the Land Disposal Restrictions may affect disposal siting decisions.

The State of New Mexico's Hazardous Waste Program was delegated authority for mixed waste by the EPA on July 25, 1990. A schedule is being negotiated with the program for submittal of RCRA Part B applications for existing and new treatment, storage, and disposal units. As such, the siting criteria necessary for RCRA waste management units will affect the Mixed Waste Disposal Facility.

Seven archeological sites may be impacted by expansion of waste disposal sites at TA-54 Area G. An informal agreement has been reached to draft a Memorandum of Understanding between

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*1994 *Mixed Waste Inventory Report*

San Ildefonso Pueblo, DOE, and LANL for issues subject to the American Indian Religious Freedom Act of 1978 and the Native American Graves Protection and Repatriation Act of 1990.

No aquifers in this area are EPA designated sole-source aquifers.

Technical Factors

Climate

Los Alamos has a semi-arid, temperate mountain climate. Summers are generally sunny with moderate, warm days and cool nights. Maximum daily temperatures are usually below 32° C (90° F). Brief afternoon and evening thundershowers are common in July and August. High altitude, light winds, clear skies, and dry atmosphere cause summer night-time temperatures to drop below 16° C (60° F) even after warm days. Winter temperatures typically range from about -9° to -4° C (15° to 25° F) during the night and from -1° to 10° C (30° to 50° F) during the day. Occasionally, temperatures drop to -18° C (0° F) or below. Some winter storms can be associated with strong winds, frigid air, and dangerous wind chills.

Average annual precipitation is nearly 48 cm (19 in). Generally, about 40% of the annual precipitation occurs during July and August thunderstorms. Winter precipitation falls primarily as snow, with accumulations of about 150 cm (59 in) annually. Snowstorms with accumulations exceeding 10 cm (4 in) are common in Los Alamos. Evapotranspiration rates in the area are approximately 70 to 100%, indicating a relatively dry environment with low moisture infiltration rates. Average annual evaporation form shallow lakes in the area could be as much as 137 cm (54 in).

Surface winds are light at Los Alamos, averaging 11 km/h (7 mph). Wind speeds are strongest from March through May and weakest in December and January. The strongest winds are generally southwesterly to northwesterly and occur in the afternoon and evening. Night winds are usually west-northwesterly at the western edge of the Pajarito Plateau due to persistent cold air drainage down the plateau. Daytime winds are generally southeasterly to southwesterly, caused by up-slope and up-valley winds, but can also be westerly during the windy season, March through May.

Geology

The Pajarito Plateau is formed by a series of sediments and volcanic extrusive rocks and is typical of a terrain produced by concurrent sedimentation and volcanism. The Plateau is cut by a series of east to west trending deep canyons forming parallel mesas. Ephemeral or intermittent streams lie at the bottoms of all the canyons. The mesa tops range in elevation from approximately 2377 m (7800 ft) above mean sea level at the flank of the Jemez Mountains, located to the west of Los Alamos, to about 1890 m (6200 ft) at their eastern extent, where they terminate above the Rio Grande Valley.

The mesas are covered by a veneer of soils and alluvial deposits but the canyon walls reveal the underlying sequence of sedimentary and volcanic rocks. The oldest geologic unit exposed around the margins of the Pajarito Plateau and penetrated by water supply wells is the Miocene and early Pliocene age (24 to 4 million year old) Santa Fe Group. The Santa Fe in this area is a thick series of terrestrial conglomerates, sandstones, and mudstones with minor limestones, evaporites, volcanic tuffs, and intercalated basalts. Sedimentary rocks usually dominate the Santa Fe Group. The Santa Fe Group is subdivided into two formations, the Tesuque and Chamita formations.

Interfingering with the Santa Fe are the volcanic rocks of the Tschicoma Formation. This formation consists of a sequence of dacitic domes and lavas that were erupted from vents in the central to northeastern Jemez Mountains between about 7 and 3 million years ago. These volcanic rocks outcrop extensively in the mountains immediately west of LANL. They are reported in the subsurface beneath the western and southern part of the LANL boundary.

Overlying the Santa Fe Group and interfingering with the Tschicoma Formation are the rocks of the Puye Formation. The Puye consists of Pliocene to Pleistocene material deposited eastward from Tschicoma volcanic centers in the northeastern Jemez volcanic field between about 4 and 1.7 million years ago. Most of the Puye conglomerates contain cobbles of dacite and andesite in a volcanic sand matrix. The Puye includes stream-flow deposits, volcanic ash and block-flow deposits, and ashfall and pumice fall deposits. In Los Alamos water supply wells, the top of the main aquifer is usually within the Puye.

The Puye is interstratified with basalts of the Cerros del Rio volcanic field under parts of LANL. These are basaltic flows, breccias, and scorias associated with the 4.6 to 2 million year old basalt field east of the Rio Grande.

Most of the mesas in the LANL area are found in and are largely made up of the Bandelier Tuff. This layer rests on the layers discussed above and consists of ash fall, ash fall pumice, and rhyolite tuff deposited as a result of a major volcanic eruption in the Jemez mountains about 1.1 to 1.4 million years ago. The Bandelier Tuff has been subdivided into three members that are from lowermost upward: the Guaje Member, a bedded pumice fall deposit; the Otowi Member, a massive pumiceous tuff breccia of ash-flow origin; and the Tshirege Member, a succession of cliff forming welded ashflows. The tuff is over 305 m (1000 ft) thick in the western part of the plateau and thins to about 79 m (260 ft) eastward at the Rio Grande. The proposed disposal site at TA-67 overlies at least 213 m (700 ft) of unsaturated Bandelier Tuff and underlying Puye Formation sediments. The corresponding depth at TA-54 Area G is about 259 m (850 ft).

A thin layer of soil cover overlies the Bandelier Tuff over much of the Pajarito Plateau, although the soil thins near canyon edges. Recently deposited sedimentary material is present in the canyons cutting the plateau. This alluvium consists primarily of detritus derived from the canyon walls formed by the Tshicoma Formation along the western edge of the Plateau and by the Bandelier Tuff further east.

Erosion of material on the Pajarito Plateau occurs primarily by shallow runoff on the relatively flat parts of the mesas, by deeper runoff in channels, and by rockfall and colluvial transport on the canyon walls. Wind erosion of disturbed soils also occurs. Erosion within the canyon bottoms occurs primarily by channelized flow along stream courses on the canyon floors.

Erosion rates of the Bandelier Tuff on the Pajarito Plateau have not been established. Estimates of long-term vertical erosion rates on the mesa tops based on stripping of overlying units have been of limited value in predicting the stability of waste sites because the resistant, cliff forming units may be eroded primarily by lateral cliff retreat and not vertical erosion. Mesa wall erosion rates may vary between the north and south facing sides of the mesas due to local moisture retention and vegetative effects. Spatial variability in erosion rates also exists on the mesa tops, being greatest in and near drainage channels and in areas of locally steeper slope gradient.

Given the long history of geologically continuous volcanic activity in the Jemez Mountains region, future volcanism and seismic activity can be expected. LANL is located in Seismic Risk Zone 2, which means that moderate damage could occur from earthquakes. Numerous small earthquakes are recorded in the Los Alamos and northern New Mexico area each year. Hazardous waste management facilities in Los Alamos County are required to demonstrate compliance with seismic location standards under the RCRA due to the possibility of being sited near recent fault zones.

No recent faults are known to occur in the Mesita del Buey at TA-54 Area G. Three faults, the Frijoles segment of the Pajarito fault zone, the Guaje Mountain fault, and the Rendija Canyon fault, have been mapped within or near TA-67 but no evidence of fault movement in the last 60,000 years is present at the Mixed Waste Disposal Facility site.

<u>Hydrology</u>

The major surface hydrologic feature in northern New Mexico is the Rio Grande, which flows north to south several miles east of these disposal sites. Los Alamos area surface water occurs primarily as intermittent streams flowing east toward the Rio Grande in the canyons. Springs on the flanks of the Jemez Mountains supply base flow into upper reaches of some canyons, but the amount is insufficient to maintain surface flows across the LANL site before it is depleted by evaporation, transpiration, and infiltration.

Surface runoff occurs on the mesas and small drainages off the mesa for brief periods during spring snowmelt and intense summer thunderstorms. Runoff from summer storms on the Pajarito Plateau reaches a maximum discharge in less than two hours and has a duration generally less than 24 hours. High discharge rates can transport suspended and bed sediments down the canyons. Spring snowmelt runoff occurs over a period of several weeks to several months at a low discharge rate. Runoff from heavy thunderstorms or heavy snowmelt may reach the Rio Grande several times a year in some drainages. Water from the Rio Grande is used for irrigation of crops both upstream and downstream of LANL. No municipal water supplies are taken directly from the Rio Grande downstream of LANL.

Groundwater occurs in three modes in the Los Alamos area: (1) water in shallow alluvium in canyons; (2) perched water (a groundwater body above an impermeable layer that separates it from the underlying main body of groundwater by an unsaturated zone); and (3) the main aquifer of the Los Alamos area.

Intermittent stream flows in canyons of the plateau have deposited alluvium that ranges from less than 1 m (3 ft) to as much as 30 m (100 ft) in thickness. The alluvium is permeable, in contrast to the underlying tuff and sediments. Intermittent runoff in canyons infiltrates the alluvium until its downward movement is impeded by the less permeable tuff and volcanic sediment, resulting in a shallow and restricted groundwater body that moves downgradient within the alluvium. As the water moves downgradient, it is depleted by evapotranspiration and movement into underlying sediments.

Perched water has been found in conglomerates and basalts beneath the alluvium in portions of Pueblo, Los Alamos, and Sandia Canyons. Water has been encountered in wells in these canyons at levels between 37 and 137 m (120 and 450 ft).

The main aquifer of the Los Alamos area is the only aquifer capable of serving as a municipal water supply. The aquifer supplies the primary source of drinking water for the towns of Los Alamos and White Rock and for Bandelier National Monument to the south but has not been classified as a sole-source aquifer. Estimated usage in the LANL area is 15 million liters (4.1 million gallons) per day. The surface of the aquifer rises westward from the Rio Grande within the Tesuque and Cerro del Rio Formations into the lower part of the Puye Formation beneath the central and western part of the Plateau. The top of the main aquifer is about 335 m (1100 ft) beneath TA-51 to the west and about 259 m (850 ft) beneath TA-54, Area G to the east. The primary recharge for the main aquifer is inferred to be from the west because of the slope of the piezometric surface. The hydraulic gradient of the aquifer averages about 11 to 15 m/km (60 to 80 ft/mi) within the Puye Conglomerate but increases to 15 to 19 m/km (80 to 100 ft/mi) along the eastern edge of the plateau as the water in the aquifer enters the less permeable sediments of the Santa Fe Group. The rate of movement of the water in the upper section of the aquifer varies, depending on the aquifer materials. Aquifer tests indicate the movement ranges from 6 m/yr (20 ft/yr) in the Tesuque Formation to 105 m/yr (345 ft/yr) in the more permeable Puye Conglomerate.

The vadose or unsaturated zone consists of that part of the subsurface above the water table where pore spaces and fractures are not saturated with water. At the disposal sites discussed in this fact sheet, this zone consists of between 213 and 259 m (700 and 850 ft) of unsaturated volcanic tuff, sediments, and basalts of the Bandelier Tuff, the Puye Conglomerate, and the basaltic rocks of Chino Mesa.

The most significant aspect of the tuff is its ability to act as a sponge. Most of the pore spaces in the tuff are of capillary size and have a strong tendency to hold water against gravity by surface tension forces. The natural moisture content of the tuff forming the mesas between the canyons is generally less than 5% by volume at depths greater than a few meters, the zone affected by seasonal inputs of moisture and evapotranspiration. This low moisture content has been attributed to the protective cap of clay soil derived by weathering of the tuff near the surface, low rainfall, and high evapotranspiration. The existence of low moisture content is further supported historically by the absence of weathering below 9 m (30 ft) and the overall absence of perched water in the tuff at potential perched aquifer horizons. The combination of the Bandelier Tuff's low moisture content beneath the mesa tops, its associated hydraulic characteristics, and its thickness provide a substantial degree of protection to the main aquifer.

Sensitive Environment

Numerous archeological and cultural resource sites exist on the Pajarito Plateau; close to 1000 small ruins date from the fourteenth and fifteenth centuries. Many of these sites qualify as eligible for inclusion on the National Register of Historic Places. Both the TA-67 and TA-54 Area G disposal projects contain archeological sites, including Tshirege pueblo ruin, an important traditional and cultural location for the people of San Ildefonso Pueblo.

The Santa Fe National Forest bounds the LANL on the west, southwest, and northeast. These tracts are under the jurisdiction of the U.S. Forest Service, Bureau of Land Management, Bandelier National Monument, General Services Administration, and Los Alamos County. Bandelier National Monument lies along portions of the southern boundary. The San Ildefonso Indian Reservation bounds portions of the east side of LANL. The proposed Mixed Waste Disposal Facility at TA-67 lies in the central part of LANL property and does not border these entities. TA-54 Area G shares its northern border with San Ildefonso lands. The DOE controls the area within LANL boundaries and has the option to completely restrict access.

LANL property supports a large diversity of ecosystems due to the wide elevation range present (approximately 1524 m [5000 ft] between the Rio Grande and the Jemez Mountains) and to the many canyons with abrupt surface slope changes in the area. Six major vegetative community types are found in Los Alamos County. LANL conducts surveys to evaluate whether physical characteristics required by a threatened or endangered species are present pursuant to the Endangered Species Act of 1973. No endangered species appear to have potential occurrence in the TA-54, Area G disposal project areas. Two federal candidate species and one New Mexico listed wildlife species may potentially occur in the TA-67 site.

Wetlands within LANL boundaries have been identified in Sandia, Pajarito, and Pueblo canyons with smaller discrete ponds or marshes in other parts of LANL. Currently, there are no wetlands located within the two project areas.

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Site Fact Sheet
Sandia National Laboratories/New Mexico and
Inhalation Toxicology Research Institute
New Mexico

Site Description

Both Sandia National Laboratories/New Mexico (SNL/NM) and the Inhalation Toxicology Research Institute (ITRI) are located on Kirtland Air Force Base (KAFB), on the southern edge of the City of Albuquerque, New Mexico (Figure SNL-1). KAFB is bordered on the north by the city, on the east by the Manzano Mountains, and on the west and south by the Isleta Indian reservation and NM State lands. The facility is within several miles of the intersection of two major interstate highways, I-40 and I-25, which generally bisect the state into four general quadrants and serve as major transportation routes through the region (Figure SNL-2).

The City of Albuquerque, with a population of 385,000, is within 10 km (6.2 mi) of the site. Within 50 km (31 mi) of the site, an additional population of 74,000 is found in small towns and suburban communities, bringing the total population to 459,000.

In total, the Kirtland reservation encompasses 190 km^2 (47,000 acres), but DOE owns or operates only a fraction of this area. SNL/NM consists of five distinct technical areas and remote test areas that occupy 11.3 km^2 (2,800 acres); ITRI occupies 0.02 km^2 (5 acres) in an area south of the SNL/NM areas. DOE also manages a security-restricted office building adjacent to the SNL/NM facilities, as well as an undeveloped area as a designated buffer zone at the southern end of the reservation.

KAFB is an Air Force Materiel Command base that supports the development, management, and retirement of nuclear weapons and associated systems. SNL/NM has conducted defense-related research and development since the Laboratory was founded in 1947. It has diversified since its inception to include a broad range of research initiatives. ITRI conducts toxicology research on human-health impacts relating to inhalation of radiological, chemical, and physical hazards. Employment at SNL/NM is estimated to be 8500; ITRI employs approximately 100 staff.

Institutional Factors

Ownership

KAFB consists of the Kirtland Air Force Base Military Reservation as well as Cibola National Forest land withdrawn by the USDA Forest Service for the use of the US Air Force under a Memorandum of Agreement between the Forest Service and the Air Force. Some Cibola National Forest land has also been withdrawn for use by DOE under a similar Memorandum. DOE owns land inside the boundaries of the KAFB Reservation, which encompasses the five SNL technical areas. Remote test areas and ITRI facilities operate under a series of land-use agreements between DOE, KAFB, and the Forest Service. Two "buffer zones", which exist

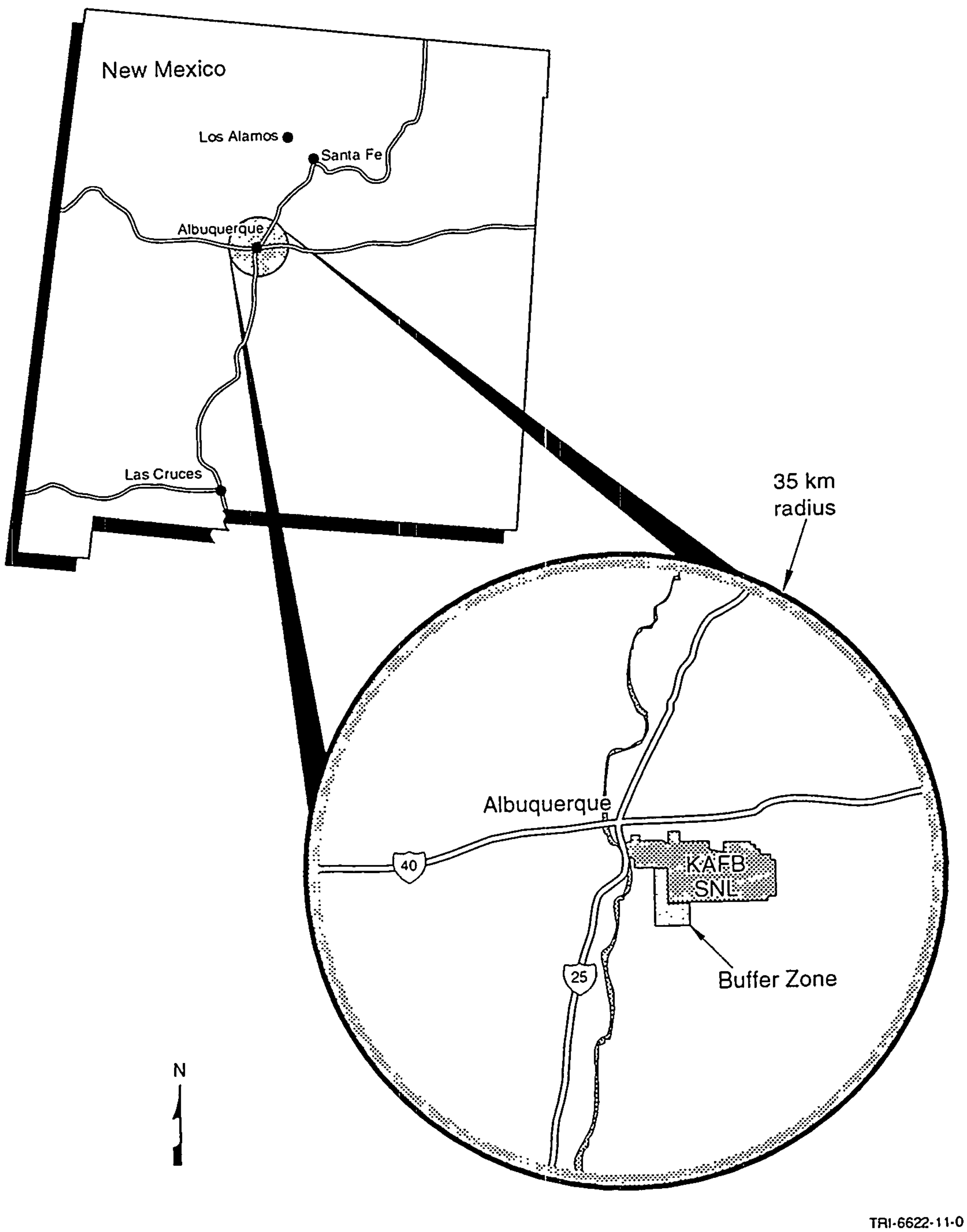

Figure SNL-1. Location Map for Sandia National Laboratories/New Mexico and Inhalation Toxicology Research Institute

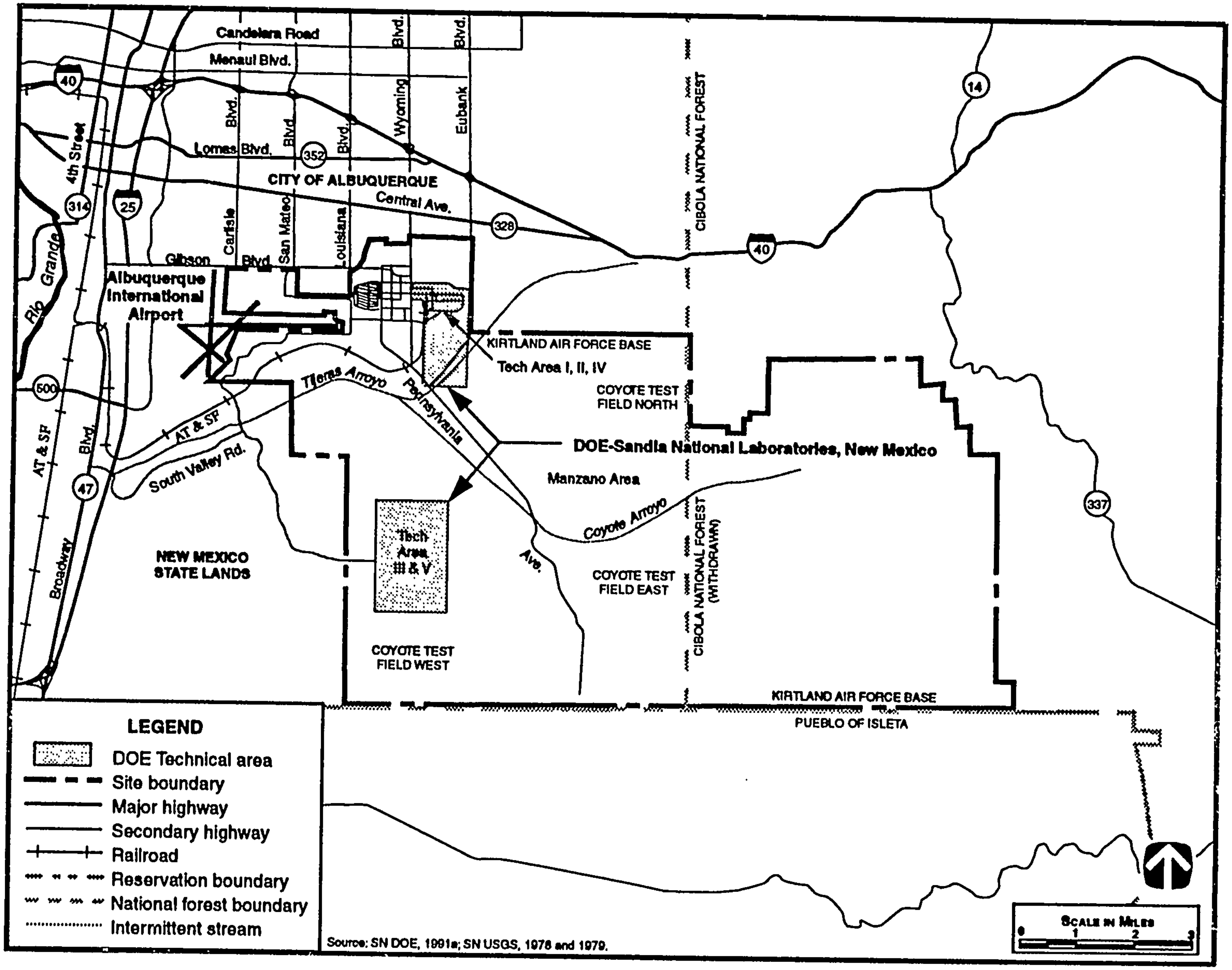

Figure SNL-2. Site Map for Sandia National Laboratories/New Mexico and Inhalation Toxicology Research Institute according to agreements with the State of New Mexico and the Bureau of Indian Affairs, are also located adjacent to the KAFB boundary.

No LLW or MLLW disposal facilities are operating at SNL/NM or ITRI, and no future LLW or MLLW disposal facilities are currently planned for either site. Historically, LLW has been disposed of at this site.

MLLW Storage and Generation

The estimated volume of MLLW inventory at SNL/NM and ITRI is reported to be 69.3 m^3, with an additional 11 m^3 anticipated to be generated through 1997.*

Regulatory Considerations

No federal or cooperative agreements are in place regarding MLLW management or facility siting at KAFB.

The groundwater underlying the facility is not an EPA-designated sole-source aquifer.

Technical Factors

Climate

The climate in the Albuquerque area is arid with low precipitation, high evapotranspiration, wide temperature extremes, and seasonal winds. The average annual temperature in Albuquerque is 13° C (56° F) with an average diurnal temperature range of 15.6° C (28° F). Normally, temperatures rarely fall below -18° C (0° F). The valley and mesa areas are arid, with an average annual precipitation of 20 cm (8 in). Half of the average annual precipitation occurs in the form of brief but heavy thunderstorms during the summer that are diverted to two surficial drainage channel (arroyo) systems on the base. Evapotranspiration in the area is estimated at 95% of the annual rainfall, or about 19.3 cm (7.6 in). Average annual evaporation from shallow lakes in the area could be as much as 142 cm (56 in). Prevailing winds are generally from the north in winter and from the south along the river valley in summer. Wind speed is generally greater in late winter and early spring, but sustained winds greater than 19.2 km/h (12 mph) occur only 20% of the year.

Geology

KAFB is situated in the eastern portion of the Albuquerque Basin, which is one of the largest of a series of north-trending basins along the Rio Grande. This basin is bounded by the Sandia and Manzano Mountains in the east, the Lucero uplift and Puerco plateau in the west, and the Nacimiento uplift in the north. Large-scale faulting, deepening of the basin, and tilting of the mountain areas occurred approximately 11.2 to 5.3 million years ago. Since then, basin deposits have been laid down in a complex sequence of sedimentary and volcanic rocks.

The majority of the Albuquerque Basin is composed of poorly consolidated sediments eroded from the surrounding mountain areas following the faulting and structural changes that occurred

*1994 *Mixed Waste Inventory Report*

11.2 to 5.3 million years ago. The upper part of the basin fill is comprised of a complex sequence of gravel, sand, silt, clay, and caliche deposits known as the Santa Fe Formation (middle to late Cenozoic). Underlying these rocks are sedimentary rocks of unknown total thickness, although gravity and aeromagnetic mapping indicate that these rocks extend about 4,600 m (15,000 ft) below ground level.

With the exception of the Manzano Mountains on the eastern edge of the reservation, the KAFB topography is generally flat. Some areas of the facility have arroyos that are evidence of historical surface flooding, but these are localized.

The Albuquerque area is located in Seismic Risk Zone 2, which means that moderate damage could occur from earthquakes. Records for the region show fairly high activity but low magnitude and intensity. No evidence exists of movement on any fault at or near the facility in recent time periods.

Soils in the Albuquerque basin are generally well-drained loamy soils, with minor amounts of gravely and stony soils along the arroyos and on the mountains. They are not generally subject to mass wasting or erosion except during runoff from heavy storms.

The only potential natural resources that might be exploited beneath the KAFB site are sorted rock materials that could be quarried for construction. Such borrow pits are common along the Rio Grande floodplain to the north of Albuquerque, and are not unique to KAFB.

Hydrology

The major surface hydrologic feature in central New Mexico is the Rio Grande, which flows north to south through Albuquerque and lies approximately 8 km (5 mi) west of KAFB. Surface water on KAFB is in the form of sheet flow draining into small gullies and carried by natural and artificial flow paths into two primary arroyos that flow intermittently during heavy thunderstorms and spring snow melts. Most of this flow does not reach the Rio Grande as surface water due to evapotranspiration and percolation into the permeable alluvial deposits. Tijeras Arroyo and Arroyo del Coyote are identified by the US Army Corps of Engineers as within the 100 year floodplain, but these channels remain undeveloped. No permanent surface water bodies are found on the reservation with the exception of a small pond on the Tijeras Arroyo Golf Course.

The vadose zone is an important part of the hydrologic system in the KAFB area and its thickness is generally quite large (from 15 to more than 150 m [50 to more than 500 ft]); consequently, any contaminants released near the ground surface must travel a long distance before reaching the water table. The regional area recharge rate outside of the arroyos is estimated to be less than 5% of the total annual precipitation.

KAFB is situated in an area that included two very different geologic environments separated by an assemblage of fault systems that have a major impact on the area's hydrology. The framework consists of three hydrogeology regions. Region 1 encompasses essentially the entire western half of KAFB, with depths to groundwater in excess of 120 m (400 ft) and with unconfined and partially confined aquifers composed of basin-fill deposits. Region 3 comprises a large area on the east side of KAFB in the foothills and canyons of the Manzano Mountains and which is characterized by shallow unconfined groundwater with fractured rock hydrology. Region 2 represents the transition region between Regions 1 and 3, and is characterized by a system of steeply dipping normal faults and associated complex groundwater flow.

The basin-fill (Santa Fe Group) deposits are the primary aquifer in the Albuquerque Basin. The basin-fill aquifer consists of interbedded gravel, sand, silt, and clay and is part of a complex stream-aquifer depositional system that has been extensively developed in parts of the basin for irrigation and for domestic and municipal water supplies. Values of hydraulic conductivity range from 0.08 to 15 m/day (0.25 to 50 ft/day). The aquifer properties have a considerable range of values due to the large variations in lithology of basin-fill deposits. Groundwater flows to the west-northwest, with the flow direction strongly affected by the cone of depression caused by Albuquerque municipal drinking water supply wells located north of KAFB.

This groundwater system is used as the main water supply for the City of Albuquerque, as well as for other communities along the Rio Grande. Private wells to the west and south are also used by residents to withdraw potable water for domestic use.

Sensitive Environment

The Cibola National Forest is northeast of KAFB and just east of the City of Albuquerque. The Manzano Mountains lie immediately to the east of the base, with a portion of the range reserved for federal government use. Manzano Mountains State Park is located south of the center of the reservation, but access is limited to the east side of the range. Indian Petroglyphs National Monument is located in western Albuquerque. The Isleta Indian Reservation extends over a wide area southwest of the facility and borders KAFB.

No federally listed threatened or endangered species are known to occur within KAFB. Three New Mexico-listed endangered cacti and five state-listed endangered-wildlife species occur within KAFB. Only limited archeological and cultural resources have been identified on the KAFB land area, but such resources abound in central New Mexico.

The arroyo and canyon drainage systems on KAFB include two small areas with wetlands habitats.

Sources

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Site Fact Sheet
Brookhaven National Laboratory
New York

Site Description

Brookhaven National Laboratory (BNL) is a multi-disciplinary scientific research center located on Long Island close to the geographical center of Suffolk County, New York, about 97 km (60 mi) east of New York City (Figure BNL-1). Vehicular access to the site is from the William Floyd Parkway (CR46), a divided four-lane parkway running north and south along the western site boundary. The Long Island Expressway (Interstate 495) borders the southern boundary of the Laboratory. The principal BNL facilities consist of 21.3 km^2 (5265 acres) of mostly wooded habitats, except for a developed area of about 6.7 km^2 (1650 acres) (Figure BNL-2).

Within a 10 km (6.2 mi) radius of BNL, Coram (population 30,500), Shirley (population 24,000), and Mastic (population 14,000) are the only communities with greater than 10,000 people. The area west of the site is more urbanized than the eastern region. The population within a 50-km radius of the site is estimated to be 1.8 million; about 180,000 people are estimated to live within 10 km (6.2 mi) of the site.

BNL is a diverse research and development facility with ongoing programs and projects in nuclear physics, chemistry, and medicine. The Laboratory plays a central role in national and international research on high energy physics.

Institutional Factors

Ownership
The site is owned by DOE.

No LLW disposal facilities are operating on the site, and no LLW or MLLW disposal facilities are planned. Historically, LLW has been disposed of at this site.

MLLW Storage and Generation
The estimated volume of MLLW inventory at BNL is 84.9 m^3, with an additional 27 m^3 anticipated to be generated through 1997.*

Regulatory Considerations
BNL was placed on the National Priorities List in 1989. In 1992 an Interagency Agreement was signed by DOE, EPA, and New York State for environmental restoration activities under CERCLA, RCRA, and State regulations.

Both the lower aquifer system and the Pleistocene Upper Glacial Aquifer that underlie BNL are EPA designated sole source aquifers.

*1994 *Mixed Waste Inventory Report*

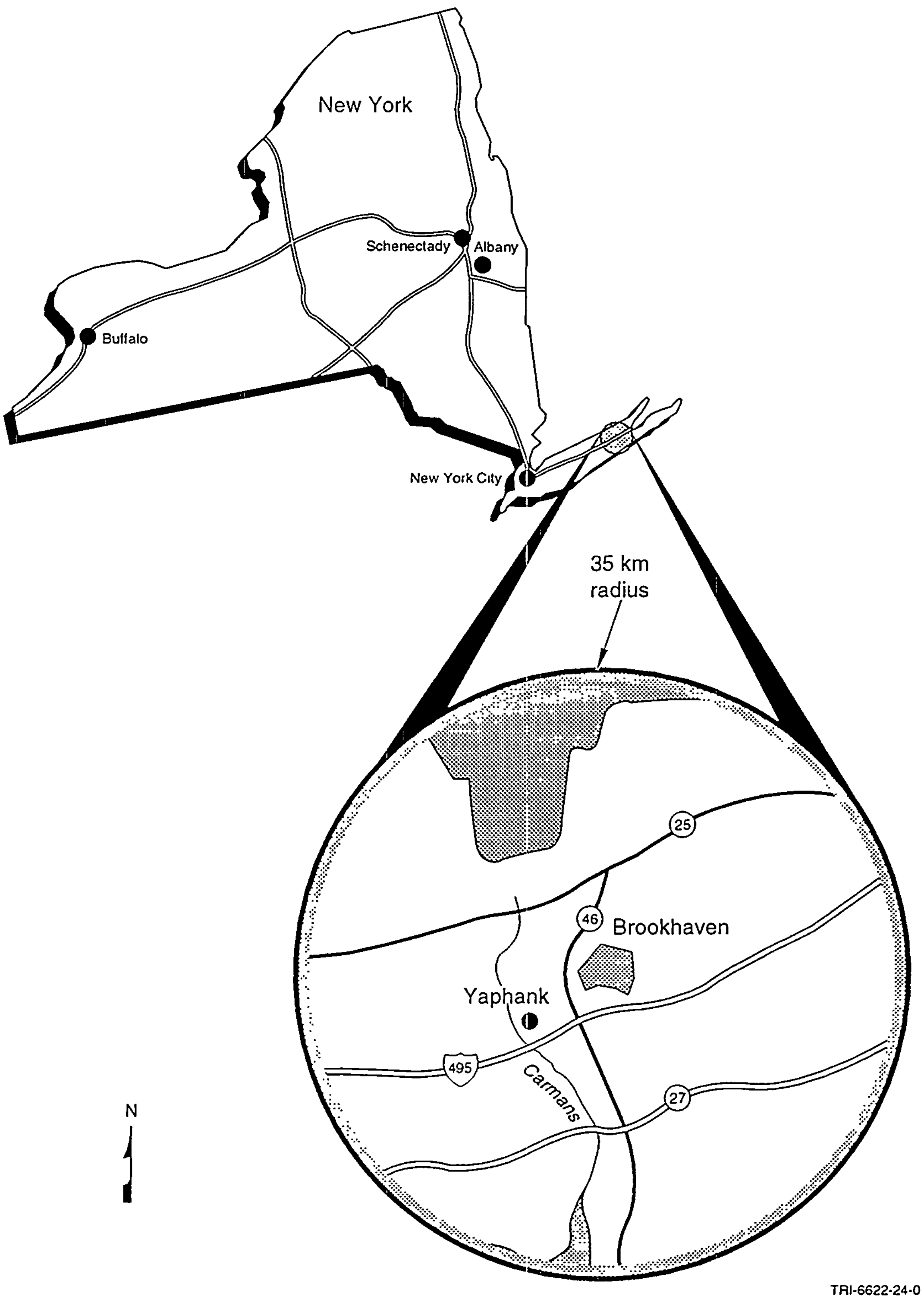

Figure BNL-1. Location Map for Brookhaven National Laboratory

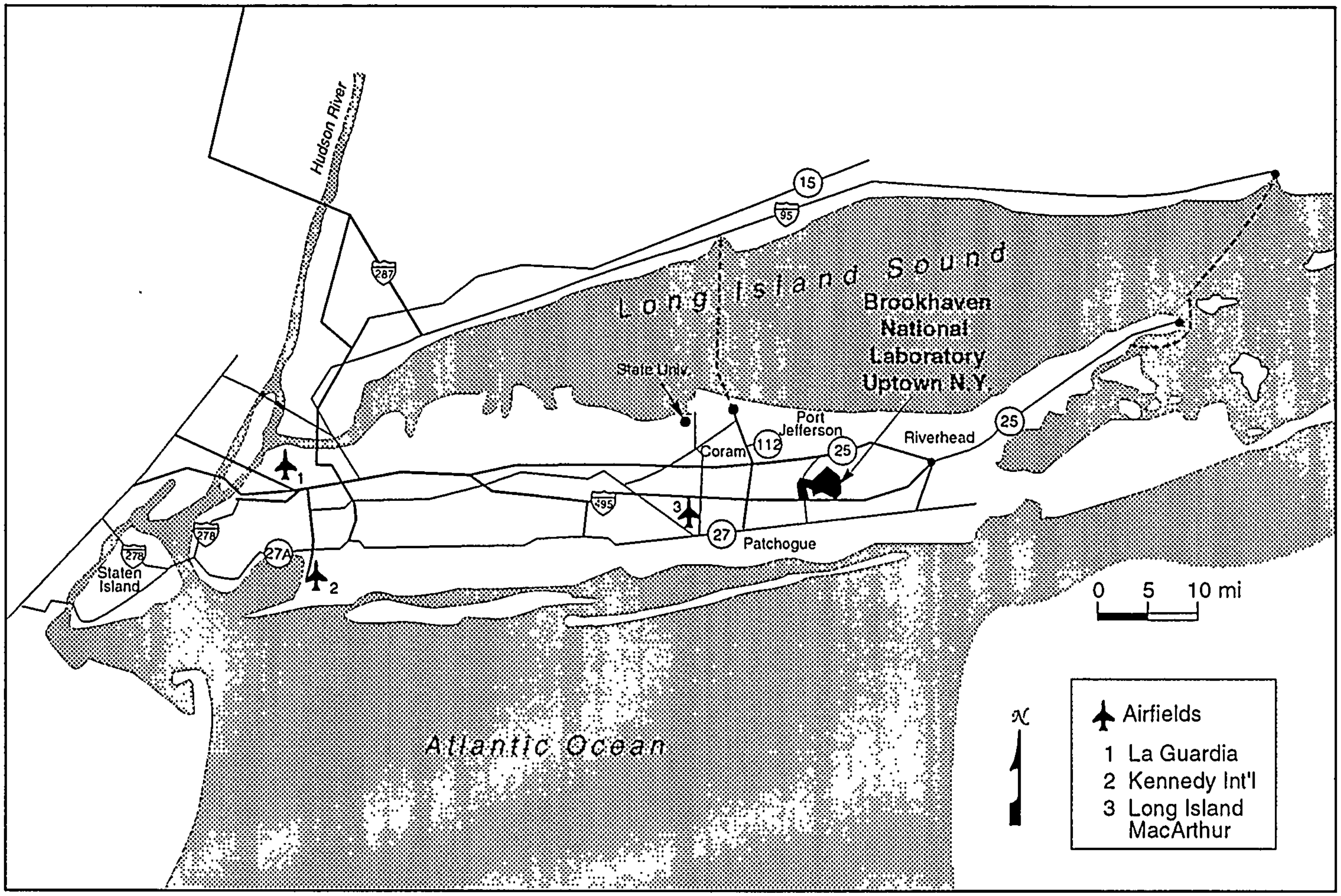

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Figure BNL-2. Site Map for Brookhaven National Laboratory

Technical Factors

Climate

The BNL site exposure is a cross between maritime and continental, greatly influenced by the Atlantic Ocean, Long Island Sound, and the various associated bays that moderate both summer and winter temperatures. Temperatures at BNL range from 0° C (minimum average day) in January to 21° C (maximum average day) in July. Precipitation averages about 122 cm (48 in) per year, and a major feature of this pattern is the small range of average monthly values, from about 6.35 cm to 12.7 cm. Evapotranspiration is estimated to be about 53 cm (21 in) per year. Prevailing ground level winds are from the southwest during the summer, from the northwest during the winter, and about equally from these two directions during the spring and fall.

Geology

BNL is located on Long Island, which is composed of unconsolidated sands, gravels, and clays. The uppermost sediments on Long Island were deposited along the leading edges of the last continental glaciers more than 8,000 years ago. The Lab site is in the upper part of the Peconic River Valley, which is bordered by two lines of low hills or terminal moraines. The moraines extend east and west beyond the limits of the valley nearly the full length of Long Island and form its most predominant topographic features. Just west of the Laboratory, the two moraines are connected by a narrow north-south ridge. East of the ridge, and enclosed by it and the two moraines, is Manorville Basin. The BNL grounds are on the Basin's relatively high west margin. The site terrain is gently rolling, with elevations varying between 13.3 and 36.6 m (43.6 and 120 ft) above sea level.

The basement rocks underlying the site are overlain by approximately 366 m of unconsolidated sands, gravels, and clays that were deposited 140 to 65 million years ago (Raritan and Magothy Formations) and by Pleistocene sediments deposited 2 million to 10,000 years ago (0-3 m of Gardiners Clay overlain by 52-61 m [170-200 ft] of glacial sands and gravel).

Long Island lies in Seismic Risk Zone 1, which means that minor damage could occur from earthquakes. Seismologists have concluded that the probability of an earthquake sufficiently intense to damage buildings is remote.

Surface deposits vary in texture over the site but are generally sands and loams. Sandy soils are generally well-drained and moderately to coarsely textured. These soils have slight erosion potential, and the lack of clay fractions suggests that both slope stability and consolidation problems are remote. Nearby areas have been designated as Prime Farmland or contain Soils of Statewide Importance by the State of New York.

No mineral resources are known to be present at or near the site. All mineral exploration and development was formally prohibited at BNL by the Acquired Lands Act of 1947.

Hydrology

The land lies on the western rim and headwaters of the Peconic River watershed. The onsite tributary of the Peconic River both recharges and receives water from the groundwater aquifer depending on the elevation of the water table. In times of drought the tributary typically recharges to groundwater, while in times of normal to above average precipitation, the tributary receives water from the aquifer. During times of low precipitation, water in the tributary does not flow offsite. Freshwater marshes in the north and east quadrants of the site remain in an area once part of a principal tributary to the Peconic River system.

The 100 year floodplain associated with the Peconic River encompasses all natural grades within 3 meters of the riverbank and the wetland areas of BNL located in the central to south central portion of the property. The remainder of the site is on higher ground above the floodplain.

The groundwater reservoir of Long Island comprises a saturated, unconsolidated mass of gravel, sand, silt, clay, and mixtures of these that overlies impermeable, consolidated bedrock. The major groundwater units in the BNL area include, from deepest to shallowest, the lower Lloyd aquifer, Magothy aquifer, and the uppermost (Pleistocene) Upper Glacial Aquifer. The principal water table aquifer in the area is 40 to 61 m (131 to 200 ft) of glacial deposits. The Pleistocene deposits are generally highly permeable. Water penetrates these deposits readily, with little direct runoff into surface streams. On average, about 50% of the annual precipitation percolates through the soil to recharge groundwater, and less than 2% becomes surface water runoff. Recharge is estimated to be approximately 57 cm (23 in) per year. Groundwater is found in unconfined water table conditions, and in confined aquifers under artisan conditions. Depth to groundwater varies between 1 m (3 ft) in the low-lying areas near the Peconic River to as much as 15 m (49 ft) in the central area of the site.

BNL has been identified as being over a deep recharge zone for the lower aquifer system. It is estimated that two fifths of the recharge from rainfall moves into the deeper aquifers.

Groundwater in the vicinity of BNL moves predominantly in a southerly direction towards Great South Bay, although the flow becomes somewhat easterly within the Peconic River watershed. Percolation occurs rapidly into the sandy sediments of the uppermost deposits underlying BNL. The estimated rate of groundwater velocity is 15 to 30 cm/day (0.5 to 1.0 ft/day).

Almost all supplies of water for individual and municipal use in the BNL area, in addition to the water used by BNL, are drawn from groundwater. BNL's water supply is obtained exclusively from the Pleistocene Upper Glacial Aquifer, whereas nearby municipal water supplies are obtained from both the Upper Glacial and Magothy aquifers.

Sensitive Environment

No historic sites have been listed in the Federal Register of Historic Places, and no archeological sites have been identified in the area. Three areas--the old cyclotron enclosure, Brookhaven Graphite Research Reactor, and remnant Army training trenches--have been identified by the

New York State Historic Preservation Officer as potentially eligible for inclusion on the National Register of Historic Places.

The portion of the Peconic River that flows through BNL is classified as "scenic" under the State's Wild, Scenic, and Recreational River System Act. Brookhaven State Park (undeveloped) lies just north of the site. A national cemetery is located 10 km (6.2 mi) to the north, and the Wertheim National Wildlife Reservation and the Poospatuck Indian Reservation are approximately 10 km (6.2 mi) south. Prosser Pines in Yaphank, the only virgin stand of white pine on Long Island, is located in nearby Cathedral Pines Park. A number of state parks and national seashore areas are less than 20 km (12.4 mi) from the site to the north and south.

Except for occasional transient individuals, no listed or proposed federally threatened or endangered species occur at BNL. The tiger salamander, a New York State Endangered Species, has been found to breed at several locations at BNL. The banded sunfish, a New York States species of special concern, is a confirmed inhabitant of the Peconic River within BNL boundaries.

Freshwater wetlands can be found at BNL along the Peconic River and in the central to south central portion of the site. These wetlands are identified in the U.S. Fish and Wildlife Service's National Wetlands Inventory and jurisdictional mapping completed by the New York State Department of Environmental Conservation. These wetlands map up approximately 8-10 percent of BNL's land surface.

Approximately 75% of BNL is primarily woodland. As surrounding areas are cleared and developed, the BNL site is becoming a refuge for wildlife; however, no formal wildlife refuges have been designated.

Sources

Brookhaven National Laboratory, *Brookhaven National Laboratory 1993 Technical Site Information Document*, prepared for the U.S. Department of Energy, 1993.

Naidu, J.R., B.A. Boyce, and R.P. Miltenberger, *Brookhaven National Laboratory Site Environmental Report for Calendar Year 1991*, Brookhaven National Laboratory Associated Universities, Inc., Upton, New York, prepared for the U.S. Department of Energy, BNL-52347, September 1992.

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Site Fact Sheet
Knolls Atomic Power Laboratory—Kesselring
New York

Site Description

The Knolls Atomic Power Laboratory—Kesselring (KAPL-K) site is located in Saratoga County in mideastern New York (Figure KAPLK-1). The reservation consists of over 15.8 km^2 (3900 acres) centered about 24 km (15 mi) north of the city of Schenectady and about 13 km (8 mi) west of Saratoga Springs. The site includes three operating naval nuclear propulsion prototype plants and support facilities, as well as one prototype plant that is in the process of being permanently shut down. One of the three operating plants is currently scheduled to be shut down in 1996. The developed portion, or security area, of the reservation, which contains the prototype plants, consists of approximately 0.2 km^2 (50 acres) (Figure KAPLK-2).

The four largest towns within a 50 km (31 mi) radius of KAPL-K are Schenectady (population 66,000), Saratoga Springs (population 25,000), Rotterdam (population 28,000), about 25 km south-southwest of the site, and Amsterdam (population 21,000), about 25 km southwest. Estimated population within a 10 km (6.2 mi) radius is 2000; estimated population within a 50 km (31 mi) radius is 400,000.

Development of KAPL-K began in 1948. The site was originally considered as a potential location for testing of power breeder reactors that are liquid metal cooled, although none were ever built. The scope of KAPL-K's activities changed during the early 1950s and became focused on testing nuclear propulsion plants for the U.S. Navy and subsequent training of Navy operators for these propulsion plants. Employment at KAPL-K consists of approximately 650 contractor employees, 600 subcontractor employees, and 1400 U.S. Navy personnel.

Institutional Factors

Ownership
The KAPL-K site is owned by the U.S. DOE. KAPL-K was operated from its inception in 1950 until 1993 under U.S. government contract by the General Electric Company. In April 1993, responsibility for operation of KAPL-K was transferred to a subsidiary of Martin Marietta. No LLW disposal facility is operating at KAPL-K, and no future LLW or MLLW disposal units are currently planned.

MLLW Storage and Generation
The estimated volume of MLLW inventory at KAPL-K is 2 m^3, with an additional 31 m^3 anticipated to be generated through 1997.*

*1994 *Mixed Waste Inventory Report*

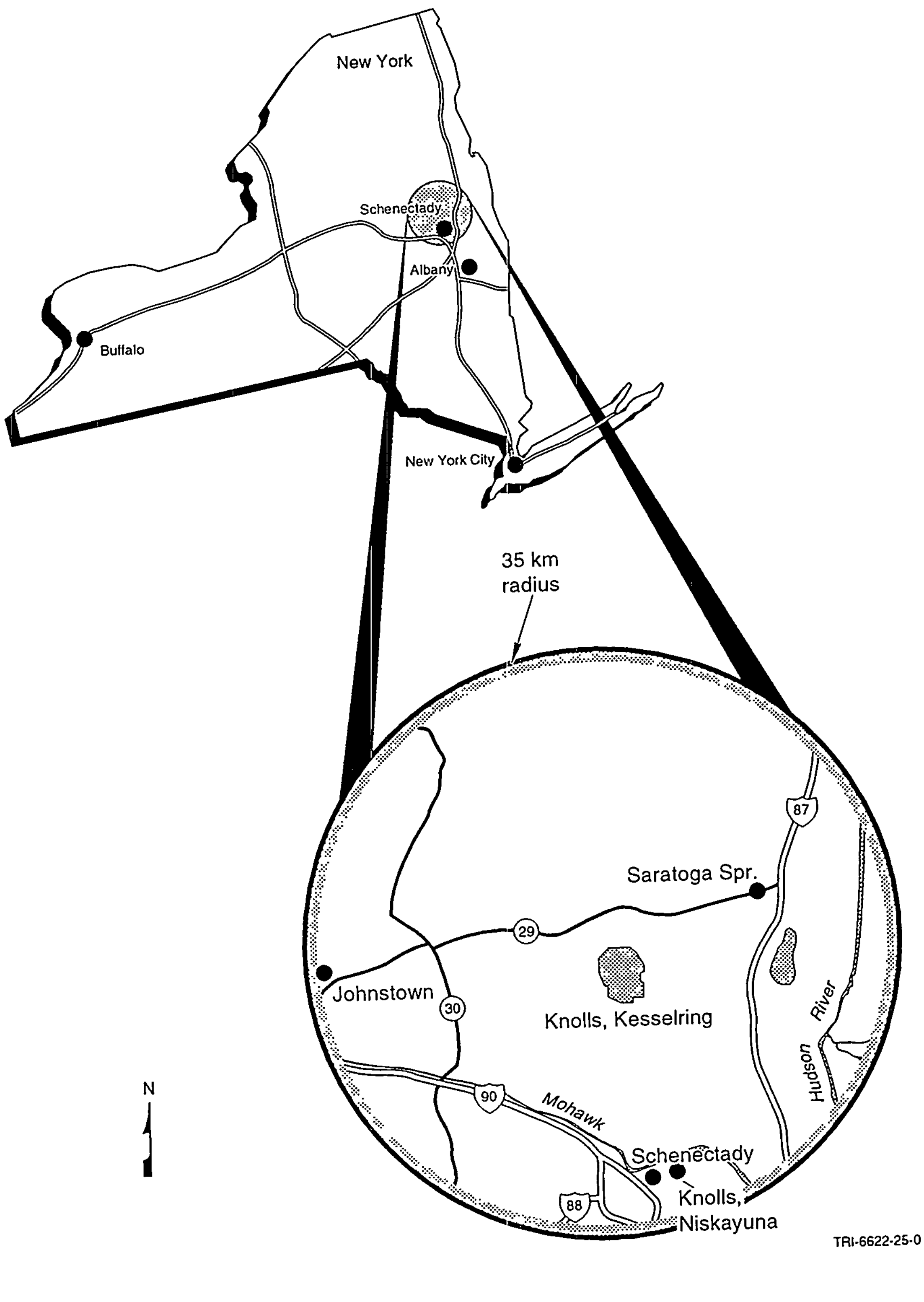

Figure KAPLK-1. Location Map for Knolls Atomic Power Laboratory-Kesselring

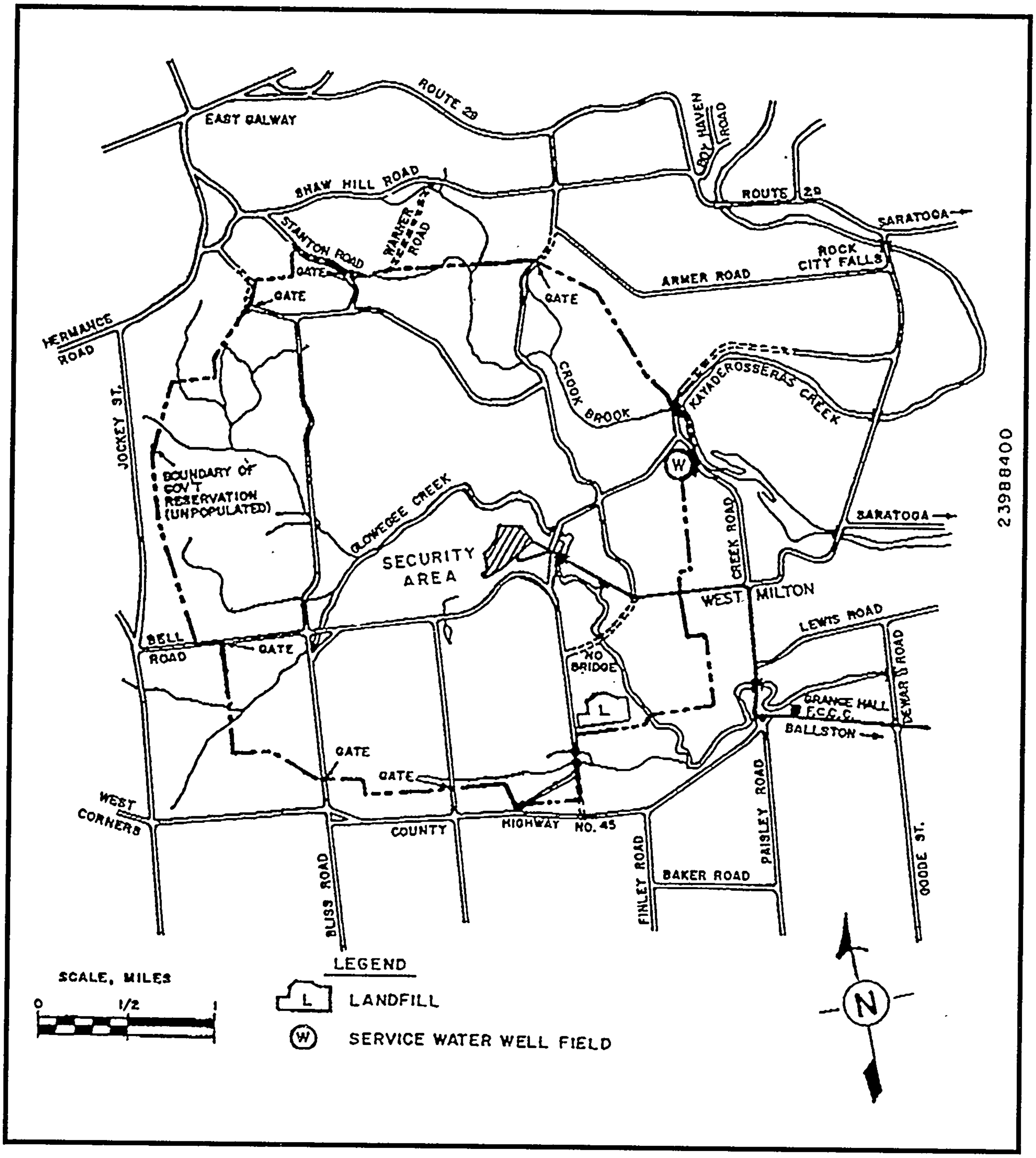

Figure KAPLK-2. Site Map for Knolls Atomic Power Laboratory-Kesselring

Regulatory Considerations

Because the reservation contains operating nuclear plants, the KAPL-K site has been designated an Exclusion Area as defined in 10 CFR 100. An evaluation of the areas containing radioactivity or chemical residues at KAPL-K has been conducted in accordance with CERCLA. This preliminary assessment indicated that the environmental significance of these areas is small. Working within the bounds of state and federal environmental regulations, KAPL-K is continuing actions to preclude any impact on the environment from residual chemical or radioactive materials.

No aquifers beneath the site are EPA designated sole-source aquifers; however, the Schenectady/Niskayuna designated sole-source aquifer lies just south of the site.

Technical Factors

Climate

The east-central part of New York State is situated approximately 240 km (150 mi) inland from the Atlantic coastline and about 320 km (200 mi) south of the Canadian border. The climate of the region is primarily continental in character but is affected by the Atlantic Ocean. The mean monthly temperature of the region is about 10° C (50° F). Daily extremes can range from -34° C (-30° F) in the winter months to 40° C (100° F) in the summer. Total yearly precipitation averages about 91.5 cm (36 in). The average yearly snowfall is about 147 cm (58 in), and the maximum snowfall in 24 hours is about 56 cm (22 in). Average annual evaporation from shallow lakes in the area is about 68.5 cm (27 in). On the average, a frost depth of about 91.5 cm (36 in) can be expected.

On an annual basis, the mean daytime relative humidity values range from 50 to 80%. During the summer months, relative humidity values frequently approach 100% during the night. During the winter months, winds are generally from the west or northwest. During the warmer months, the winds are from the south. Wind velocities are moderate, and generally average less than 16 km/hr (10 mph). Destructive winds (i.e., winds in excess of 129 km/hr [80 mph]) occur infrequently, and tornadoes are rare.

Geology

Regionally, the KAPL-K site lies within the moderately undulating transition zone between the Kayaderosseras Range of the Adirondack Mountains and the Hudson-Mohawk Valley lowlands. The reservation is hilly, whereas the site is essentially flat-lying with ground elevations ranging from 120 to 275 m (400 to 900 ft) above mean sea level.

Bedrock geology is variable at the KAPL-K site and consists of crystalline rocks overlain by sedimentary rocks of the Potsdam, Galway, Gailor, Trenton/Amsterdam/Lowville, and Canajoharie Formations. The Canajoharie Shale underlies the majority of the reservation.

Surface deposits consist mainly of glacial till, overlain in places by silt and sand deposits. The thickness of the surficial deposits overlying the bedrock generally ranges between 1 and 61 m

(3 and 200 ft). At the site, approximately 6 to 9 m (20 to 30 ft) of surficial deposits overlie the Canajoharie Shale. The silt and sand deposits are generally softer than the till, and their exact composition varies with location.

The area around the site is characterized by a series of irregular, northeast-trending topographic steps that descend southeastwardly between the mountains and lowlands. The western half of the developed portion of the site is surrounded by elliptical hills approximately 61 m (200 ft) in elevation.

The site is located at the transition between Seismic Risk Zones 1 and 2, which means that minor to moderate damage could occur from earthquakes. The area in which the KAPL-K site is located contains a number of faults but is only moderately active with respect to seismic events. Three branch faults exist in the vicinity of the site: West Galway, East Galway, and Rock City Falls faults. These branch faults are the lines of demarcation between the various bedrock formations in the immediate area. The East Galway branch lies approximately 1060 m (3500 ft) northwest of the site and is believed to be the predominant influence on earthquake loading for site facilities. The two Galway faults are end branches of the Hoffman's Ferry fault. Data accumulated from 300 years of historic records indicate that damage from a maximum intensity earthquake for the region within a 30-km (100-mi) radius of the site would be slight to moderate. The most recent earthquake of that intensity occurred in 1931 and probably had an epicenter where the Rock City Falls fault meets the Hoffman's Ferry fault. Because the West and East Galway branch faults are extensions of the Hoffman's Ferry fault, an earthquake of similar intensity might occur anywhere along the East Galway fault within the lifetime of the site structures.

Other than small open-pit gravel mines, no mined or drilled natural resources are believed to exist near the site.

<u>Hydrology</u>

Three small creeks—Glowegee Creek, Hogback Brook, and Crook Brook—drain the reservation. Drainage from the site is eastward, with Hogback Brook a tributary to Glowegee Creek. Glowegee Creek joins Kayaderosseras Creek approximately 1.5 km (0.95 mi) east of the town of West Milton; Crook Brook joins Kayaderosseras Creek about 1.5 km (0.95 mi) north of West Milton. Kayaderosseras Creek empties into Saratoga Lake about 30 km (19 mi) to the east. Average stream flow near the site is 11.5 m^3/sec (41 cfs). From the KAPL-K site to 15 km (9 mi) from Saratoga Lake, both the Glowegee and the Kayaderosseras are classified as Class C Trout Streams by New York State and are not recommended as a source of potable water. A number of perennial springs exist in the area. Existing records do not indicate a history of flooding of the site.

Only small areas of the site are underlain by deposits that could be considered an aquifer and used as a water supply. At the developed portion of the site, the overburden sequence, consisting of till and lake deposits, and the underlying Canajoharie Shale generally form poor aquifer systems. Water productivity in the Canajoharie Shale is dependent on the presence or absence of fractures. Also, its water may contain naturally occurring hydrogen sulfide.

Typically, the water table under the developed portion of the site is within 1 to 2.5 m (3 to 8 ft) of the ground surface. The configuration of the water table is, for the most part, a replica of the configuration of the surface topography. Mapping of the shallow water table shows that the groundwater gradient is low. This low gradient combined with the low permeability of the glacial deposits indicates that the groundwater flow rate is very low, on the order of 1.5 to 3 m (5 to 10 ft) per yr. Also, water table mapping indicates that the Glowegee Creek, approximately 60 to 300 m (200 to 1000 ft) east of the operating facilities boundary, forms an aquifer boundary. No aquifer appears capable of readily transmitting groundwater originating at the site over long distances or outside the KAPL-K property. Groundwater flows easterly, toward the nearby Glowegee Creek, but given the slow groundwater flow rate, discharge to Glowegee Creek probably requires decades.

The area surrounding the KAPL-K site is sparsely populated, and the major source of potable water is individual domestic wells. There are a few private wells off-site near the KAPL-K boundaries. The closest population centers providing municipal water service, Ballston Spa and Saratoga Springs, are 8 and 13 km (5 and 8 mi) away, respectively. These municipal water services draw on both surface and groundwater sources.

Sensitive Environment

No national historic sites have been designated or archeological sites identified on the KAPL-K site. Several state multiple use areas are within several miles north of the reservation. Several endangered and/or threatened species listed by the State of New York are found in Saratoga County. To date, none have been observed on the reservation. Thirteen areas on the KAPL-K site are classified as wetlands by the State of New York.

Sources

"Kesselring Site Environmental Summary Report," KAPL-4752, June 1993.

Site Fact Sheet
Knolls Atomic Power Laboratory—Niskayuna
New York

Site Description

The Knolls Atomic Power Laboratory—Niskayuna (KAPL-N) is located in the town of Niskayuna in Schenectady County, New York, on the banks of the Mohawk River (Figure KAPLN-1). The site consists of 0.7 km^2 (170 acres) that extend 1280 m (4200 ft) along the river. The site facilities occupy about 0.2 km^2 (60 acres) of the property (Figure KAPLN-2). The balance of the site consists of woods and fields. The KAPL-N site is largely self-supporting, but water is supplied by the nearby towns of Schenectady and Niskayuna, and electrical power is furnished by the Niagara Mohawk Power Corporation. KAPL-N is bounded by the Niskayuna Landfill and Park, a research and development center, and a residential area.

The estimated population within 10 km (6.2 mi) of the site is 135,000, including Niskayuna (17,000) and Rotterdam (28,000). Within 50 km (31 mi), the population is estimated to be 432,000, which includes Schenectady (66,000), Saratoga Springs (25,000), Amsterdam (21,000), Albany (101,000), and many towns with populations less than 20,000.

The original missions of KAPL-N, which was opened in 1949, were to develop a chemical process for the separation of radionuclides from irradiated nuclear fuel, to develop a central nuclear reactor plant for an electric power station based on sodium coolant technology, to develop the basic science of reactor design, and to conduct research and develop improved nuclear propulsion plants for U.S. Navy submarines and surface ships. Since the mid-1950s, KAPL-N's work has been devoted to Naval programs. Employment at KAPL-N is approximately 2,300.

Institutional Factors

Ownership

KAPL-N is owned by the DOE and was operated from its inception until 1993 under Federal contract by the General Electric Company. In April 1993, responsibility for operation of the KAPL facilities was transferred to a subsidiary of Martin Marietta.

No LLW disposal facility is operating at KAPL-N, and no future LLW or MLLW disposal units are currently planned.

MLLW Storage and Generation

The estimated current MLLW inventory at KAPL-N is 1.3 m^3. Future generation volumes through 1997 are anticipated to be 27 m^3.*

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*1994 *Mixed Waste Inventory Report*

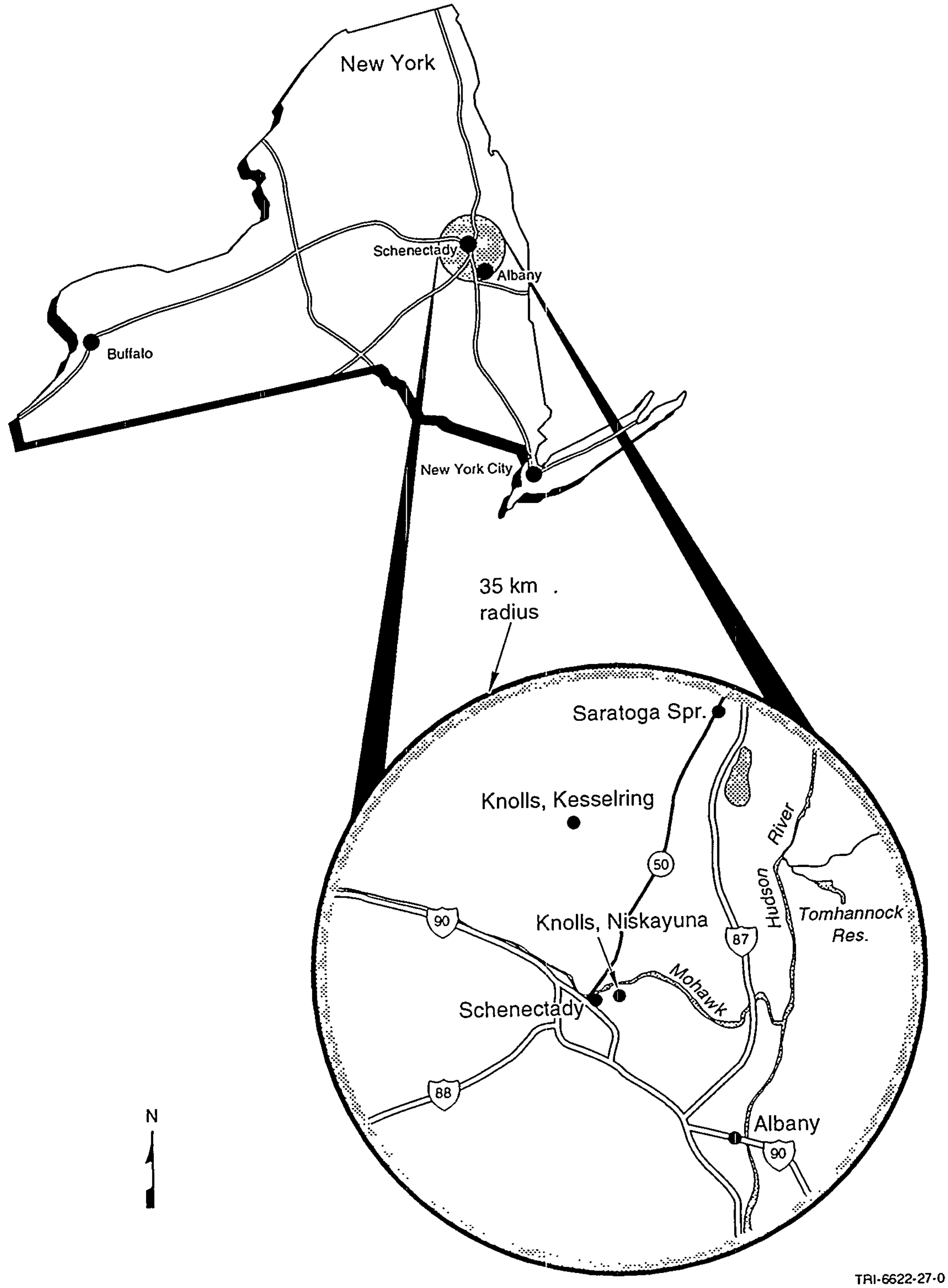

Figure KAPLN-1. Location Map for Knolls Atomic Power Laboratory-Niskayuna

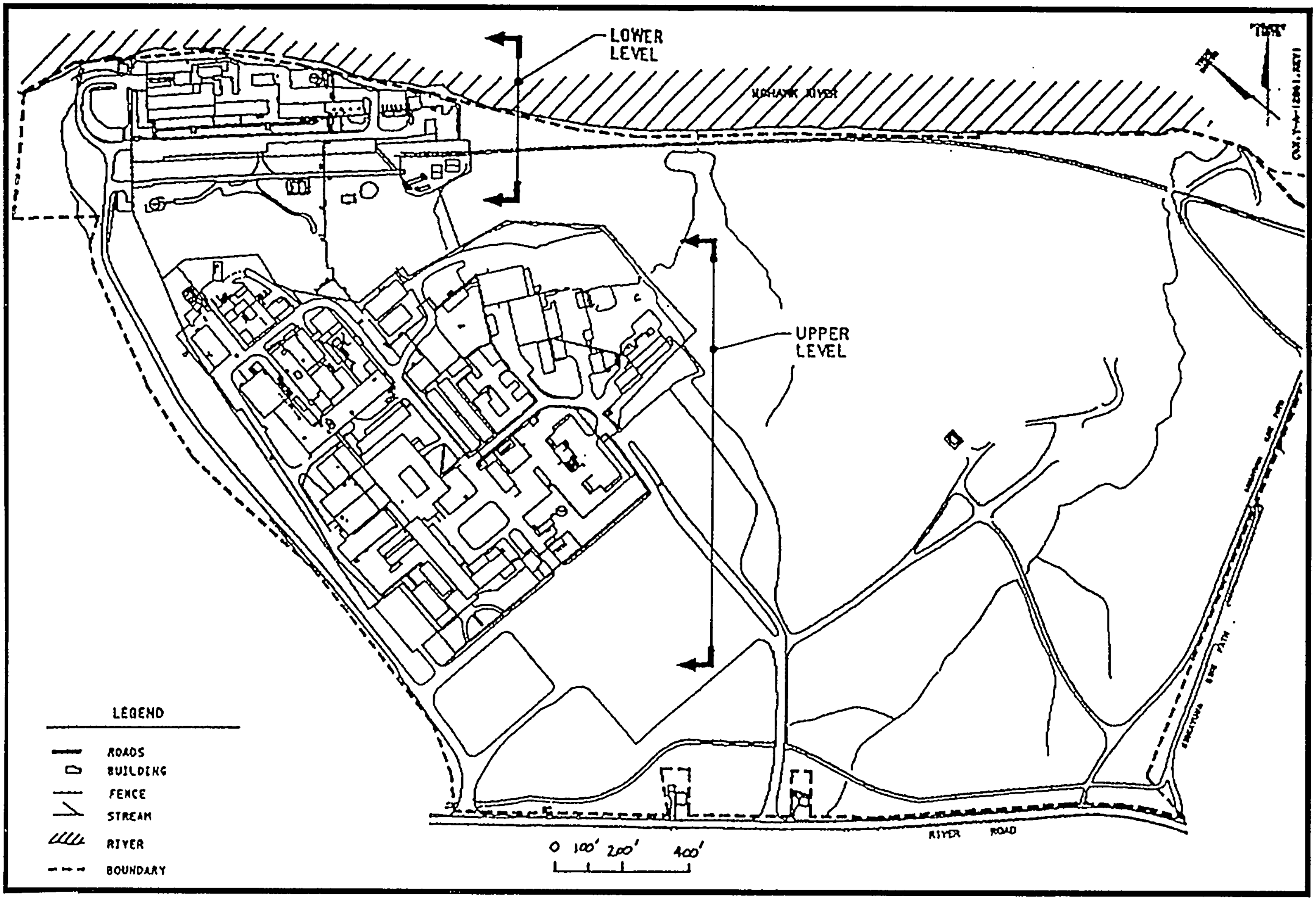

Figure KAPLN-2. Site Map for Knolls Atomic Power Laboratory-Niskayuna

Regulatory Considerations
No federal or cooperative agreements are in place regarding MLLW management or facility siting at KAPL-N.

The Schenectady/Niskayuna aquifer system to the north and west of the site is designated an EPA sole source aquifer.

Technical Factors

Climate
January is the coldest month with an average temperature of -8°C (18°F), and July is the warmest month with an average temperature of 20°C (68°F). Precipitation averages 91.5 cm (36 in). Average annual snowfall is 147 cm (in). Average annual evaporation from shallow lakes in the area is about 71 cm (28 in). The prevailing wind direction is from the north-northwest. Average wind speed is less than 16 km/h (10 mph), with highest wind speeds averaging 129 km/h (80 mph).

Geology
The eastern sector of Schenectady County in which KAPL-N is located is in the Hudson-Mohawk lowlands. The lowland has been deeply eroded and has considerable relief. Near KAPL-N, surface deposits consist mainly of basal till overlying shale. The depth to the shale bed rock beneath the land surface generally ranges between 1.5 and 21 m (5 and 70 ft). The basal till deposits underlying the site are dense, tough, and compact because of both composition and compression during glaciations about 1.6 million to 10,000 years ago.

The site facilities are located in two principal areas. The larger area is at the top of the bluff on the northwesterly section of the property about 30 m (100 ft) above the river. The smaller area is located on a topographic bench adjacent to and about 5 to 6 m (15 to 20 ft) above the river. The bedrock is relatively flat-lying and undeformed at the site.

The site is located at the transition between Seismic Risk Zones 1 and 2, which means that minor to moderate damage could occur from earthquakes. The area in which KAPL-N is located contains a number of faults but is relatively inactive with respect to seismic events. No earthquakes within 160 km (100 mi) of the site with intensities that could cause more than moderate damage have been recorded in 300 years of recorded history.

No mined or drilled natural resources are found on or adjacent to the site.

Hydrology
The major surface water feature near KAPL-N is the Mohawk River, serving as the main water course for the Mohawk River Drainage Basin. The site is located on the south bank of Niskayuna Pool of the Mohawk, a 17 km (10.7 mi) pool formed by a movable dam at Scotia and a permanent dam at Vischer Ferry. KAPL-N is about 2.7 km (1.7 mi) upstream from the Vischer Ferry Dam. At normal stages the pool has a surface area of about 3 km^2 (2 mi^2).

Surface water from the undeveloped sections of the site drains to the Mohawk by way of three unnamed intermittent streams. KAPL-N is not located in a 100-year flood plain.

Along with its role as a navigable waterway and recreational resource, the Mohawk River supplies water for domestic and industrial purposes. The nearest downstream user of Mohawk River water as a potable supply is the Latham Water District located approximately 8 km (5 mi) from KAPL-N. Approximately 22.7 million liters (6 million gal) per day of treated Mohawk River water are used to meet half of Latham's water needs.

The till deposits underlying KAPL-N form poor aquifers with low permeabilities because of their high degree of compaction and small grain size. Groundwater moves under KAPL-N towards the river at much less than 3 m (5 ft) per yr through the till. No aquifers are suitable for development under the site because of the dense, clay-bearing soil and the lightly fractured bedrock. The nearest known well used for domestic consumption that draws from groundwater not associated with the Mohawk is approximately 2.5 km (1.5 mi) from the site.

Other major sources of potable water in eastern Schenectady County and southern Saratoga County are from wells located in gravel deposits adjacent to the Mohawk River. The gravel deposits are recharged in part from the river as water is withdrawn. Wells that provide approximately 7.6 million liters (2 million gal) per day for the town of Niskayuna are located about 3 km (2 mi) downstream from KAPL-N. Similar wells located about 13 km (8 mi) upstream of KAPL-N serve the city of Schenectady.

Sensitive Environment

No designated historic sites are on the National Register of Historic Places and no archeologic sites have been identified. No national or state parks, forests, monuments, or preserves are on or adjacent to the site. No federal or state listed threatened or endangered species are on site. Wetlands or wildlife refuges do not exist on site.

Sources

"Niskayuna Site Environmental Report," KAPL-4751, June 1993.

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Site Fact Sheet
West Valley Demonstration Project
New York

Site Description

The West Valley Demonstration Project (WVDP) site is located in Ashford Township, Cattaraugus County, about 56 km (35 mi) southeast of Buffalo, New York (Figure WVDP-1). Regional land uses are predominantly rural, with the land immediately adjacent to the site being used primarily for agriculture and arboriculture.

The WDVP occupies about 0.9 km^2 (220 acres) within the 13.5 km^2 (3345 acre) Western New York Nuclear Service Center (Figure WVDP-2). The WVDP site includes a secured, fenced area of about 0.6 km^2 (156 acres) that contains the plant facilities.

The two largest towns in the area are West Seneca (population 48,000) and Lackawanna (population 21,000), both about 45-48 km (28-30 mi) north-northwest of the site. Estimated population within a 10 km (6.2 mi) radius of the WVDP is 500; estimated population within a 50 km (31 mi) radius is 182,000.

From 1966 to 1972, the Western New York Nuclear Service Center was the site of the only commercial nuclear fuel reprocessing facility to have operated in the United States. The plant reprocessed spent nuclear fuel assemblies from various nuclear power plants. Reprocessing operations generated approximately 2 million liters (560,000 gal) of highly radioactive liquid waste that was stored in underground steel tanks. In 1972 the plant was closed for expansion. However, the expansion did not occur, and in 1976 the plant was permanently closed, with the liquid waste left in the storage tanks.

In 1980, the U.S. Congress authorized the DOE to carry out a nuclear waste management project at the Western New York Nuclear Service Center. The WVDP was established to demonstrate that liquid waste from reprocessing of spent nuclear fuel can be managed safely in the United States. Current activities at the WVDP are directed towards decontaminating and decommissioning the site. Employment at the WVDP is approximately 1,200.

Institutional Factors

<u>Ownership</u>
The Western New York Service Center is owned by the New York State Energy Research and Development Authority. Through a contractual agreement with the State of New York, the DOE is operating the WVDP in conjunction with the Energy Research and Development Authority. Westinghouse Corporation manages the WVDP through a wholly-owned subsidiary.

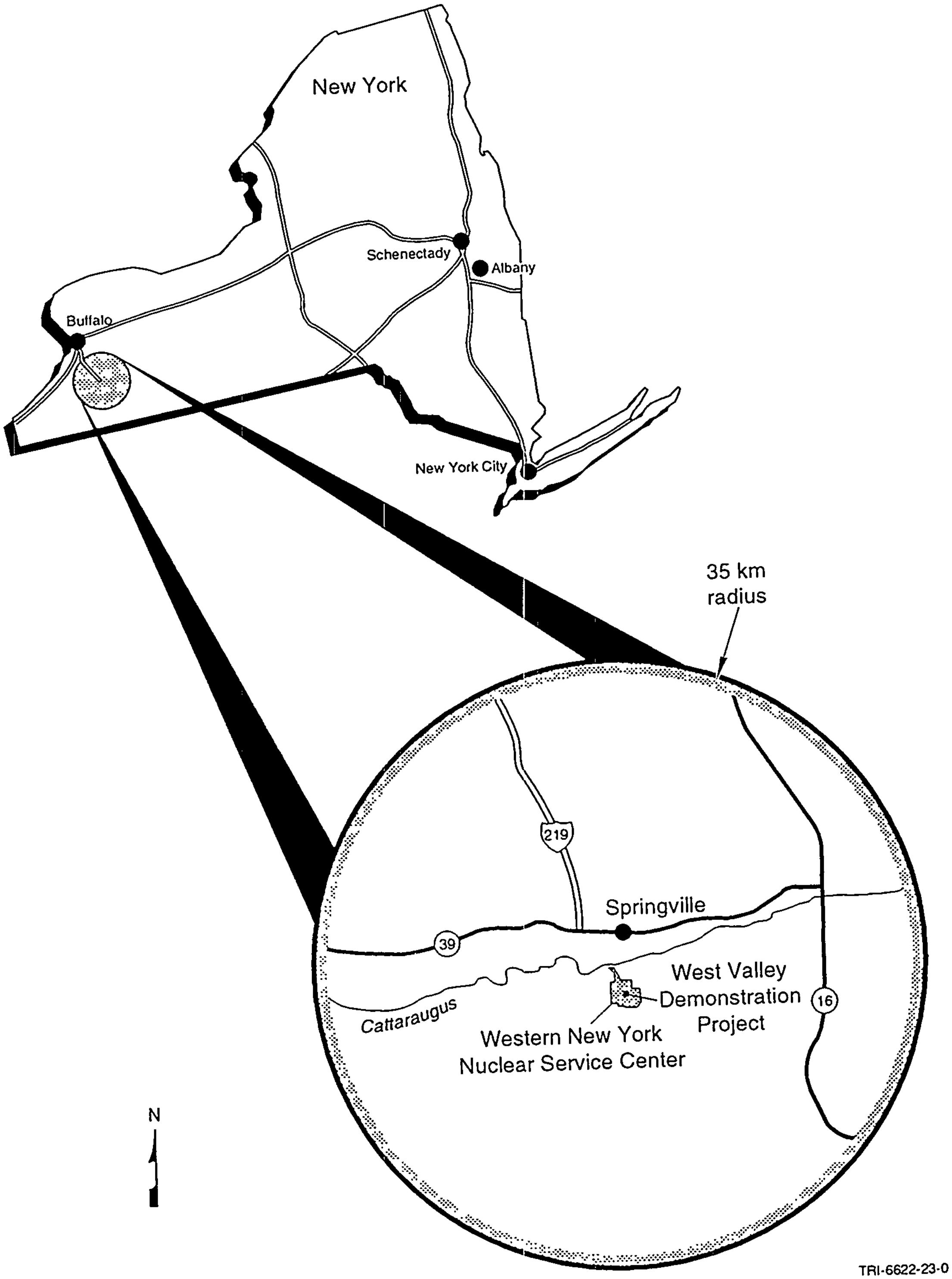

Figure 1. WVDP-1. Location of Map for West Valley Demonstration Project

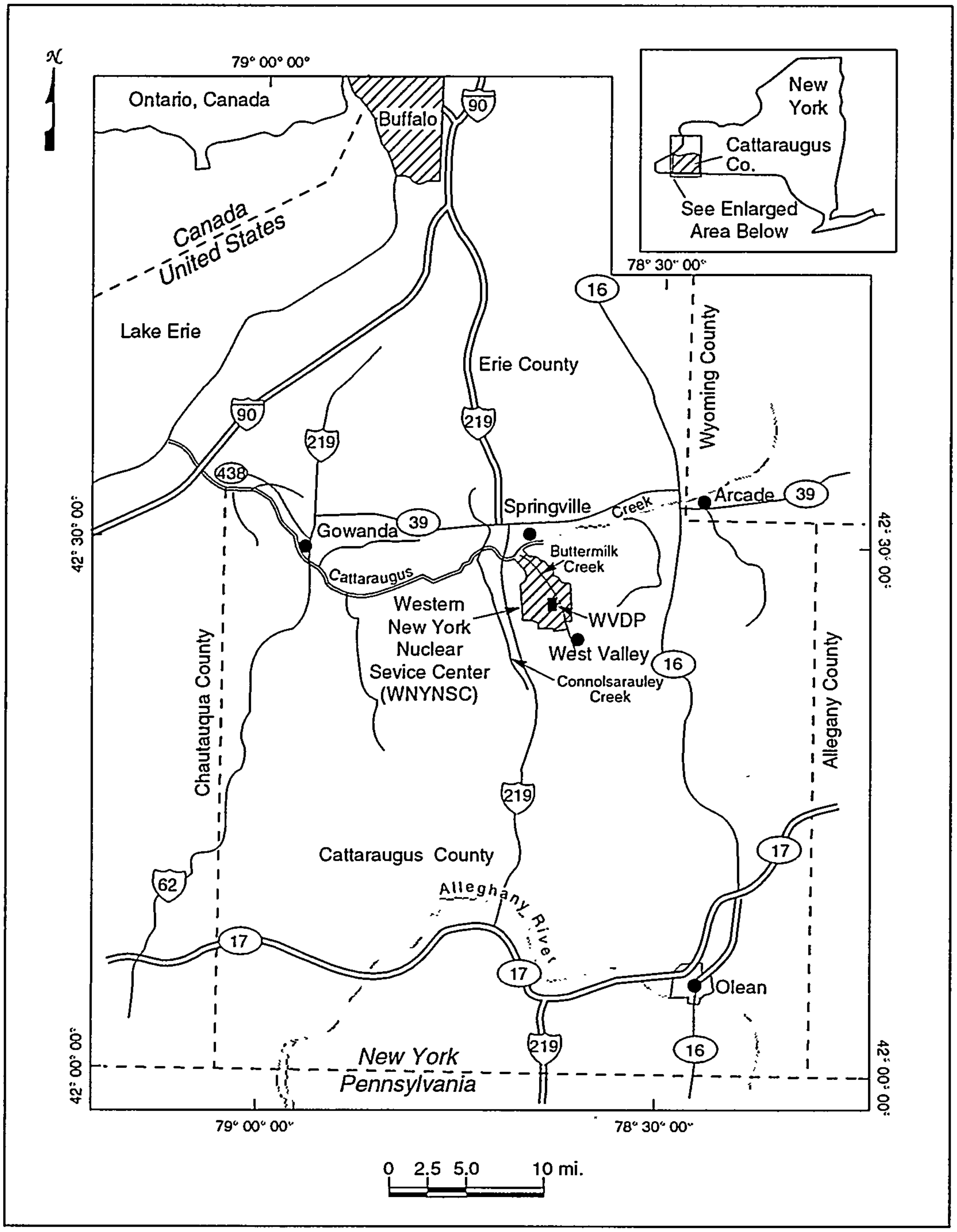

Figure 2. WVDP-2. Site Map for West Valley Demonstration Project

The WVDP currently does not dispose of any waste on site. An Environmental Impact Statement is being prepared to address, among other things, disposal options for LLW in storage and to be generated. On site disposal is one alternative under evaluation. However, due to DOE's unique role at the Project, per the WVDP Act, only site waste is being considered; accepting wastes from other sites is not included under the provisions of the WVDP Act or any other legal agreement. Disposal of waste from elsewhere at the Western New York Nuclear Service Center is specifically excluded by law.

MLLW Storage and Generation

The estimated MLLW inventory at WVDP is 22.9 m^3, and future generation volumes through 1997 are anticipated to be 13 m^3.*

Regulatory Considerations

No federal or cooperative agreements are in place regarding MLLW management or facility siting at WVDP.

The Cattaraugus Creek Basin Aquifer System underlying the WVDP is an EPA designated sole-source aquifer.

Technical Factors

Climate

Climate in western New York is moderate, with an average annual temperature of 7.2° C (45° F). Extremes of 37° C (98.6° F) and -42° C (-43.6° F) have been recorded. Rainfall is relatively high, averaging about 104 cm (41 in) per year. Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and, to a lesser extent, by Lake Ontario to the north. Evapotranspiration in the area is estimated to be 91 cm/yr (36 in/yr), or about 88% of the annual precipitation. Regional winds are predominantly from the west and south at about 14.4 km/h (9 mph).

Geology

The WVDP is located within the Cattaraugus highlands, a transitional zone between the Appalachian Plateau Province and the Great Lakes Plain. The site is on the Allegheny Plateau in the Great Lakes-St Lawrence watershed. Geologic conditions at the site are the result of geologically recent events, especially repeated glaciation about 1.6 million to 10,000 years ago. The glacial deposits occupy an older valley that was cut into the sedimentary rocks underlying the entire region.

The WVDP is underlain by igneous and metamorphic rocks older than 570 million years that are covered by approximately 2300 m (7546 ft) of nearly flat-lying sedimentary rocks deposited 570 to 245 million years ago. These rocks are covered by up to 150 m (500 ft) of unconsolidated glacial deposits. The two lowermost glacial deposits are clayey silt tills, the Kent and Olean Tills. Above these till deposits is a unit of lake deposits composed of silt and clay

*1994 _Mixed Waste Inventory Report_

overlain by coarse sand and silt and locally capped by gravel. The uppermost glacial unit is the Lavery Till, a very dense, silty clay deposited about 15,000 years ago that is approximately 24 m (80 ft) thick but varies considerably in thickness across the site. In some places the glacial tills are covered by alluvial sands and gravels deposited between 15,000 and 14,200 years ago.

The topography at the WVDP site is generally gently rolling. The site can be divided into two regions: the north plateau, on which the WVDP and its associated facilities are located; and the south plateau, which contains an inactive NRC-licensed disposal area as well as an inactive LLW disposal area that is not part of the WVDP but is managed by the State of New York.

No fold or fault of any consequence is recognized within the installation. The Clarendon-Linden Structure is the closest active, earthquake-producing feature known to exist in the region. Movement on the structure either has occurred at or near the ground surface at least once within the past 35,000 years or is a recurring event within the last 500,000 years. The structure is approximately 37 km (23 mi) from the site.

The major soils types present at the WVDP include well-drained gravelly loam and poorly drained silty loam. There is a possibility of liquefaction of the alluvial deposits with the occurrence of a moderate earthquake. The Lavery Till below the alluvial deposits is not prone to liquefaction.

Many areas at the Western New York Nuclear Service Center are subject to active erosion and mass wasting. Available data indicate that these processes might impact long-term disposal of some low-level radioactive wastes.

All mineral exploration and development was formally prohibited at the WVDP in 1947. Neither bedrock nor surficial deposits possess characteristics that suggest the presence of economic mineral deposits.

Hydrology

Surface waters in the WVDP area consist of creeks that ultimately drain into Lake Erie. Potential flow rates are 1.8 to 20 m^3/sec. Historical evidence and stream flow modeling indicate that flood conditions will not result in streams overtopping their banks and flooding the plateau where the WVDP is located. In addition, a 100-yr flood would not impact any current safety-related facilities.

Although precipitation is evenly distributed throughout the year, its contribution to groundwater is not. Intense infiltration occurs during the spring as a result of snowmelt superimposed on normal precipitation.

A few of the water-bearing units at the WVDP are considered highly permeable in limited areas. On the south plateau, the water table occurs in the upper 0 to 6 m (0 to 20 ft) of weathered Lavery Till and alluvial gravels. For the most part, groundwater flow in this unit is vertical to the unit of lake deposits. The upper, weathered portion of the Lavery Till, however, exhibits a horizontal flow that enables groundwater to move laterally before moving downward or discharging to nearby land-surface depressions or stream channels. On a field scale, the permeability of the fractured, unweathered Lavery Till is five times greater than that of the unfractured, unweathered Lavery Till, and the permeability of the fractured weathered till is one to three times greater than that of the unfractured, unweathered till. The sequence of lake deposits below the Lavery Till acts as a semiconfined aquifer that is recharged primarily from the bedrock to the west. Flow in this unit is primarily to the northeast. The lake deposits are underlain by the relatively impermeable Kent Till.

The north plateau differs from the south plateau in that it is mantled by a sequence of alluvial sand and gravel up to 12.2 m (40 ft) thick that is immediately underlain by the Lavery Till. Most of the groundwater on the north plateau moves horizontally through the alluvial sand and gravel unit toward the northeast, southeast and east; a small percentage percolates downward into the underlying Lavery Till. Groundwater discharge occurs at seepage points along the banks of nearby creeks, and at the wetlands near the northern perimeter of the security fence. An aquifer occurs in the uppermost bedrock below the tills. This aquifer consists of decomposed shale and rubble that ranges in depth from 2 to 170 m (6 to 550 ft) and is generally 0.5 to 1.0 m (1.6 to 3.3 ft) thick, with a maximum thickness of 3 m (9.8 ft).

Subsidence is not likely to occur at the installation because the shallowest rock unit susceptible to solution by groundwater is at depths greater than 600 m (2000 ft). In addition, subsidence due to groundwater withdrawal is unlikely because groundwater resources beneath the site are marginal. Groundwater beneath the WVDP is not used for process or drinking water; the installation receives all of its water supply from surface water. Offsite water supplies north and south of the installation derive mainly from springs and shallow dug wells completed in the deposits that overlie the Lavery Till. Offsite supply wells on the uplands bordering the installation typically are completed in the shallow bedrock aquifer, which supplies groundwater of good quality to wells at rates of 40 to 60 liters (10 to 15 gal) per min. The Lavery Till and underlying lake deposits are not utilized in the area as groundwater supplies. The EPA designated sole-source aquifer, the Cattaraugus Creek Basin Aquifer System, is described as permeable sand and gravel deposits above and below the lake deposits and glacial till, and fractured shale bedrock. The aquifer area is approximately 325 square miles of the southernmost part of the Erie-Niagara River drainage basin in New York State.

Sensitive Environment

The WVDP is currently applying for a Determination of Eligibility for placement of the plant (Nuclear Fuel Services' Irradiated Fuel Processing Plant) on the National Register of Historic Places. No other historic sites have been designed at the WVDP.

No national or state parks, forests, monuments, or preserves are on or near WVDP. No archeological sites have been designated at WVDP.

No threatened or endangered species listed by the federal or state government have been identified at the WVDP. However, based on population range maps, several federal- or state-listed species of birds, mammals, and reptiles have the potential for occurring at the site.

Small areas of wetlands occur within the larger Western New York Nuclear Service Center. The site provides a habitat especially attractive to white-tailed deer and various indigenous birds, reptiles, and small mammals. The State of New York has identified through latitude and longitude coordinates a segment of the Western New York Nuclear Service Center site as a critical habitat due to its extensive use as a white tail deer wintering area.

Sources

WVDP-EIS-010 Ecological Resources of Western New York Nuclear Services Center.

Final Wetlands Investigation and Delineation of the 550-Acre West Valley Assessment Area. Dames and Moore, December 1993.

WVDP:015 Ecological Baseline Report, West Valley Nuclear Services. Dames and Moore, 1982.

West Valley Demonstration Project Site Environmental Report, Calendar Year 1993.

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Site Fact Sheet
Fernald Environmental Management Project
Ohio

Site Description

The Fernald Environmental Management Project (FEMP) is located in southwestern Ohio, about 27 km northwest of downtown Cincinnati, Ohio (Figure FEMP-1). The facility is located just north of Fernald, a small farming community. The land contiguous to FEMP is primarily open land, such as agricultural and undeveloped lands, industrial lands, and some residential lands. The FEMP site encompasses 4.2 km^2 (1,050 acres) (Figure FEMP-2).

The largest population center near FEMP is the city of Cincinnati (population 364,000), located in Hamilton County. The estimated population within a 50 km radius of the site is 1.5 million, located in the states of Ohio, Indiana, and Kentucky. In addition to Hamilton County, with an estimated population of 886,000, other populous areas include Hamilton (61,000), Fairfield (40,000), Oxford (19,000) and Middletown (46,000) in Ohio; Covington (43,000), Fort Thomas (16,000), Erlanger (16,000), Florence (19,000), and Union (17,000) in Kentucky; and Connersville (16,000) in Indiana. The remaining population is distributed over a large number of small towns. The population within 10 km of the site is estimated to be 15,000, mostly in Ross and Colerain Townships.

The primary mission of the FEMP since 1954 was the production of purified uranium metal and uranium compounds for use at other DOE defense facilities. In 1989, DOE suspended production at the site and FEMP was placed on the National Priority List of Federal facilities in need of remediation. In 1991, DOE formally ended production at FEMP and changed the mission to environmental restoration of the site.

Employment at FEMP is approximately 2100.

Institutional Factors

Ownership

The land and the facilities that comprise the FEMP site are owned by the DOE. No facilities exist for the storage or disposal of LLW or MLLW at FEMP. The FEMP stores LLW and MLLW in either warehouses or pad areas. Most of the waste stored at the FEMP is the result of uranium processing operations conducted over a 36-year period. Some mixed waste streams will be generated as a result of CERCLA environmental restoration activities. No MLLW disposal facilities are planned for FEMP. Historically, LLW has been disposed of at this site.

MLLW Storage and Generation

The estimated volume of MLLW inventory at FEMP is 2,597.3 m^3, with an additional 43 km^2 projected to be generated through 1997.* According to information provided by the site, at least

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*1994 *Mixed Waste Inventory Report*

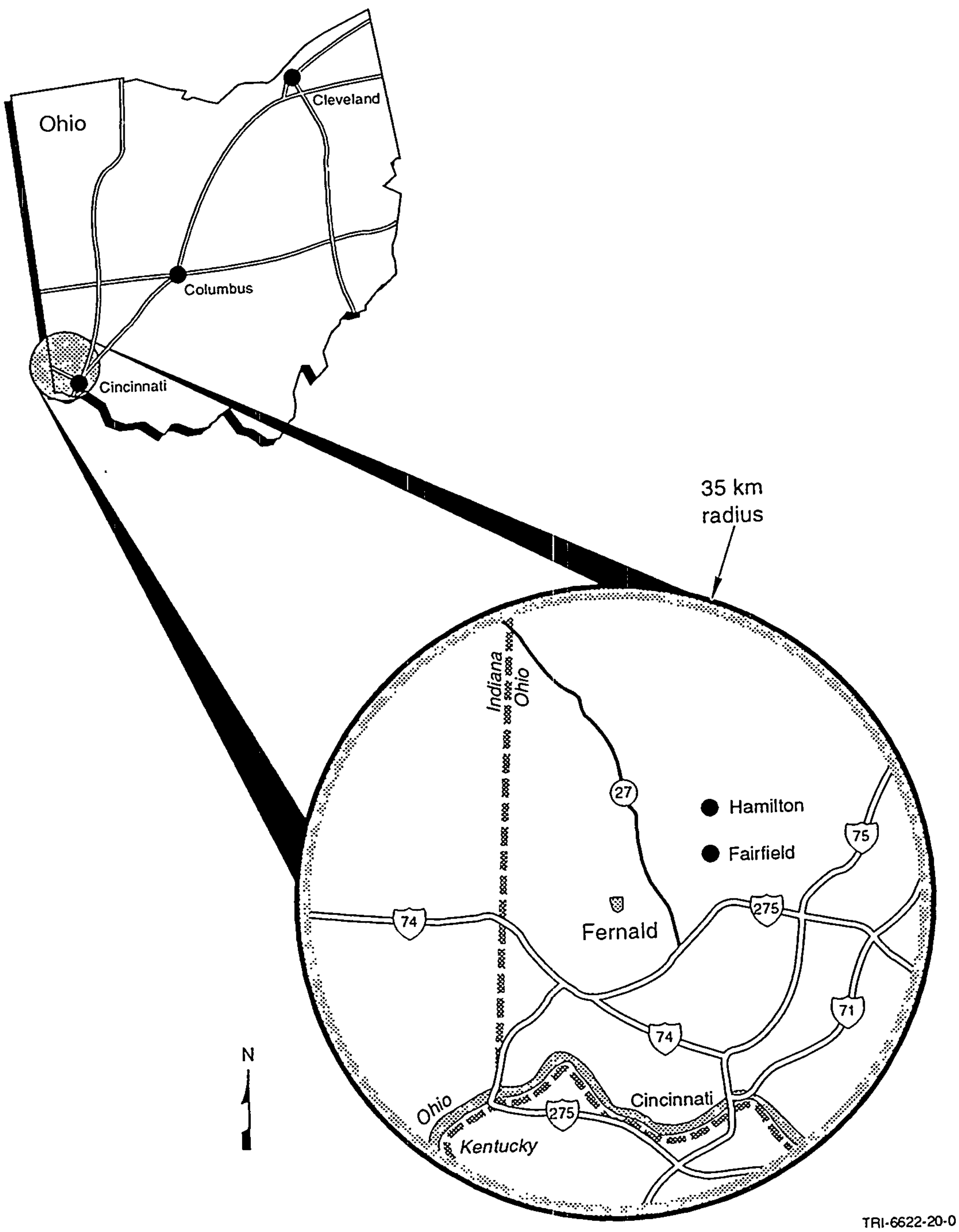

Figure FEMP-1. Location Map for Fernald Environmental Management Project

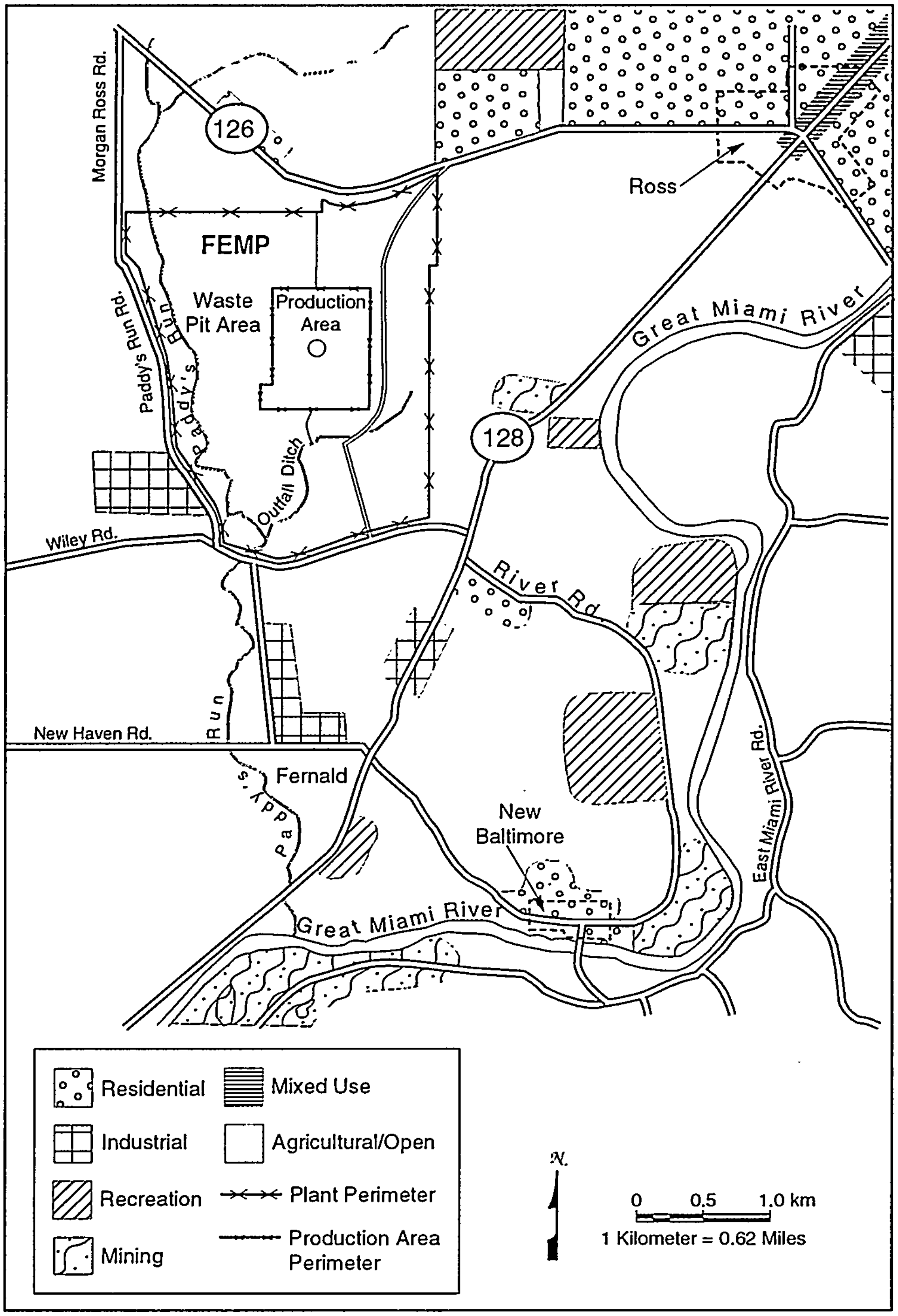

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Figure FEMP-2. Site Map for Fernald Environmental Management Project an additional 169 m^3 is anticipated to be generated through 1997.

Regulatory Considerations
In November 1989 FEMP was placed on the National Priority List of Federal facilities in need of remediation. Several regulatory agreements are being implemented at the site as part of DOE remediation activities in response to the Amended Consent Agreement with EPA, a Consent Decree with the State of Ohio, and a Federal Facility Compliance Agreement with EPA.

The Great Miami Aquifer, over which the FEMP is located, is an EPA-designated sole source aquifer.

Technical Factors

Climate
The temperatures in the Cincinnati area cover a wide range. The average temperature is -2° C (29° F) in January and 24° C (75° F) in July. Annual average precipitation is approximately 104 cm (41 in). The annual average snowfall is 58 cm (23 in) with the highest monthly average of 18 cm (7 in) occurring in December. Average annual evaporation from shallow lakes in the area is about 81 cm (32 in). The prevailing wind near the FEMP site is from the southwest and the annual average wind speed is 8 km/h (5 mph).

Geology
The topography in the FEMP region is dominated by glacial features such as gouged troughs, glacial till, and terrace remnants. The bedrock underlying the FEMP region from 18 to 60 m below ground surface is composed of alternating layers of limestone and shale deposited about 450 million years ago. Overlying the bedrock are sand and gravel that make up the Great Miami Aquifer. At the surface throughout most of the FEMP is a layer of clay-rich material referred to as glacial overburden. The overburden ranges in thickness from 0 to 15 m (0 to 50 ft).

No major faults have been mapped at the site. FEMP is located at the transition between Seismic Risk Zones 1 and 2, which means that minor to moderate damage could occur from earthquakes. The potential for subsidence to occur in the dense glacial deposits on which the site is situated is low.

Most of the soils on the site are silty loams that are poorly drained and characterized by low permeability and seasonal saturation. In the southeastern and northern portions of the site, the soils exhibit moderate drainage and permeability. Soil erosion is not expected to be a problem in the relatively flat-lying areas of FEMP.

All mineral exploration and development has been formally prohibited at FEMP by the Acquired Lands Act since 1947. Mined resources in the area include sand and gravel.

Hydrology

The FEMP site is located in the Great Miami River drainage basin, and a small portion is located in the 100- and 500-year flood plain. The 100- and 500-year floodplain within the FEMP site property is confined to the north-south corridor containing Paddys Run. Outside the boundaries of the FEMP site, the 100- and 500-year floodplain of the Great Miami River extends west of the "Big Bend" area and northward along Paddys Run from the confluence of the two streams past the southern boundary of the FEMP site. The Great Miami River, about 1 km east of FEMP, runs in a southwesterly direction and flows into the Ohio River about 39 km (24 mi) downstream of FEMP. Paddys Run, an intermittent stream that is periodically dry from July to October, begins north of FEMP and flows southward along the western edge of the site, and eventually flows into the Great Miami River. Natural drainage from FEMP to the Great Miami River is primarily by way of Paddys Run.

The Great Miami River is not a source of public drinking water between FEMP and the Ohio River.

Groundwater beneath the FEMP site occurs in the glacial overburden, as perched water tables, in the extensive sands and gravels that comprise the Great Miami Aquifer, and in bedrock below the glacial deposits. The Great Miami Aquifer varies from 0 to 24 m (0 to 80 ft) beneath FEMP, and the aquifer is 38 to 61 m (125 to 200 ft) thick. Groundwater generally moves eastward and southward from recharge areas in the glacial overburden toward the Great Miami River. The Great Miami Aquifer supplies drinking water to two-thirds of a million people and several major industries. Bottled water is being provided to residents near the FEMP with private wells due to contaminated groundwater.

Sensitive Environment

The Ohio Archaeological Inventory lists 44 sites within a one mile radius of the FEMP. These include both single- and multi-component sites and represent prehistoric occupations ranging from Paleoindian through Late prehistoric periods.

The National Register of Historic Places indicates two Archaeological Districts are located within one mile of the FEMP. The Colerain Works Archaeological District (33HA3) and the Dunlap Archaeological District (33HA205). Three mounds in the area are also on the National Register of Historic Places, namely the Adena, Demoret, and Hogen-Borger. There is potential for the existence of unrecorded prehistoric cultural resources on the lower terrace in the vicinity of Paddys Run and near the horseshoe bend in the vicinity of the Great Miami River.

Miami Whitewater Forest, a Hamilton County Park, is within an 8 km (5 mi) radius of the FEMP.

A federally listed endangered plant, running buffalo clover (*trifolium stoloniferum*), is found at FEMP. Potential habitats exist for one federally listed endangered mammal. Potential habitats exist for two state listed endangered plants and a state listed salamander. A state listed threatened crayfish has been found on the FEMP property.

The majority of wetlands at the FEMP are comprised of forested wetlands (0.11 km^2 [27 acres]) located in the northern section of the site. There are also 0.003 km^2 (7 acres) of drainage ditches and 0.001 km^2 (2.5 acres) of persistent emergent wetlands.

Sources

1991 Annual Site Environmental Report.

Site Fact Sheet
Mound Plant
Ohio

Site Description

The Mound Plant is located in southern Montgomery County in southwestern Ohio, within the southern boundary of the Miamisburg city limits and 0.93 km (0.58 mi) due east of the Great Miami River. The site is 16 km (10 mi) southwest of Dayton and 50 km (31 mi) northeast of Cincinnati (Figure MP-1). Land use adjacent to the site includes municipal facilities (golf course and park), industrial, and low density residential. Mound is near Interstate 75, while Interstate 70 passes through Dayton to the north. Several railroads operate in the region, including Conrail tracks that roughly parallel the western boundary of the plant site. Mound occupies an area of 1.24 km^2 (306 acres) (Figure MP-2). The site is subdivided into a 0.74 km^2 (183 acre) northern half and a 0.50 km^2 (123 acre) southern half. The northern half consists of a heavily industrialized area, while the southern half is a former farm that currently consists of wooded areas, old fields, and a parking lot.

Miamisburg has an estimated population of 18,000. Estimated population within a 10-km radius of Mound is 40,000. Within 50 km, the estimated population is 1,478,000. The largest population center is Dayton (186,000). Other nearby towns include Kettering (61,000), Beaver Creek (34,000), Huber Heights (39,000), Middletown (46,000), Hamilton (61,000), Fairborn (31,000), Centerville (23,000), and Fairfield (31,000). The remaining population comprises small towns and cities with populations less than 20,000.

Mound's mission since 1947 has centered around the development of processes and the production and testing of components for nuclear weapons, as well as recovery and purification of tritium from scrap materials. Under the Nonnuclear Consolidation Plan of DOE's Nuclear Weapons Reconfiguration Program, these activities will be essentially completed by the end of FY 1994.

Mission assignments for the development and fabrication of satellite heat sources fueled by plutonium 238 and the manufacture of stable isotopes will continue for the next several years; activities associated with the decontamination and decommissioning of facilities and the environmental restoration of contaminated areas on the plant site will continue past the year 2000. As Mound ceases nuclear weapons production activities at the site, commercial economic development is being actively pursued to utilize the existing facility, equipment, and personnel resources in order to maintain the established technological base and minimize the economic impact on the Miamisburg community of DOE consolidation activities.

FY95 employment at the site is estimated at approximately 1285 salaried and hourly personnel.

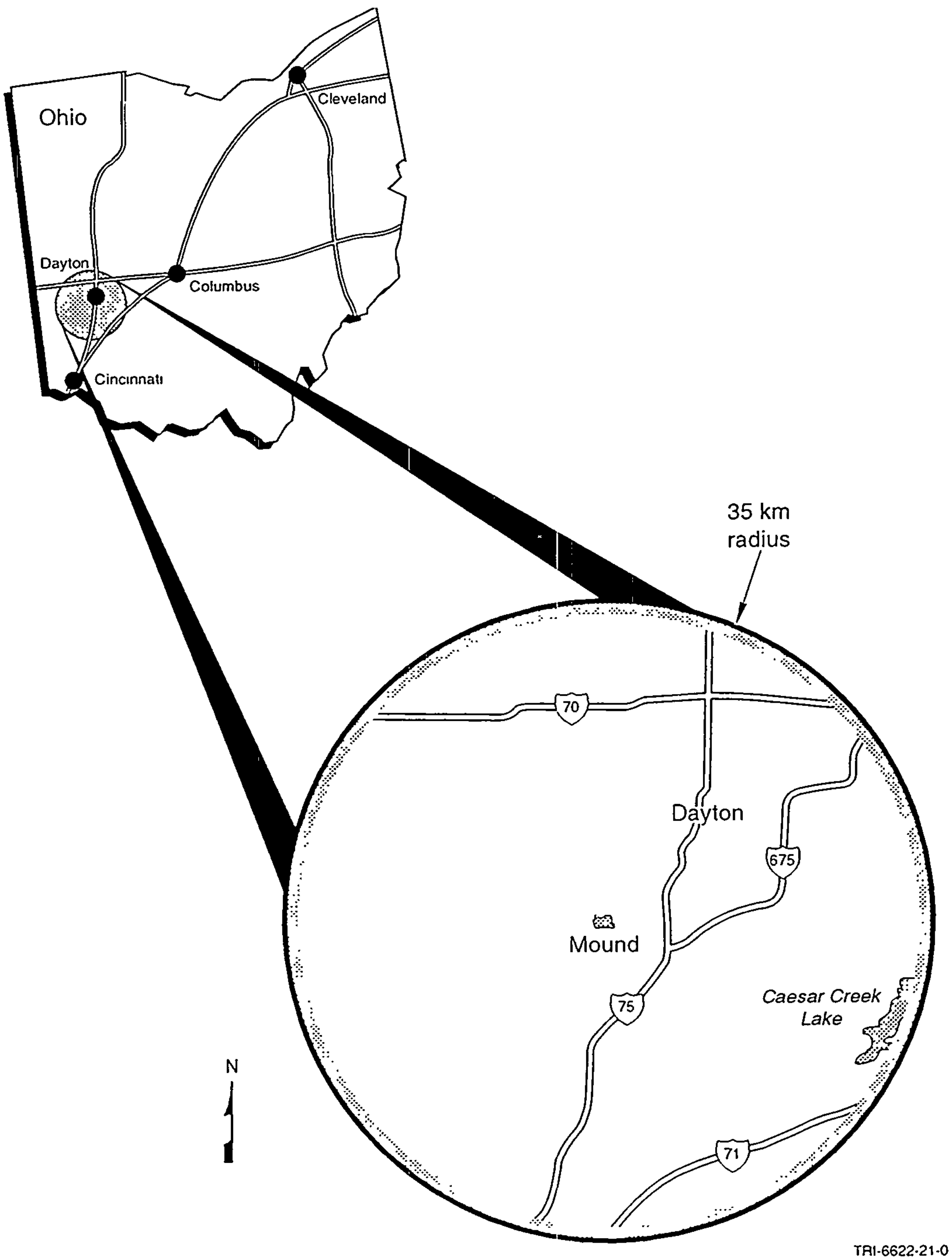

Figure MP-1. Location Map for Mound Plant

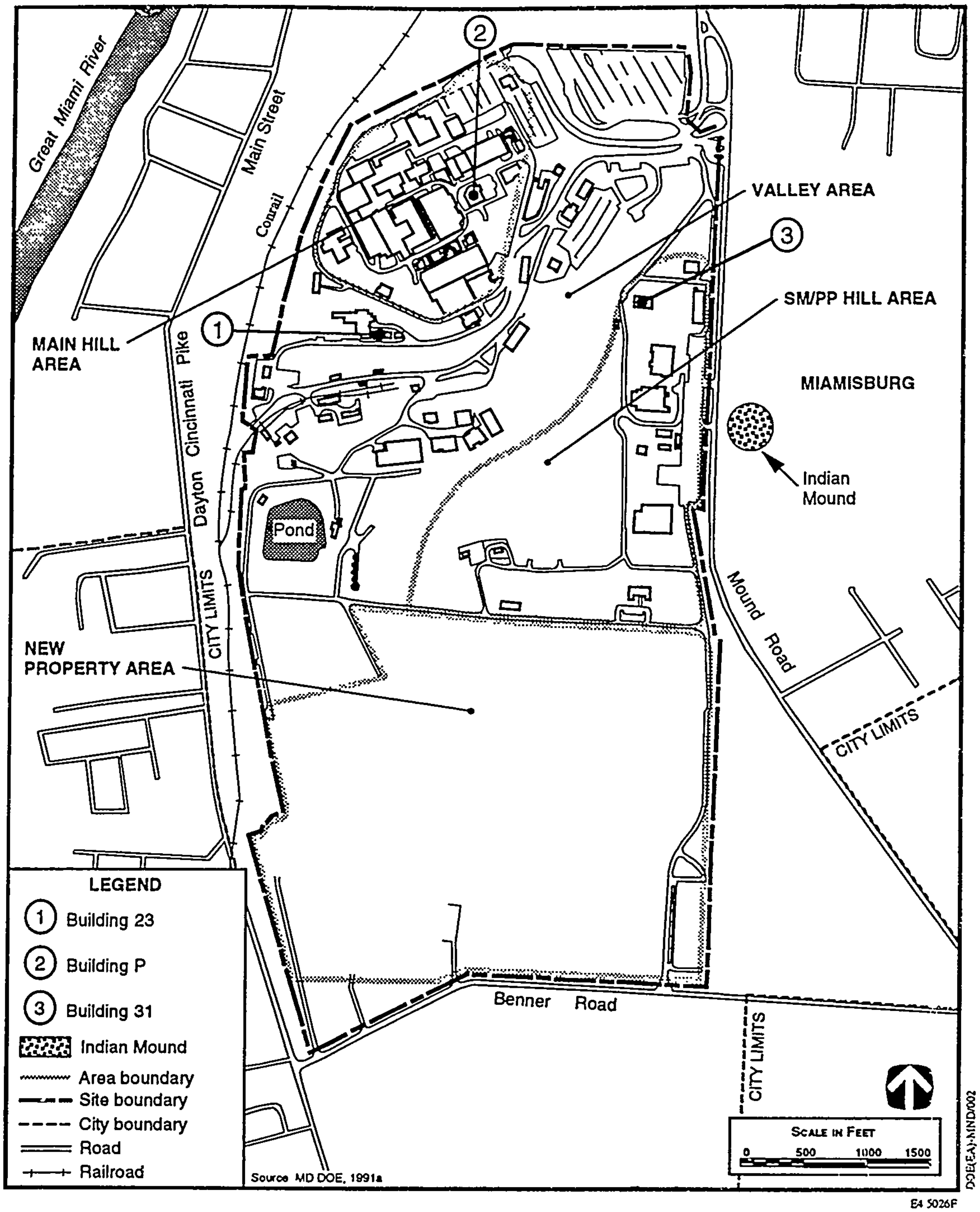

Figure MP-2. Site Map for Mound Plant

Institutional Factors

Ownership

Mound is owned by DOE and operated by EG&G Mound Applied Technologies for the DOE. Mound is slated for closure as a DOE facility, and may be released for commercial or other non-government uses. No LLW disposal facility is operating at Mound and no future LLW or MLLW disposal units are currently planned.

MLLW Storage and Generation

The estimated volume of MLLW inventory at Mound is reported to be 76.6 m^3, and an additional 4 m^3 is anticipated to be generated through 1997.*

Regulatory Considerations

Mound is on the CERCLA National Priorities List (Superfund), and environmental restoration programs are currently being implemented. Mound is under a Tri-Party Agreement with DOE, EPA, and the State of Ohio (negotiated under CERCLA, section 100).

The Buried Valley Aquifer, located immediately west of the plant and underlying the western portion of the site, is an EPA designated sole-source aquifer.

Technical Factors

Climate

The climate of the area is continental, with moderate extremes in temperature. Temperatures in the Dayton area range from an average daily minimum of -4.9° C (23.1° F) in January to an average daily maximum of 17.8° C (86.9° F) in July. The average annual precipitation of 9 cm (36 in) is evenly distributed throughout the year. Evapotranspiration in the area is estimated to be 90% of the annual rainfall. Winds are predominantly out of the south-southwest. Average annual wind speeds range from about 11.2 to 16 km/h (7 to 10 mph). Tornadoes occur in the region, but not frequently.

Geology

Miamisburg is located on the eastern portion of the Indiana-Ohio platform, which is in the Central Stable Province. The platform, also known as the Cincinnati Arch, is a nearly flat structural element occupying eastern Indiana and Western Ohio for a width of 160 to 320 km (100 to 200 mi). The platform is bounded by the Illinois Basin on the west, the Michigan Basin on the north, the Appalachian Basin on the east, and the Kentucky River Fault Zone on the south. The closest structural divide adjacent to the Mound facility is the Appalachian Basin.

Near-surface bedrock in the area is limestone and interbedded shale deposited more than 440 million years ago, supported by a thick sedimentary sequence of shale, dolomite, limestone, and sandstone up to 570 million years old, which in turn rests on basement rocks more than 570 million years old. The areas below 230 m (760 ft) in elevation are underlain by dense glacial

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*1994 *Mixed Waste Inventory Report*

soils supported by the same sedimentary sequence. Topographically high areas of fractured bedrock are generally covered by a thin 0 to 60 m (0 to 200 ft) layer of glacial till comprised of silt, clay, and some fine gravel. Sand and gravel deposits fill bedrock valleys.

The land in the Mound area is characterized by gently rolling plains. The plant is situated topographically upon a high area overlooking Miamisburg, the Great Miami River, and the river plain area to the west. The property is characterized by two high areas divided by a minor northeast-southwest trending valley that drains to the river.

The site is in the transition between Seismic Risk Zones 1 and 2, which means that minor to moderate damage could occur from earthquakes. No geophysical factors at the site would either cause or compound seismic disturbances. No active faults are at or in the vicinity of Mound. The closest potentially active fault is over 80 km (50 mi) away and has not been active for over 60 years.

Natural slopes range from 0 to approximately 20% from horizontal. Most slopes are composed of surficial soil (glacial till), 0.45 to 6.7 m (1.5 to 22 ft) thick, that overlies bedrock. These natural slopes are considered stable.

Soils that underlie Mound are typically silt and clay loams deposited as glacial till over limestone. Many of these soils rest on slopes of 2 to 6%, and some soils lie on slopes exceeding 25%. Most soils at Mound are moderately to severely eroded and are unsuitable for cultivation or have severe limitations because of the risk of erosion. All of the soils at Mound are either cohesive or extremely dense, and are not considered a risk for liquefaction.

No natural or mineral resources have been identified at Mound.

Hydrology

The Great Miami River borders Mound to the west and is the predominant hydrological feature in the region. The river is classified for recreation, agriculture, and water supply uses. No natural surface water bodies are onsite, although a drainage basin is in the valley between the two highest areas of the facility. The basin is small with relatively steep slopes, so runoff is rapid.

The Buried Valley Aquifer is composed primarily of glacial outwash of fine to coarse sands and interbedded gravels that are locally interrupted by discontinuous glacial tills. The tills do not form a significant aquifer in the vicinity of the Mound Plant due to their discontinuous nature. The aquifer yields abundant drinking water and is considered a Class II aquifer. Depth to the aquifer is as shallow as 1.8 m (6 ft), and water from the aquifer supplies Mound Plant.

Recharge to aquifers is available from 3 major sources: direct infiltration from the Great Miami River; leakage along valley walls at the bedrock-outwash contact; and induced infiltration caused by pumping of wells.

Karst terrain is not found at or near the site.

Groundwater flow is toward the central valley area from both the east and west, then southwest down the valley. The general hydraulic gradient in the outwash aquifer under the valley floor is southwest at 2.4 to 4.8 m/km (5 to 10 ft/mi). Groundwater flow rates are between 0.23 and 0.46 m/day. The groundwater level varies seasonally and yearly, and ranges from 208 to 212 m (680 to 696 ft).

Sensitive Environment

An historic landmark in the vicinity of Mound Plant is Miamisburg Mound, an ancient Indian mound located 120 m (380 ft) east-southeast of the facility site in Miamisburg Mound State Memorial Park. The Miami Erie Canal on the west side of the site is a landmark of historic significance.

The only federally or state-listed threatened or endangered species potentially occurring in the vicinity of Mound is the Indiana bat. Although no bats have been officially recorded on the site, the Indiana bat is known to occur in the surrounding area.

Wetland boundaries have not been delineated at the plant site. Wetlands at Mound are likely limited to a small area of seeps, narrow intermittent stream channels, some drainage ditches, and man-made ponds.

No wildlife refuges are located on site.

Sources

U.S. Department of Energy. "Nonnuclear Environmental Assessment".

EG&G Mound Applied Technologies. "Mound Site Environmental Report for Calendar Year 1992". MLM-3778.

U.S. Department of Energy and EG&G Mound Applied Technologies. "Final Environmental Impact Statement", Mound Facility, Miamisburg, Ohio. DOE/EIS-0014, June, 1979.

U.S. Department of Energy, "Operable Unit I Remedial Investigation Report".

Site Fact Sheet
Portsmouth Gaseous Diffusion Plant
Ohio

Site Description

The Portsmouth Gaseous Diffusion Plant (PORTS) is located approximately 35 km (22 mi) northeast of Portsmouth, Ohio (Figure PORTS-1). Wayne National Forest borders the site on the east and southeast. Most of the remaining land adjacent to PORTS is generally rural with little residential, commercial, or industrial development. Regional land use consists primarily of marginal farmland. The facility is serviced by U.S. Route 23, U.S. Route 52, and U.S. Route 50. Ohio Routes 124/32 are immediately north of the site. The Chesapeake and Ohio Railroad and Norfolk and Western Railroad are also located within the region. PORTS occupies an area of 16.2 km^2 (6.3 mi^2) in Pike County, Ohio (Figure PORTS-2).

Within 10 km (6.2 mi) of the site, the population is estimated to be 2,500. The nearest population center is the village of Piketon (population 1,700) 5 km (3.1 mi) north. Waverly is the largest community in the county (population 4,500) and is located 19 km (12 mi) to the north. The nearest cities are Portsmouth (population 23,000), 35 km (22 mi) to the south, and Chillicothe (population 22,000), 43 km (27 mi) to the north. The total population within a 50 km radius is approximately 231,000.

The Energy Policy Act of 1992 established the U.S. Enrichment Corporation (USEC) and gave it the responsibility of operating the gaseous diffusion plant at Portsmouth. The primary mission of PORTS is the separation of uranium isotopes using a gaseous diffusion process, producing enriched uranium for nuclear fuel. The DOE mission at PORTS is conducting investigations for identification and remediation of environmental contamination stemming from prior operations. Employment at PORTS is approximately 2600.

Institutional Factors

Ownership
The entire PORTS site is owned by DOE. About 20% of the land area at PORTS is actively used. The DOE maintains responsibility for waste management and environmental restoration activities from operations conducted prior to transfer of the diffusion plant to the USEC. Most of the facilities located within the perimeter road are leased to the USEC.

No LLW disposal facility is operating at PORTS, and no future LLW or MLLW disposal units are currently planned. Historically, LLW has been disposed of at this site.

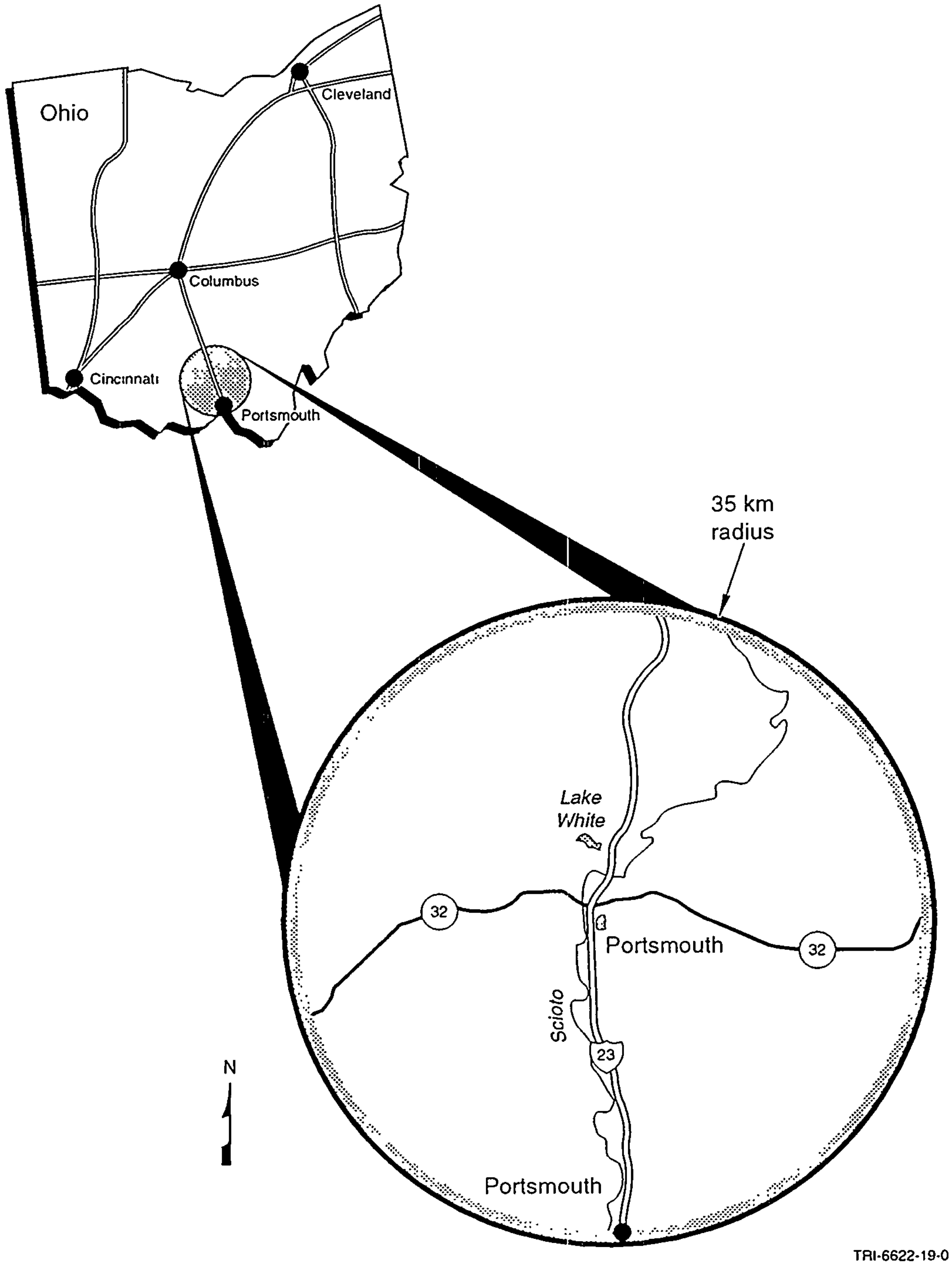

Figure PORTS-1. Location Map for Portsmouth Gaseous Diffusion Plant

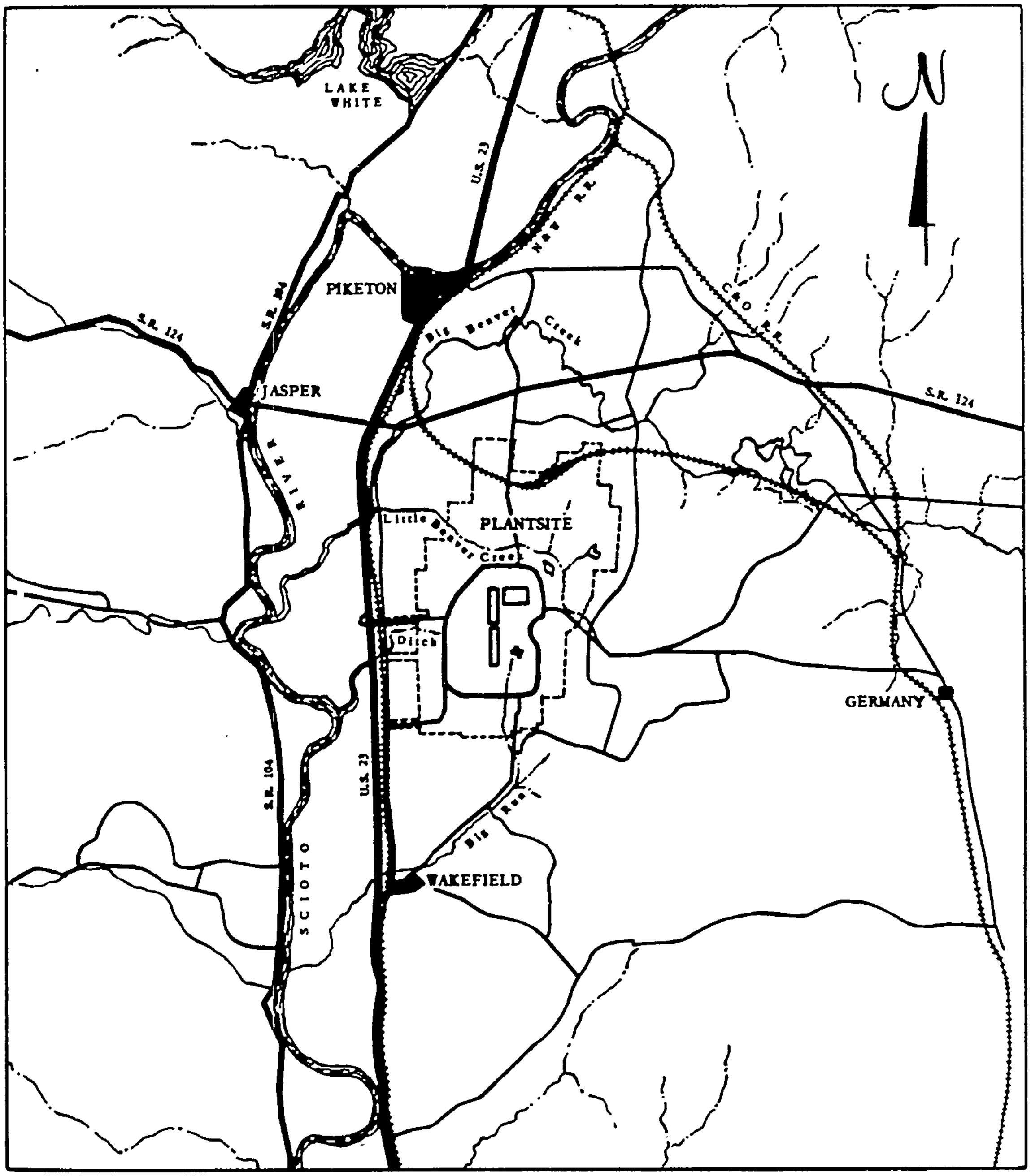

Figure PORTS-2. Site Map for Portsmouth Gaseous Diffusion Plant

MLLW Storage and Generation
The estimated volume of MLLW inventory at PORTS is reported to be 9,050 m^3, with an additional 6,383 m^3 anticipated to be generated through 1997.*

Regulatory Considerations
Judicial Consent Decree with Ohio EPA, (September 1, 1989), required compliance with RCRA in all matters, and required closures to be performed on specific units under RCRA. Additionally, the decree required a study of the conditions of the site resulting from past operations and site remediation. The decree also required that DOE seek specific approval from the state prior to siting or operation of additional disposal facilities.

No aquifers in this region are EPA designated sole-source aquifers.

Technical Factors

Climate
The average winter temperatures at PORTS are at or below 0° C (32° F) and average summer temperatures are at or above 32° C (90° F). Annual precipitation averages 101 cm (39 in). The precipitation is usually well distributed throughout the year with fall being the driest season. Evapotranspiration in the area is estimated to be 54% of annual rainfall or about 53 cm (21 in). The prevailing wind direction is from south to southwest, averaging about 8 km/h (5 mph), although winds of up to 120 km/h (75 mph) have been recorded.

Geology
PORTS is located within the Appalachian Plateau physiographic province near its northwestern boundary. Regional topography varies from level areas adjoining water bodies to gentle and steep hills in the outlying areas.

The five bedrock units under PORTS are, oldest to youngest, the Ohio Shale, Bedford Shale, Berea Sandstone, Sunbury Shale, and Cuyahoga Shale. At the site these rocks are overlain by 0 to 16 m (0 to 52 ft) of unconsolidated sediments, called the Teays Formation, deposited in the late Pliocene and Pleistocene (about 3 million years ago). Alluvium and colluvium deposited 10,000 years ago or less are also locally present.

The relatively level, filled valley of the Portsmouth River is the predominant landform in the area. The valley runs north to south and is bounded on the east and west by ridges or low-lying hills that have been deeply dissected by smaller drainages.

Bedrock strata in the area dip gently to the east; no major structural features are reported.

The site is located in Seismic Risk Zone 1, which means that minor damage could occur from earthquakes. Five geological studies have delineated only one fault, 18 miles to the west of the facility, and no seismicity has been recorded on it. In addition, no recorded seismic events have

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occurred within 40 km (25 mi) of the site. Pike County is not one of the political jurisdictions listed in Appendix VI of 40CFR264 for which compliance with seismic standards must be demonstrated.

The soils onsite are generally well-drained, upland silty loams. Shrink-swell potential is generally low to moderate, with some areas of high potential. Erosion hazard is slight to moderate.

Potential natural resources include sandstone beds saturated with crude oil and a small zone of sulfide mineralization. Additional natural resources include sand and gravel.

Hydrology

PORTS lies within the Scioto River drainage basin approximately 1.6 km (1 mi) east of the river. The Scioto River is a major tributary of the Ohio River. Two small tributaries of the Scioto River, Little Beaver Creek and Big Run Creek, cross the site. Little Beaver Creek flows toward the west-northwest and drains the portion of the site north of the main plant area. Big Run Creek flows toward the southwest and drains the southeast portion of the site. A small unnamed stream drains the west central portion of the site. All of these streams flow into the Scioto River a short distance from the site boundary and currently carry only stormwater runoff. The potential for flooding is reported to be slight. Upstream of PORTS, these small streams are intermittent. The PORTS site is not within a 100-year floodplain.

The primary source of groundwater in the area is the 18 to 30 m (60 to 100 ft) thick alluvial deposits along the river valleys. Near the site, the 32 m (104 ft) thick Scioto River Aquifer system is the most productive aquifer. This aquifer connects with other aquifers in ancestral river valleys. Large supplies of water are available because of the proximity of the deposits to the Scioto River. Pumping from wells near the river induces recharge from the river into the aquifer supplying the wells. Generally, depth to the water table is about 5 m. Nearby residential wells currently are being used for potable drinking water. The Scioto River is nonpotable and is not recommended for contact recreational use such as swimming or fishing. Aquifers in the immediate area of PORTS are not sole-source aquifers.

Regional groundwater flow is from north to south, primarily along the sand and gravel deposits within the old Newark River valley. Onsite, groundwater generally moves vertically through the Minford Clay and then horizontally in the Gallia Sand to discharge locations along the stream valleys. Velocities of up to 6.4 m/day are reported.

Sensitive Environment

No archeological or historic sites have been identified on the PORTS site, although evidence of pre-Indian cultures have been found and potential historic sites identified in the region. An old church (no longer actively used) and a cemetery are located in the northeast corner of the site.

Wayne National Forest borders the site. No other national or state parks, forests, monuments, or preserves are in the area.

No federal or state threatened or endangered species have been observed on the PORTS site. Seven state-listed wildlife species and seventeen state-listed plant species are known to occur in the Portsmouth region or have ranges that may include the PORTS site.

A number of forested wetlands occur along Little Beaver Creek on the PORTS site. In addition, small wetland areas have formed around holding ponds and ditch lines on PORTS.

Sources

Martin Marietta Energy Systems, Inc. "Portsmouth Gaseous Diffusion Plant Environmental Report for 1992". ES/ESH-37, September, 1993.

U.S. Department of Energy. "Environmental Site Description for a Uranium Atomic Vapor Laser Isotope Separation Production Plant at the Portsmouth Gaseous Diffusion Plant Site". ANL/EAIS/TM-57, September, 1991.

Site Fact Sheet
Bettis Atomic Power Laboratory
Pennsylvania

Site Description

Bettis Atomic Power Laboratory (Bettis) is located in the Borough of West Mifflin, Allegheny County, Pennsylvania, approximately 13 km (8 mi) southeast of central Pittsburgh (Figure BET-1). A residential district and municipal park border the site on the east. On the northern boundary, an industrial district is adjacent to the site. Commercial and residential developments border the site on the south and the west. Two public roadways run along the length of the southeastern and southwestern perimeter of the property. A railroad runs by the northern end of the site. The site consists of approximately 0.8 km^2 (202 acres) of land. The active portion of the Bettis Site consists of 0.08 km^2 (20 acres) of buildings and 0.07 km^2 (17 acres) of parking area (Figure BET-2).

The Bettis Site is located in the southeastern portion of Allegheny County. The population within 10 km (6.2 mi) of the site is estimated to be about 352,000, which includes the Borough of West Mifflin (24,000), where the site is located, as well as Wilkinsburg (21,000), Baldwin (22,000), McKeesport (26,000), and about 50 other towns with populations less than 20,000. The major population center within 50 km (31 mi) of the site is Pittsburgh (370,000). Also within that radius are Penn Hills (51,000), Bethel Park (34,000), Mount Lebanon (33,000), Monroeville (29,000), and numerous small towns with populations less than 20,000.

Bettis conducts research and development work on improved nuclear propulsion plants for U.S. Navy warships and is the headquarters for all of the Laboratory's operations. Much of the work at the Bettis Site does not involve chemicals or radioactivity but is conducted in office and computer spaces employing scientists and engineers in propulsion plant design, operator training development, and procedure preparation activities. Employment at Bettis is approximately 2,400.

Institutional Factors

Ownership
Bettis is owned by the DOE. No LLW disposal facilities are on site, and no MLLW disposal facilities planned.

MLLW Storage and Generation
The estimated volume of MLLW inventory at Bettis is 32.9 m^3, with an additional 6 m^3 anticipated to be generated through 1997.*

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*1994 *Mixed Waste Inventory Report*

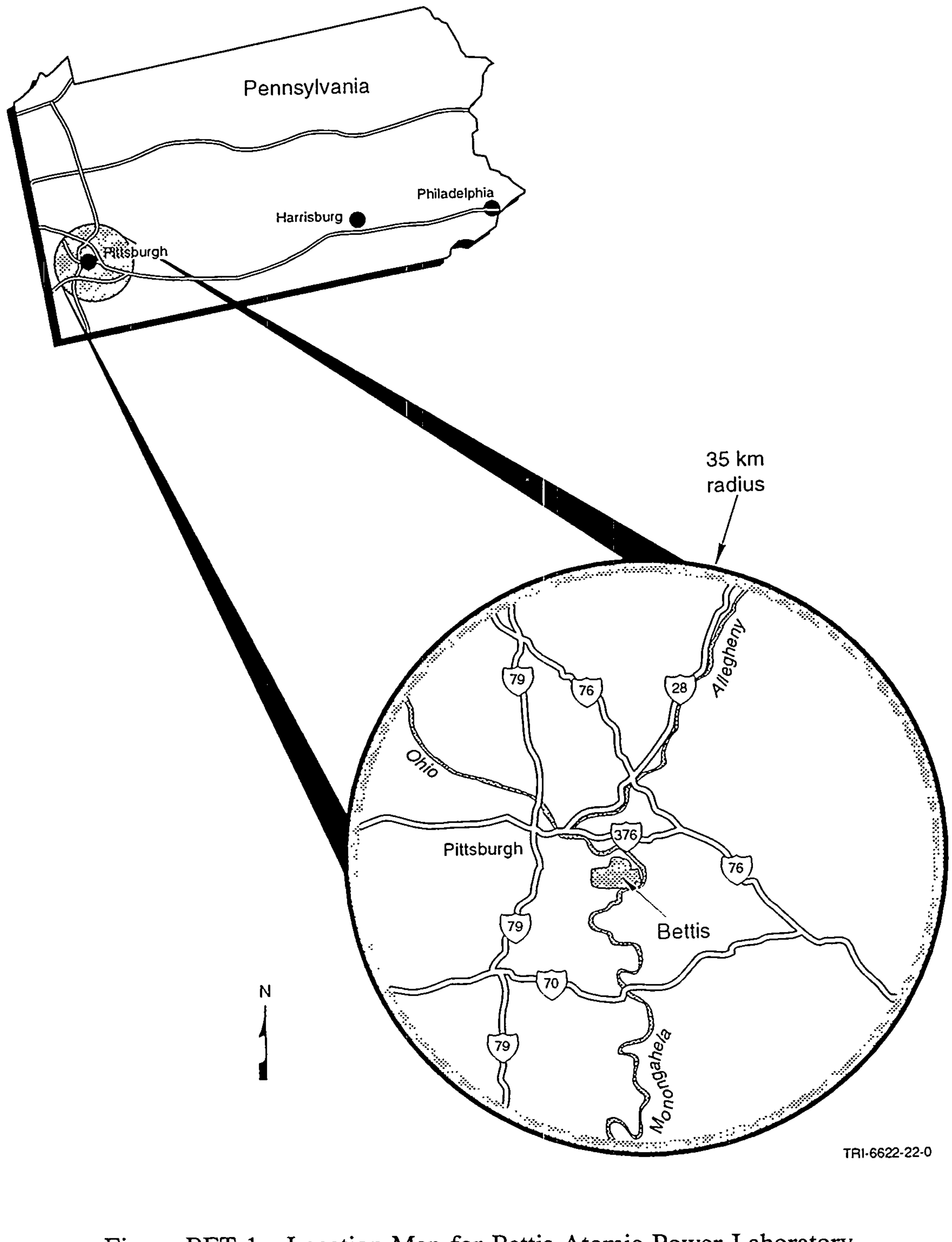

Figure BET-1. Location Map for Bettis Atomic Power Laboratory

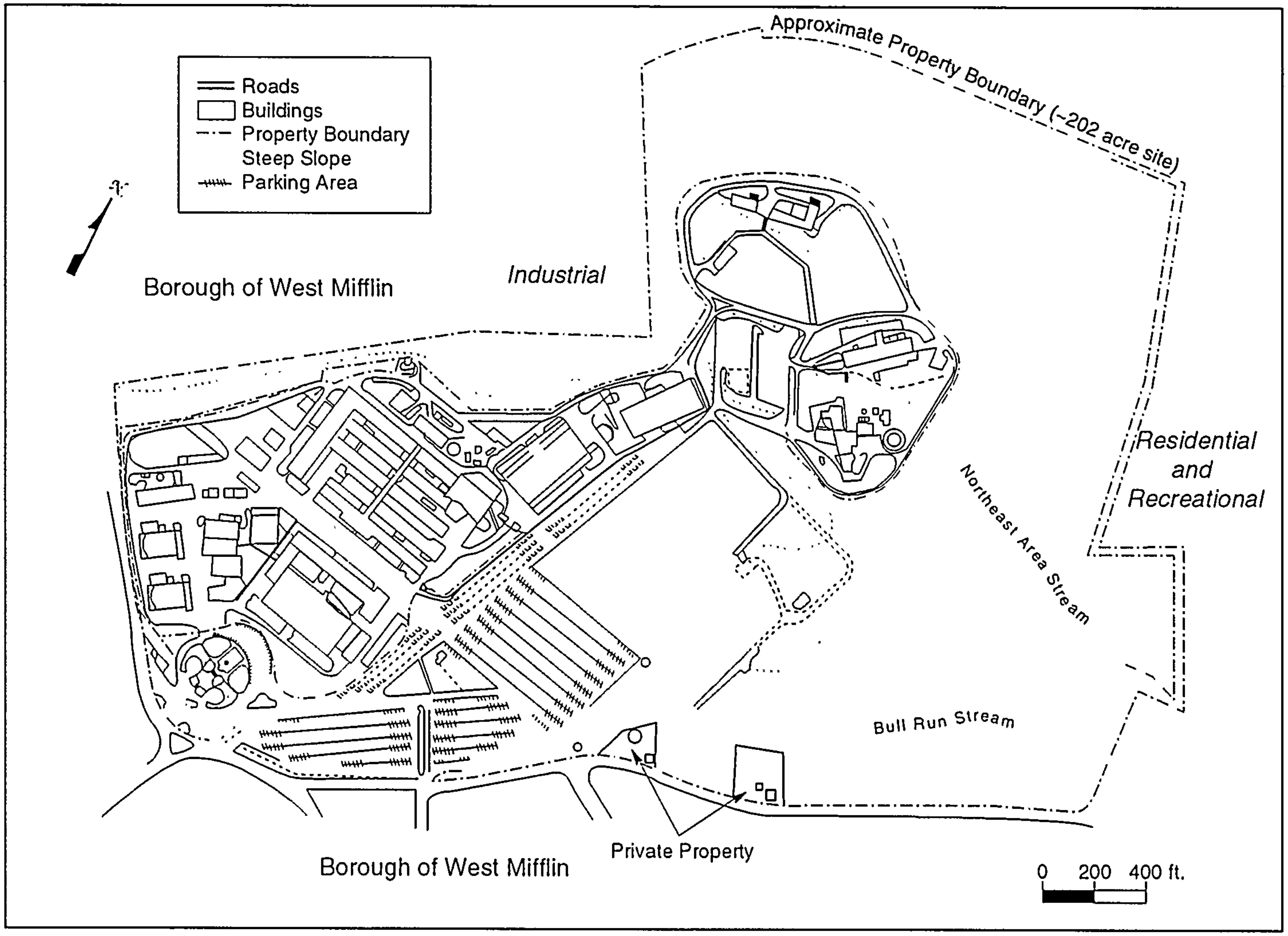

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Figure BET-2. Site Map for Bettis Atomic Power Laboratory

Regulatory Considerations
No records of decision, tri-party agreements, facility compliance agreements, or other agreements related to MLLW or LLW are in place.

No EPA designated sole source aquifers are on or near the site.

Technical Factors

Climate
The temperature in the area averages 10.7° C (51° F), reaching a minimum daily average of -4.4° C (24° F) in February and a maximum daily average of 23.3° C (74° F) in July. Annual rainfall is 81.3 cm (32 in), which is relatively evenly distributed over the year. Average annual evaporation from shallow lakes in the area is about 71 cm (28 in). Prevailing winds are from the west or northwest and average about 11.3 km/hr (7 mph).

Geology
The Bettis Site is underlain by the geologic units of the Monongahela Group, deposited more than 286 million years ago. The bedrock underlying the soil is composed of nearly horizontal layers of consolidated sandstone, shale, limestone, and coal. The rock layers are highly fractured. The major coal seam under the site has been mined.

The Bettis Site is situated on a plateau 140 m (460 ft) above the normal water level of the nearby Monongahela River.

The site is in Seismic Risk Zone 1, which means that minor damage could occur from earthquakes. The seismic risks for the region in which the Bettis Site is located are judged to be minimal.

The surface soil is from 0.3 to 2.7 m (1 to 9 ft) deep and consists principally of silt and clay with varying amounts of rock fragments. Bettis is located in a landslide and mine subsidence prone area of western Pennsylvania. However, the developed area of the site is considered free of landslide hazards, although steep slopes on the eastern and northern edge could be affected. Currently, these areas are stabilized with vegetative growth. The probability of mine subsidence is considered very low based on experience in the area and the fact that the mines are approximately 60 m (200 ft) below the site.

The available land on the site principally consists of slopes of approximately 10 to 20%, making construction difficult.

No known oil, natural gas, or other mineral resources other than coal have been identified in the immediate vicinity of the site.

Hydrology

The surface water from the Bettis Site flows into the Bull Run and Northeast Area streams. Both streams originate on the Bettis Site, with the Northeast Area stream joining Bull Run while still on the site. Bull Run then flows approximately 2.2 km (1.4 mi) before joining Thompson Run, which subsequently discharges into the Monongahela River. Along with its role as a navigable waterway, the Monongahela River is a significant recreational source and supplies water for domestic and industrial purposes. A public water supply intake (Becks Run) is located about 12.9 km (8 mi) downstream of the confluence of Thompson Run with the Monongahela River.

Because the Bettis Site is situated on a plateau 140 m (460 ft) above the normal water level of the Monongahela River, there is no potential for flooding.

The Monongahela Group that underlies the site is not an important local aquifer. Well yields from the Monongahela Group range from less than 3.6 to 108 liters (1 to 30 gallons) per minute. Groundwater flow generally follows the site topography. The nearest known wells that utilize groundwater are more than 4.8 km (3 mi) from Bettis.

The recharge areas of the Monongahela Group in the vicinity of the site are the undeveloped portions of the site on top of the plateau. The discharge areas include several springs that discharge into adjacent surface water, streams, and the underlying coal mines. The depth to the first major water-bearing zone is greater than 6.1 m (20 ft). On level portions of the site, the vadose zone is important to groundwater recharge. Groundwater flow rates are highly variable depending on geologic stratum conditions.

Sensitive Environment

No designated historical sites on the National Register of Historic Places are present, and no archeological sites of interest have been identified.

No federal or state threatened or endangered species or habitats have been identified on the site.

Sources

Annual Effluent and Environmental Monitoring Report.

Bettis Site Environmental Summary Report.

Conceptual Site Treatment Plan for Bettis.

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Site Fact Sheet
Savannah River Site
South Carolina

Site Description

The Savannah River Site (SRS) is located in south-central South Carolina (Figure SRS-1). The site is 160 km (100 mi) from the Atlantic Coast. The major physical feature is the Savannah River, which forms the southwestern boundary of the site and is also the South Carolina-Georgia border. The SRS includes portions of Aiken, Barnwell, and Allendale Counties in South Carolina. U.S. Route 278 and State Route 125 border the site.

The SRS occupies an almost circular area of approximately 780 km^2 (300 mi^2 or 192,000 acres). The SRS is comprised of 18 production, service, and research and development areas scattered across the site (Figure SRS-2). The production facilities occupy less than 10 percent of the SRS area. The remainder of the site is undeveloped forest or wetlands.

The two largest population centers located within reasonable proximity of the SRS are Augusta (40 km [25 mi] northwest) and Aiken (35 km [22 mi] north). Smaller towns of lesser populations within a 40-km (25-mi) radius of the site include Jackson, Barnwell, Snelling, Williston, N. Augusta, and New Ellenton, South Carolina, and Waynesboro, Georgia. Estimated population within a 10-km radius of the SRS is fewer than 1000; estimated population within a 50-km radius is 420,000.

Construction of the SRS was begun by the U.S. Government in 1950. The current mission of the SRS is to serve the national security interest of the U. S. by safely processing nuclear materials while protecting employee and public health and the environment. As of April 1993, estimated employment at SRS was 24,500; about 22,000 of this total are WSRC/Bechtel SR, Inc. employees and 600 are DOE employees.

Institutional Factors

Ownership

The Savannah River Site is owned and operated by the DOE. Certain daily activities are carried out by managing and operating contractors, including the Westinghouse Savannah River Company that, as co-operator, signs permits for the purpose of its activities at the SRS. Historically, LLW has been disposed of at this site.

MLLW Storage and Generation

The volume of MLLW inventory at SRS is reported to be 6,554.4 m^3, with an additional total volume of 4,432 m^3 anticipated to be generated through 1997.*

*1994 *Mixed Waste Inventory Report*

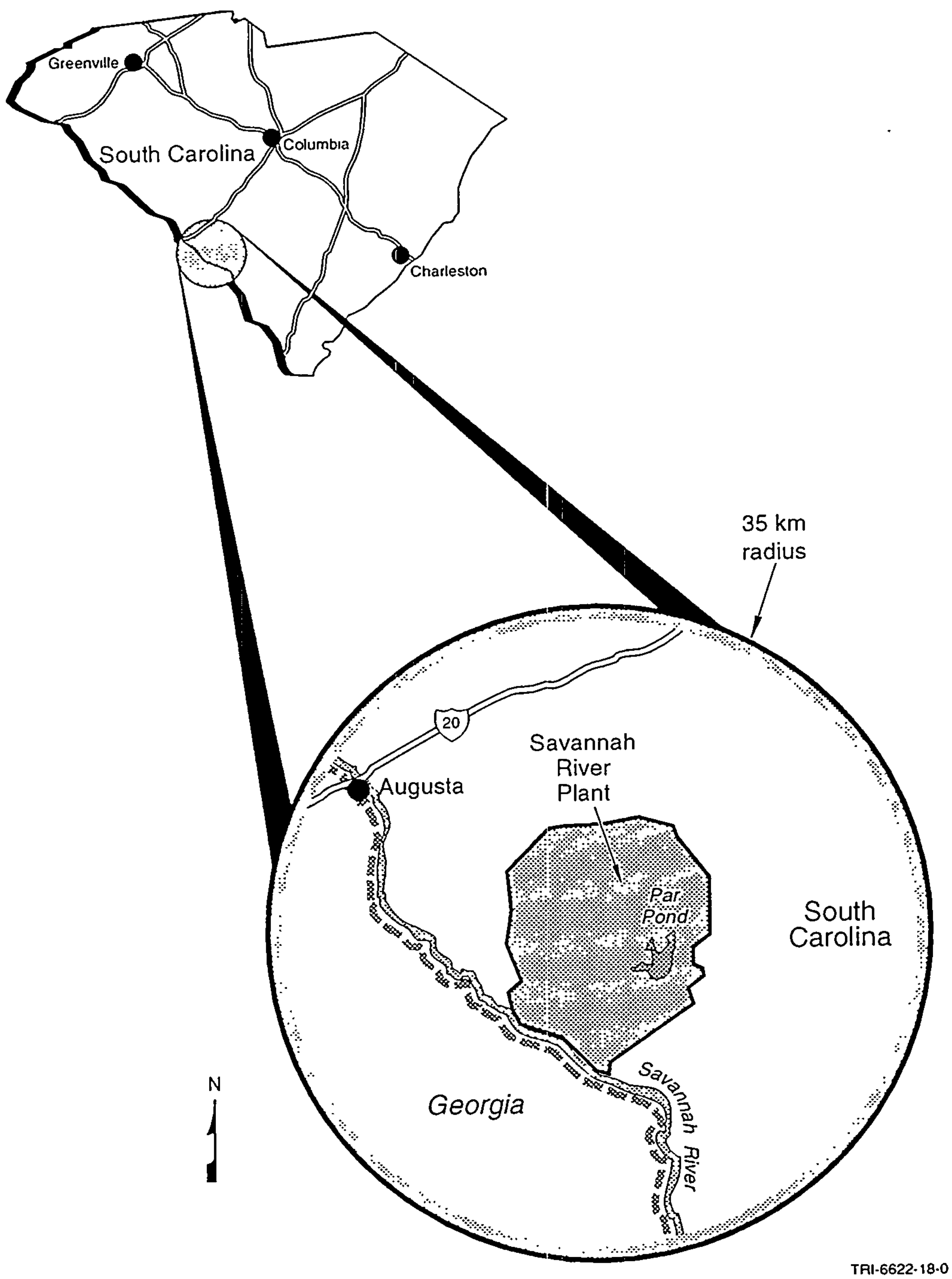

Figure SRS-1. Location Map for Savannah River Site

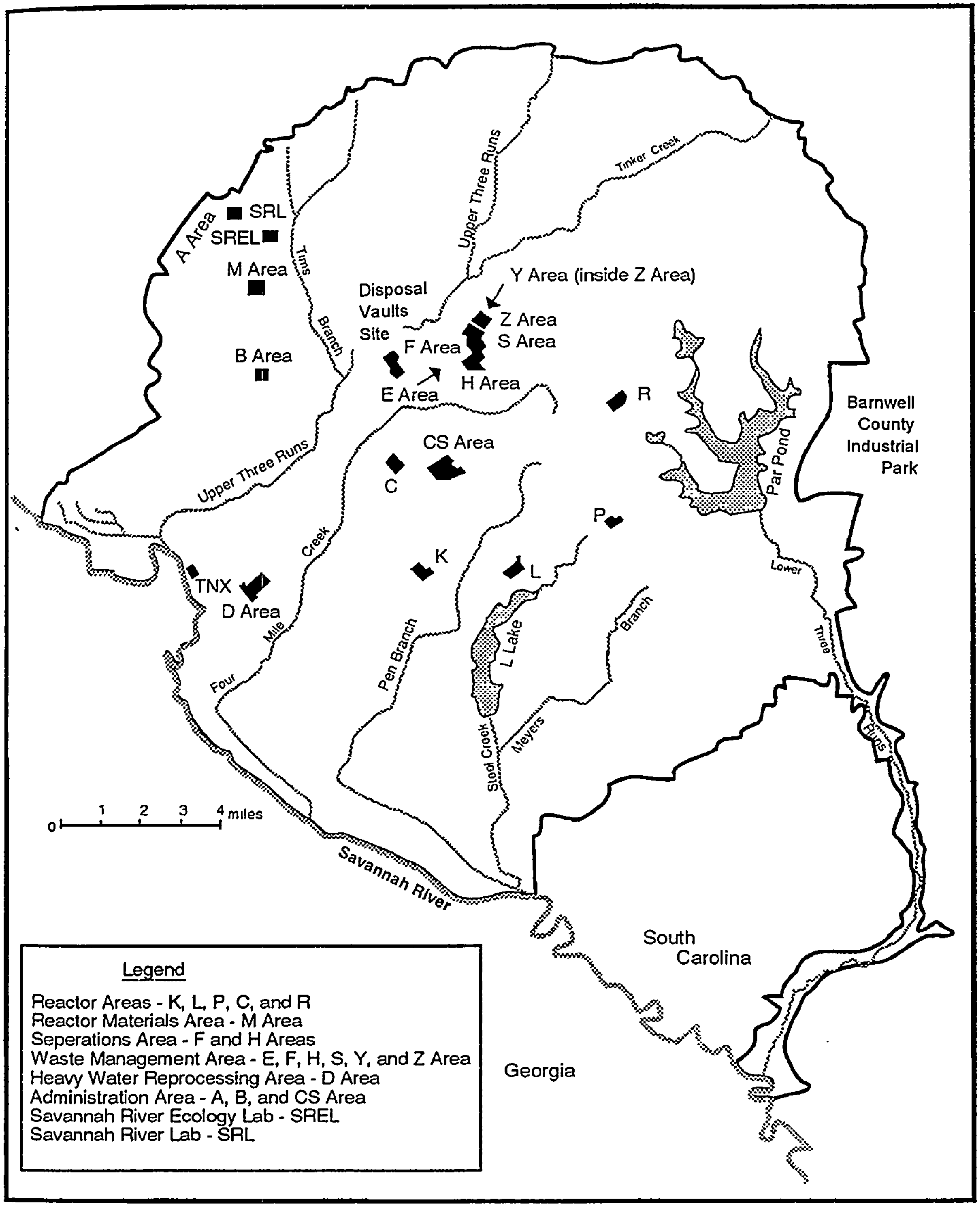

Figure SRS-2. Site Map for Savannah River Site

Regulatory Considerations
EPA and DOE entered into a Federal Facility Compliance Agreement to address the storage and treatment of RCRA Land Disposal Restrictions mixed waste. The Agreement has been renegotiated to align with the activities of the Federal Facilities Compliance Act. It does not include commitments for the disposal of MLLW.

In order to site a MLLW disposal facility at the SRS, compliance with regulation R.61-104, Hazardous Waste Management Facility Location Standards, will need to be demonstrated. This regulation contains state requirements for the location (siting) of hazardous waste treatment, storage, and disposal facilities. New facilities are required to submit this demonstration with the Part B Permit Application process.

No EPA-designated sole-source aquifers are in the area.

Technical Factors

In order to properly dispose of hazardous and MLLW waste generated at the SRS, a project to construct hazardous waste/mixed waste disposal vaults was authorized by DOE in 1989. A RCRA Part B permit application as well as a location standards demonstration has been submitted the State of South Carolina. This project has been temporarily suspended in order to assess current and projected needs. However, the location of a potential disposal site will remain at the hazardous waste/mixed waste disposal vaults location. Therefore, the following technical information is provided for the vaults site.

Climate
The SRS has a temperate climate with mild winters and relatively warm and humid summers. Extremely cold temperatures associated with outbreaks of Arctic air into the United States are moderated by Appalachian Mountains to the northwest of the area. Average temperatures at SRS are warmest in July (27.3°C) and coolest in January (7.6°C). Temperatures below freezing occur approximately 58 days per year.

The average annual rainfall at SRS, based on data from 1952 through 1992, is about 123 cm (48 in). Precipitation is fairly well distributed throughout the year. Average rainfall during the fall is slightly less than for any of the other three seasons. The annual average snowfall is 2.8 cm (1.1 in). Average annual evaporation from shallow lakes in the area is about 112 cm (44 in).

The winds in the area are relatively light with an annual speed of about 11 km/h. Due to seasonal changes in prevailing weather patterns, winds tend to blow somewhat more frequently from the northwest during the winter, from the west and southwest during the spring and early summer, and from the northeast during the late summer and fall.

Geology

The stratigraphic section underlying the location consists of nearly a thousand feet of mostly unconsolidated sands, clayey sands, sandy clays, and clays.

The SRS is located in the transition between Seismic Risk Zones 2 and 3, which means that moderate to major damage could occur from earthquakes. Based on three centuries of recorded history of earthquakes, an earthquake above Intensity VII in the Modified Mercalli Scale would not be expected at the SRS. Only two earthquakes of Intensity VII or greater have occurred within 320 km (200 miles) of the site. They were the Charleston, South Carolina, event (epicenter 145 km [90 mi] from the SRS site) and the Union County, South Carolina, event (epicenter 160 km [100 mi] from the SRS). It has been demonstrated that the soils in the disposal vaults site area are not susceptable to seismic liquifaction under a peak ground acceleration of 0.16 g.

Subsurface faults do exist in the SRS area and throughout the Piedmont and Atlantic Coastal Plain physiographic provinces. Detailed investigations of the several faults that occur beneath the SRS indicate that none of these faults continue to the ground surface and none have experienced offset (movement) for about the last 30 million years.

The principal surface and near-surface soils are clayey sands averaging about 1/3 clay. These soils in general have demonstrated a good retention capacity for most radionuclides; however, radionuclides in F-Area soils have shown fairly high mobility.

Laboratory testing performed on undisturbed samples from soils at the hazardous waste/mixed waste disposal vaults site and soils from nearby locations has been conducted to determine soil strength parameters. The results of the tests indicate that the soils at the hazardous waste/mixed waste disposal vaults site have sufficiently high strength such that bearing capacity failure will not likely occur.

Hydrology

Area surface water bodies in the vicinity of the Solid Waste Disposal Facility and hazardous waste/mixed waste disposal vaults site location consist of Four Mile Creek and Upper Three Runs Creek, and their tributaries. All drainage is to the Savannah River, approximately 13.7 km (8.5 mi) southwest of the disposal vault location. No surface waters, including intermittent streams, are within 610 m (2000 ft) of the site. The vault site is not located within an area designated as a 100 year floodplain and is located more than 30 m (1000 ft) from any navigable waters. The site is located approximately in the center of SRS and satisfies the 0.8-km (0.5-mi) minimum distance limit from a potential source of public drinking water supply. The Savannah River adjacent to the SRS is designated Class B (suitable for domestic use after treatment, for propagation of fish, and for industrial and agricultural uses). The Savannah River is used as a drinking water supply for about 65,000 persons downriver in Port Wentworth, Georgia, and near Beaufort, South Carolina. The nearest water intake is about 193 river kilometers from the SRS.

There are no sole source aquifers in the state of South Carolina; therefore, a disposal site located at SRS would not be located over a sole source aquifer. Groundwater velocity in the water table aquifer was estimated to be 21 m/yr (68 ft/yr) and travel time to the nearest surface body of water was estimated at 20.5 yrs. The groundwater flow direction beneath the hazardous waste/mixed waste disposal vaults site was determined to be northeast with respect to the plant coordinate system. Most municipal and industrial water supplies in Aiken County are developed from the aquifers in the unconsolidated sediments. Some municipal users in Barnwell and Allendale counties are also supplied with water from these aquifers.

Karst terrain is not present beneath the hazardous waste/mixed waste disposal vaults site location. Dissolution of soluble rock and sediments does not appear to be occurring beneath the location, and no surficial expressions indicate that this process occurred in the past.

Sensitive Environment

The hazardous waste/mixed waste disposal vaults site will not be located on prime farmland as described by the Soil Conservation Service, or within an area that will adversely impact sites of archaeological or historical significance as described in South Carolina Regulation R.61-104. The vaults site will not be located within 0.8 km (0.5 mi) of a national or state park, national wildlife refuge, major water impoundment, state heritage preserve, national forest wilderness area, or any other significant environmentally sensitive area. The potentially affected population for any accidents related to a MLLW facility would include personnel on the site and the general public in the areas around the SRS. Because the SRS is a controlled area, access by the general public is limited and carefully controlled by active and passive security systems. The general public does not have access to the SRS and therefore, it is highly unlikely that off-plant populations would come into contact with a MLLW facility.

In 1972, the SRS was designated the first National Environmental Research Park. The abundance of deer, turkey, and other wildlife offer a unique opportunity to study the interaction between a nuclear industrial site and the environment. Six endangered animal species visit or reside at the site.

Sources

WSRC-IM-91-53, RCRA Part B, Volume I, General Information, January 1994.

WSRC-IM-91-53, RCRA Part B, Volume IX, Hazardous Waste/Mixed Waste Disposal Vaults, September 30, 1993.

Location Standards Demonstration, Hazardous Waste/Mixed Waste Disposal Vaults, rev. 0, September 30, 1993.

US Department of Energy, 1993, "US DOE Interim Mixed Waste Inventory Report: Waste Streams, Treatment Capacities and Technologies," DOE/NBM-1100, Washington, DC.

Site Fact Sheet
Oak Ridge Reservation
Tennessee

Site Description

The Oak Ridge Reservation (ORR) is in eastern Tennessee about 10 km west of the city of Knoxville (Figure ORR-1). The ORR lies in a valley between the Cumberland and southern Appalachian Mountain ranges. The Cumberland Mountains are about 16 km (10 mi) to the northwest; the Great Smoky Mountains are approximately 113 km (70 mi) to the southeast. Topography limits land use in the region, but substantial agricultural lands yield hay, tobacco, and corn. The region ranges from rural to urban with a tendency toward increasing urbanization.

The ORR facilities are located on a 150 km^2 (37,000-acre) tract of federally owned lands. The ORR contains three major operating facilities: Oak Ridge National Laboratory (ORNL), Oak Ridge Y-12 Plant, and the Oak Ridge K-25 Site (Figure ORR-2).

Population in this region is concentrated along the Interstate 40 and Interstate 75 corridors and in the cities of Knoxville (population 165,100), about 10 km (6.2 mi) east of the site, and Oak Ridge (population 27,000). Although located within the corporate city limits of Oak Ridge, the ORR is predominantly to the west and south of the population center. Estimated population within a 10-km (6.2 mi) radius of the ORR is 30,000; estimated population within a 50-km (31 mi) radius is 308,000.

ORNL is located in the west end of Bethel Valley and was originally constructed as a research and development facility to support plutonium production technology. It is still engaged in basic research supporting the fission nuclear fuel cycle, with considerable efforts also directed toward nuclear fusion. Other major research areas include basic energy technology, materials science, environmental sciences, biotechnology, and chemical technology. ORNL is currently operating the Solid Waste Storage Area 6 as a disposal site for LLW using above-grade tumuli technology.

The Oak Ridge Y-12 Plant is located immediately adjacent to the center of the city of Oak Ridge. It was constructed to produce highly enriched uranium by electromagnetic separation. With the development of gaseous diffusion, its primary mission changed to the manufacture of nuclear weapons components. Currently, it provides support to the weapons design laboratories, maintains nuclear competency, supports dismantlement activities, acts as the nation's enriched uranium repository, supports other government agencies, and provides technology transfer to the private sector.

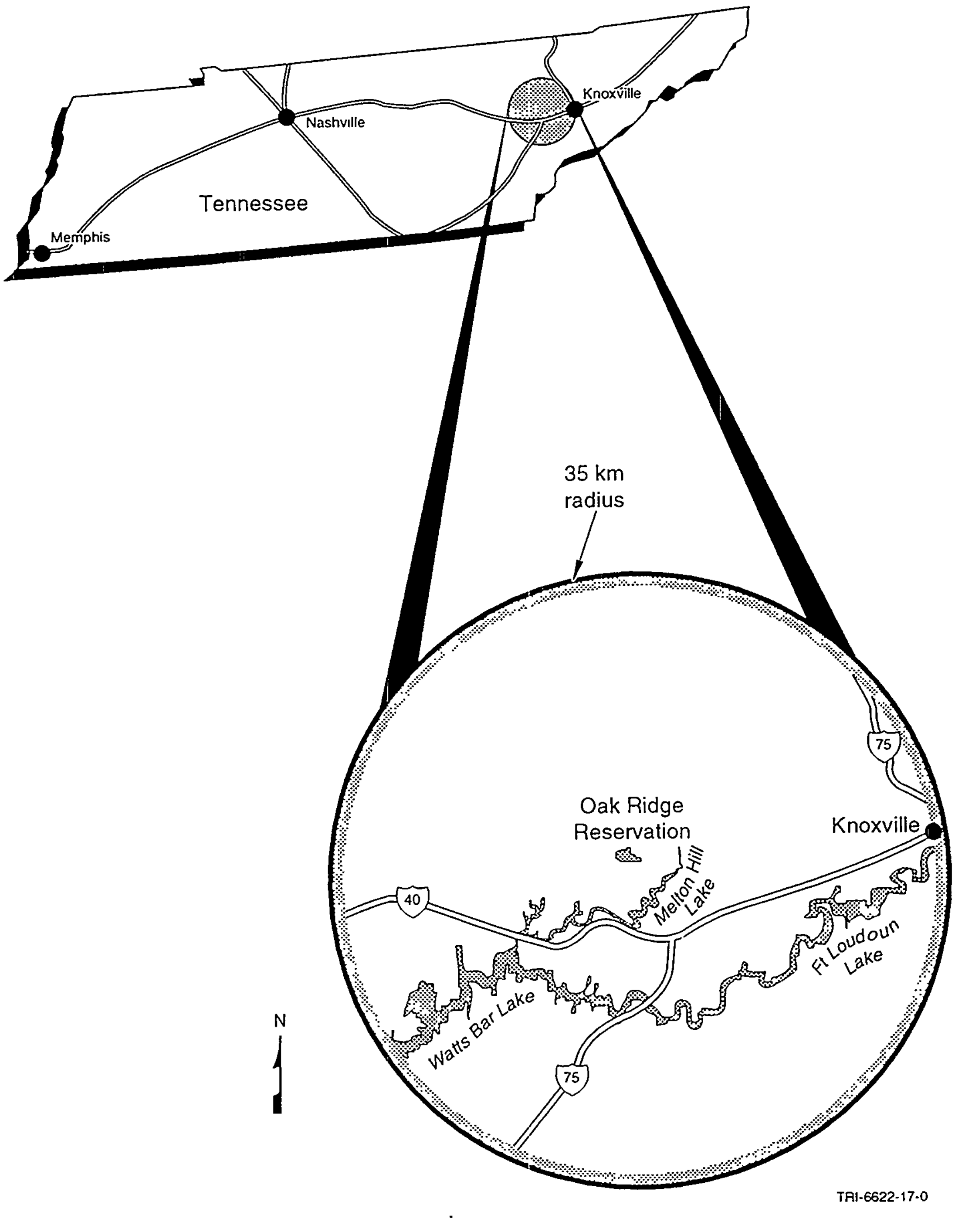

Figure ORR-1. Location Map for Oak Ridge Reservation

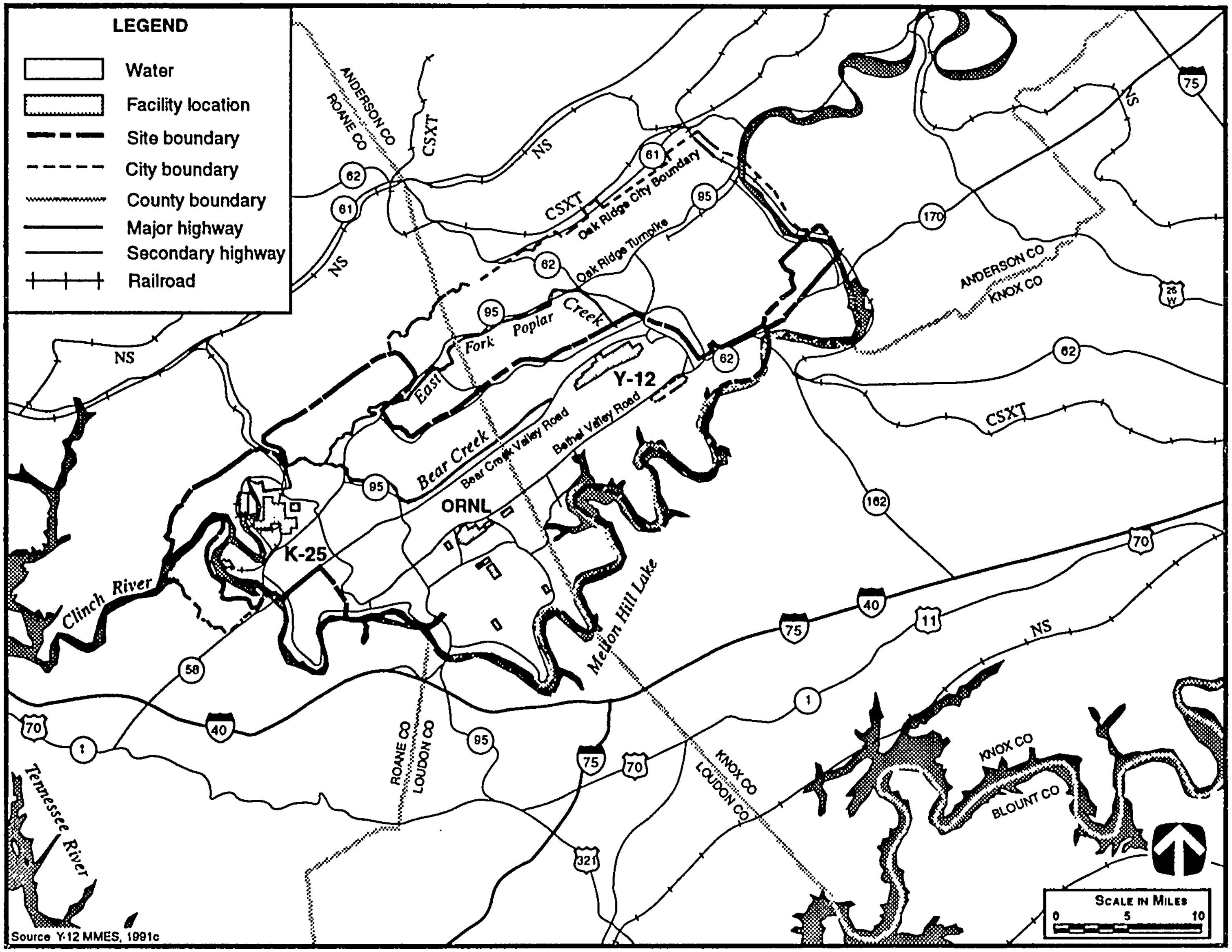

Figure ORR-2. Site Map for Oak Ridge Reservation

The K-25 Site, formerly known as the Oak Ridge Gaseous Diffusion Plant, is located approximately 13 km (8 mi) west of the population center of Oak Ridge. It was built to produce highly enriched uranium for use in the manufacture of nuclear weapons, a mission later expanded to include production of enriched uranium for commercial power reactors. The plant was permanently closed in 1987. The Environmental Restoration Program was designated the site landlord in 1989, and the facility's emphasis shifted from uranium to applied technology activities, support of DOE's environmental restoration and waste management activities, and hosting the Toxic Substances Control Act (TSCA) incinerator, a facility designed for the destruction of mixed radioactive waste. A project has been proposed for the development of an LLW disposal facility on the ORR.

Employment at the ORR is approximately 15,000.

Institutional Factors

Ownership

The ORR is owned and controlled by DOE-Oak Ridge Operations (ORO), and managed under contract by Martin Marietta Energy Systems, Inc.

ORNL is currently operating Solid Waste Storage Area 6 as a disposal site for LLW using above-grade tumuli. Historically, other LLW has been disposed of at ORR. A feasibility study for a potential MLLW disposal facility is currently underway at ORR.

MLLW Storage and Generation

Each of the three operating facilities on the ORR is currently storing and treating MLLW in some manner. No disposal of MLLW is currently ongoing at the ORR. Treatment facilities at ORNL include the Melton Valley Low Level Solidification Facility and the Nonradiological Wastewater Treatment Plant. Treatment facilities at the Y-12 plant include the Cyanide Treatment Facility, the Interim Reactive Waste Treatment Area, the Central Pollution Control Facility, and the West End Treatment Facility. Treatment facilities at the K-25 site include the Central Neutralization Facility and the TSCA Incinerator. The K-25 Site is currently storing waste for the entire ORR as well as offsite DOE waste (primarily from Portsmouth, Paducah, and Fernald) that is destined for the TSCA Incinerator. The estimated volume of MLLW in inventory on the ORR is 42,038.5 m^3, with an additional 8,295 m^3 anticipated to be generated through 1997.* A feasibility study for a proposed MLLW disposal facility on the ORR is ongoing. A conceptual design is being performed for a proposed MLLW treatment facility.

Regulatory Considerations

The DOE-ORO entered into a Federal Facility Compliance Agreement (FFCAgreement) with EPA Region IV on June 12, 1992, concerning the management of mixed waste and dioxin-containing hazardous waste subject to the Land Disposal Restrictions requirements of Subtitle C of RCRA. This FFCAgreement pertains to mixed and dioxin-containing hazardous waste from past, ongoing, and future generation, storage, treatment, and/or disposal resulting from

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*1994 *Mixed Waste Inventory Report*

DOE's operation on the ORR. The FFCAgreement requires a treatment plan for mixed wastes with identified existing treatment facilities and a treatment strategy and methods plan for wastes without identified existing treatment.

In addition to the FFCAgreement, one specific mixed-waste stream, the K-1407-B and -C ponds sludge, is covered by an existing Commissioner's Order from the Tennessee Department of Environment and Conservation. Sludge generated by a remediation activity involving these ponds constitutes a significant fraction of the mixed waste stored on the ORR. A portion of this waste stream has been processed to meet Land Disposal Restrictions treatment standards. A separate activity to store and ultimately process the untreated portion of this waste stream is currently being conducted under a Commissioner's Order from the Tennessee Department of Environment and Conservation (dated September 17, 1991).

The DOE-ORO is also developing a site treatment plan for mixed waste under the Federal Facility Compliance Act passed on October 6, 1992. The site treatment plan will include cost and schedules for developing the necessary treatment and an options analysis. The site treatment plan will be consistent with the treatment plans developed under the FFCAgreement.

The ORR was placed on the National Priorities List on December 21, 1989. The Federal Facilities Agreement between EPA Region IV, the Tennessee Department of Environment and Conservation, and DOE requires ORR cleanups to be conducted in compliance with both RCRA and the CERCLA Superfund Amendments and Reauthorization Act. The Federal Facilities Agreement, which becomes effective on January 1, 1992, is intended to satisfy the requirements for an interagency agreement under Section 120 of CERCLA.

No aquifers in this area are EPA designated sole source aquifers.

Technical Factors

<u>Climate</u>
The Oak Ridge climate is typical of the humid southern Appalachian region. The local climate is noticeably influenced by topography. Temperatures range from an average daily minimum of -2.4° C (27.7° F) in January to an average daily maximum of 30.7° C (87.2° F) in July. Annual precipitation measured in the Oak Ridge vicinity averages 138 cm (54.4 in), ranging from 94.9 cm (37.4 in) to 186.9 cm (76.3 in). Average annual evaporation from shallow lakes in the area is about 84 cm (33 in). The prevailing winds are variable and dominated by low wind speed and stable conditions. Average high wind speed is between 1.8 and 6.4 km/hr (1.1 and 4.6 mph) and occurs about half of the year.

<u>Geology</u>
Located in the Appalachian Highlands, ORR lies within the Valley and Ridge physiographic province bordering the Cumberland Plateau. Site topography is characterized by a series of alternating, elongated, and parallel valley troughs and ridges trending northeast to southwest in general accord with the strike of the underlying rock strata. The valleys have been eroded in

areas underlain by the less resistant limestone and shale strata, while the ridges are underlain by more resistant sandstone, shale, and cherty dolomite formations.

Surface elevations range from about 225 m (740 ft) at Clinch River to about 413 m (1356 ft) at the crest of Melton Hill. The rocks underlying the ORR were deposited approximately 300 million years ago and include sandstones, shales, limestones, and dolomites of the Rome Formation, Conasauga Group, Knox Group, and Chickamauga Group. These deposits generally are covered by unconsolidated residual material 5 to 30 m (16 to 98 ft) thick.

The Copper Creek and White Oak Mountain thrust faults are found on the ORR. However, there is no evidence of displacement along either fault system for hundreds of millions of years. Areas of continuing seismic activity encompass four main seismic provinces: the New Madrid (400 km [250 mi] west), the Lower Wabash Valley (375 km [230 mi] northwest), the Charleston (525 km [325 mi] southeast), and the Southern Appalachian (80 km [50 mi] east). ORR is on the western edge of the area in eastern Tennessee that lies within Seismic Risk Zone 2, which means that moderate damage could occur from earhtquakes.

In general, ORR is underlain by residual soils, mostly clays, formed by weathering of rock. Alluvium also occurs in floodplains along streambeds. The residual valley soils are a mixture of clays, silts, and weathered shale fragments and are generally much shallower than those developed on ridges. The angle of repose is about 45 degrees near the site. Considerable karst formation exists in the Knox Group and the Chickamauga Group underlying the site. The formation of karst solution pits and sinkholes has occurred in the carbonate bedrock.

All mineral exploration and development has been formally prohibited at ORR since 1947. Strip mining of coal occurs in several mountain locations west of the area; however, no coal-bearing strata exists onsite.

Hydrology

The Clinch River is the major surface water body near the ORR. The headwaters originate in Virginia and the river flows west and empties into the Tennessee River. The discharge and stages of the Clinch River are controlled by dams operated by the Tennessee Valley Authority. Floodplains of the Clinch River border the site. Drainage generally follows the northeast-southwest trending valleys.

The three DOE facilities on the ORR are located in different subbasins of the Clinch River. The Y-12 Plant drains into Bear Creek and East Fork Poplar Creek. ORNL drains into White Oak Creek and its tributaries, including Melton Branch. The K-25 Site predominantly drains into Poplar Creek and Mitchell Branch. Natural surface water quality is controlled by the geochemistry and soil-water interactions of the subbasins. Surface waters generally tend to be high in carbonate because of the extensive limestone and dolomite formations.

Potable drinking water for most of the ORR and for the city of Oak Ridge is from DOE-owned water treatment facilities. Water for the treatment facilities is obtained from the Clinch River upstream of the discharges from the facilities.

In the Oak Ridge area the Knox dolomite is the principal aquifer. The Conasauga Group and the Chickamauga Group are potential low-yield groundwater sources. The thick, weathered mantle appears to have a high-infiltration capacity and serves as a reservoir that feeds large solution cavities in bedrock. Springs at the base of Knox Ridge are primary natural sources of base flow for creeks on the ORR.

Depth to the water table varies substantially both spatially and temporally. At a given location, depth to water is generally greatest during the October-December quarter and least during the January-March quarter. In Bethel Valley, depth to water table ranges from 0.3 to 10.66 m (1 to 35 ft), while in Melton Valley the range is from 0.3 to 20.3 m (1 to 67 ft). A seasonal variation of as much as 4.57 m (15 ft) has been reported for Melton Valley. Groundwater is not used as a source of potable water on the ORR. The major portion of the industrial and drinking water supplies in the Oak Ridge area is taken from surface water sources. However, single family wells are common in adjacent rural areas not served by a public water supply system.

Sensitive Environment

The X-10 Reactor at ORNL is listed in the National Register of Historic Places. Other localities of historic interest include original ORR guard stations and old churches.

Approximately 3.2 m^2 (790 acres) of ORR's land is classified as public and consists mainly of the Clark Center Recreation Park, numerous small public cemeteries, and onsite public roads. Other parklands, campgrounds, and river assesses are in the vicinity of ORR.

Numerous species of plants and animals of special concern, such as the peregrine falcon and the Indiana and gray bats, have ranges that include the Oak Ridge area. Ten to twenty threatened or endangered species may exist on the site. Several state-listed species have also been observed. Several state natural areas on ORR provide protection of habitat for rare species.

Wetlands are associated with surface water drainage systems and some wetlands are associated with impoundments.

The ORR has been designated as a Tennessee Wildlife Management Area and a DOE National Environmental Research Park.

Sources

Performance Assessment for Continuing and Future Operations at Solid Waste Storage Area 6, ORNL-6783, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, February, 1994.

Environmental Analysis of the Operations of Oak Ridge National Laboratory (X-10 Site), ORNL-5870, Union Carbide Corp., November, 1982.

Site Fact Sheet
Pantex Plant
Texas

Site Description

The Pantex Plant is located on approximately 64.7 km^2 (16,000 acres) in the panhandle of Texas, approximately 27 km northeast of Amarillo, and 16 km west of Panhandle (Figure PAN-1). Of these 16,000 acres, 10,000 acres are owned by the Department of Energy and contain the active facility operations and related activities. Within these 10,000 acres, approximately 8.1 km^2 (2,000 acres) are dedicated to active facility operations and approximately 32.4 km^2 (8,000 acres) are devoted to storage, disposal, and miscellaneous activities in support of plant operations. The remaining approximately 6,000 acres are leased from Texas Technological University and are primarily used as a safety and security zone (Figure PAN-2).

Regional land use consists primarily of semiarid farming and ranching. The site is bordered by US Route 60 on the south and Texas Farm-to-Market roads on the north, west, and east. Interstate 40 is within a few miles of Pantex.

The nearest population center is Panhandle, with an estimated population of 2,400, located approximately 16 km (10 mi) east of Pantex. Amarillo (estimated population 164,000) is located 27 km (17 mi) southwest of the plant. The total population within a 50-km (31 mi) radius of the plant is estimated to be 200,000. About 2,100 people live within a 10-km (6.2 mi) radius.

The Pantex Plant was established in 1951 on a portion of the former Pantex Army Ordnance Plant constructed in 1942. The primary missions of the Pantex Plant include disassembly, assembly, quality evaluation, and maintenance of the nuclear stockpile. Employment at Pantex is estimated to be 3,500.

Institutional Factors

Ownership

The Pantex facility consists of 40.8 km^2 (10,080 acres) of DOE-owned land and 23.6 km^2 (5,856 acres) of land leased from Texas Technological University. The leased land primarily provides a Government-controlled safety and security zone on the south side of the facility. This buffer zone is used by Texas Tech University for agricultural purposes, and some acreage is leased for private farming. Texas Technological University also has some farming and grazing activities on DOE owned land. An additional 4.5 km^2 (1110 acres) northeast of the facility at Pantex Lake provide supplemental water rights and include a playa formerly used for disposal of sewage effluent.

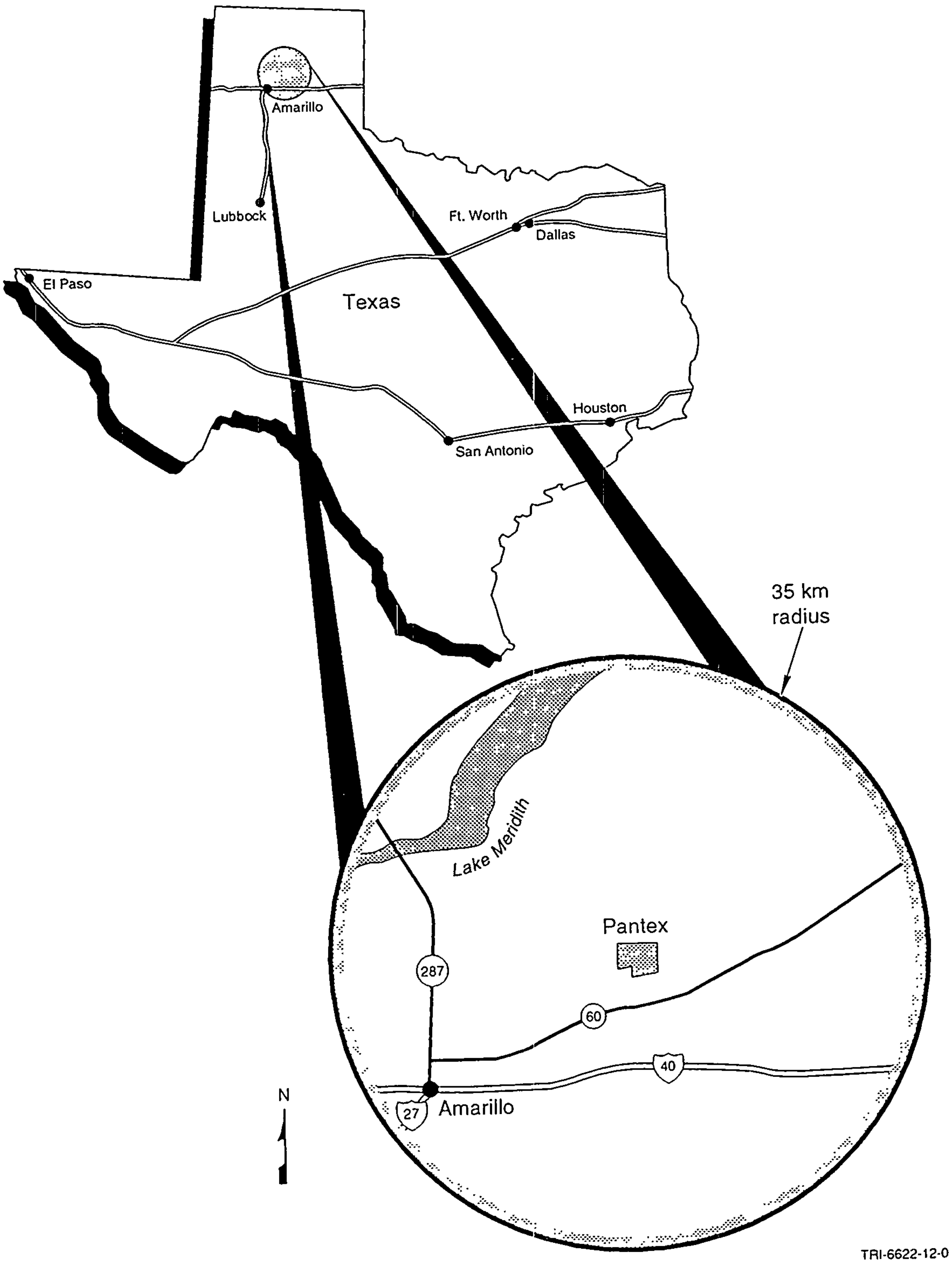

Figure PAN-1. Location Map for Pantex Plant

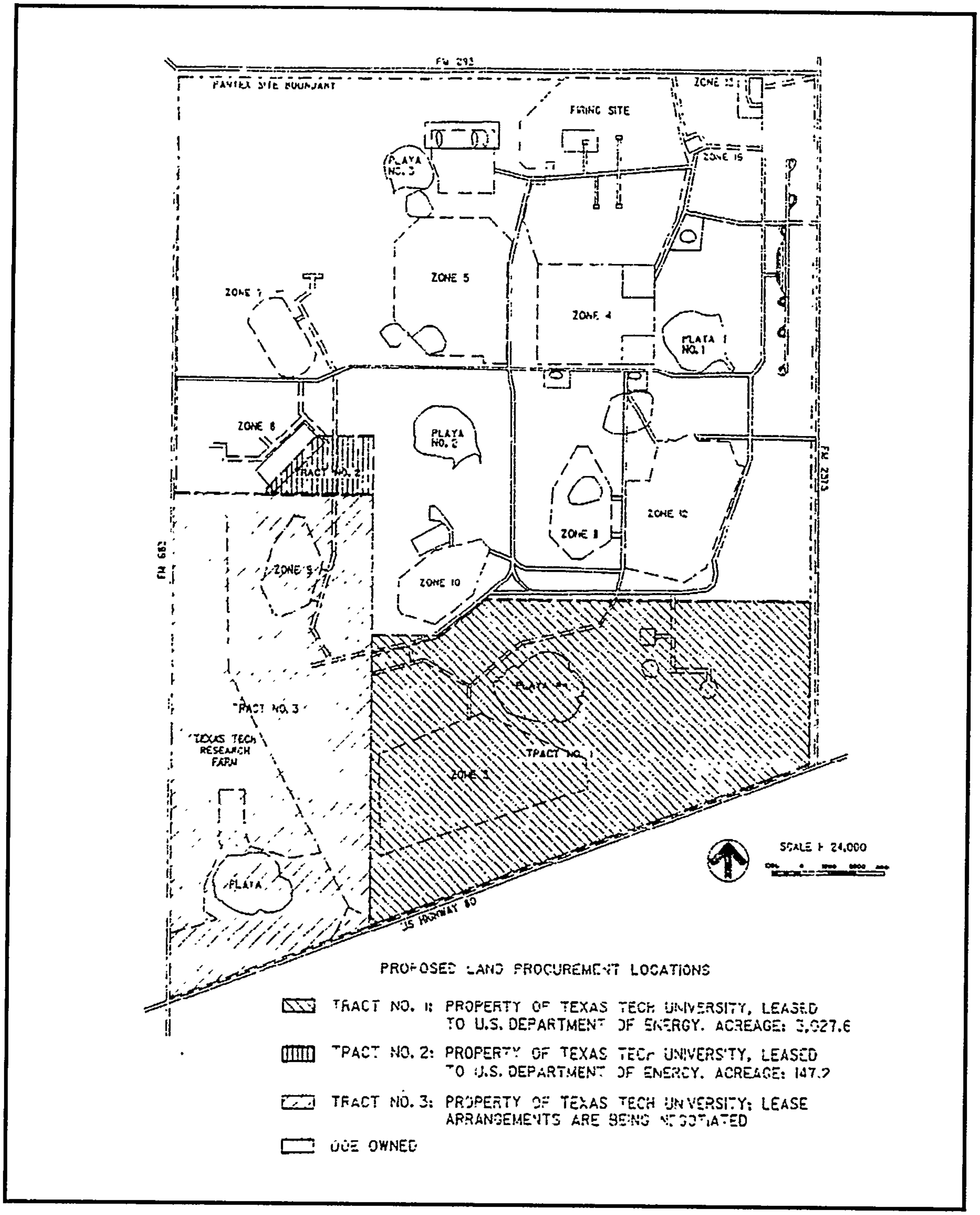

Figure PAN-2. Site Map for Pantex Plant

No LLW disposal facility is operating at Pantex, and no future LLW or MLLW disposal units are currently planned. In the past, residue from offsite military nuclear weapons accidents has been stored at Pantex pending a determination as to its final disposition. Such residue has been removed (i.e., in 1981 and 1984) and the storage area remediated.

MLLW Storage and Generation
The estimated volume of MLLW inventory at Pantex is 133.9 m^3, with an additional 344 m^3 anticipated to be generated through 1997.*

Regulatory Considerations
Perhaps the most significant regulatory consideration that applies to the Pantex Plant is its recent listing on the National Priorities List. A Sitewide Environmental Impact Statement (SWEIS) is currently being undertaken with respect to the Pantex Plant.

Even though no aquifers in this area are EPA designated sole-source aquifers, the Ogallala is the sole aquifer in this area.

Technical Factors

Climate
The region is classified as semi-arid and is characterized by hot summers with winds from the southwest and relatively cold winters with winds from the north. The annual average temperature is 14°C (57.4°F), with the minimum average daily temperature of -5.6°C (22.5°F) occurring in January and the maximum daily average of 33.3°C (91.4°F) occurring in July. Precipitation is mostly in the form of rainfall averaging 51 cm (20 in) annually. The area is subject to thunderstorms, especially in spring and summer which may be accompanied by damaging hail, lightning, and high winds. There is also the potential for tornadoes in the spring. Potential evapotranspiration is estimated to be about 350% of annual rainfall (or about 178 cm [70 in]). The region is classified as windy, with wind speeds of more than 11 km/h (7 mph) more than 95% of the year. The prevailing winds are from the south and southwest.

Geology
Pantex is in the Southern High Plains. The topography is relatively flat, characterized by rolling grassy plains and ephemeral lakes, called playa basins, mostly less than 1 km in diameter. Elevations range from approximately 1,067 to 1,097 m (3,500 to 3,600 ft) above National Geodetic Vertical Datum.

Crystalline basement rocks, more than 570 million years old, are present at a depth of approximately 2,438 m (8,000 ft) below the surface. Overlying the Precambrian basement rocks are predominantly flat-lying sedimentary rocks. Undifferentiated rocks, including a number of Permian Salt Beds more than 245 million years old, are overlain by rocks of the Dockum Group, deposited between 208 and 245 million years ago. These shales, clayey siltstones, and sandstones are less than 30 m (100 ft) thick beneath Pantex. Overlying the Dockum Group strata are

*1994 *Mixed Waste Inventory Report*

sediments of the Ogallala Formation, deposited between two and five million years ago. The Ogallala Formation consists of sand, silt, clay, gravel, and some caliche (sediment cemented by calcium carbonate). At Pantex, depths to the base of the Ogallala vary from less that 122 m (400 ft) at the southwest section of the plant, to over 235 m (775 ft) near the northeast boundary. The principal surficial deposit of the Southern High Plains is the Blackwater Draw Formation, deposited less than two million years ago and comprising a sequence of buried soils with a 14 m (45 ft) thick upper unit of mostly silty clay and caliche, and a 6 m (20 ft) thick lower unit of very fine sand with caliche.

No geologic hazards, such as major faults, land subsidence, or high seismic potential, are found at the Pantex Plant. The site is located in Seismic Risk Zone 1, which means that minor damage could occur from earthquakes.

The dominant soils are of the Pullman and Randall series. The Pullman-Randall association soils are deep clay loams and clays that occur on gentle slopes. Pullman soils cover most of the flat areas with Church, Lofton, Mansker, Randall, and Ulysses soils present in the playas. Pullman soils have moderate to high shrink-swell potential, and permeabilities that range from 0.13 to 1.3 cm/hr (0.05 to 0.5 in/hr).

No natural or mineral resources have been identified at the Pantex Plant site.

<u>Hydrology</u>

No rivers or streams flow through or near the Pantex Plant. All surface water at the Pantex Plant flows to one of the playas on or adjacent to the Pantex Plant. There are four playa wetlands on DOE owned property, one of which is on noncontiguous DOE property, and one playa wetland on DOE leased property. The industrial wastewaters generated at the Pantex Plant flow to one of three playas on property owned by the DOE and a playa on property leased by the DOE.

Two principal water-bearing units are present in the Pantex Plant region, the Ogallala aquifer and the underlying Dockum Group aquifer. The Ogallala aquifer is separated from the ground surface by up to 140 m (460 ft) of unsaturated sediments including those of the Blackwater Draw Formation. A discontinuous 0.2 to 9 m (1 to 30 ft) thick perched groundwater zone is present in the middle of the Ogallala formation above a fine-grained zone that is up to 24 m (80 ft) thick. The lateral extent of the perched groundwater has not yet been defined. The Ogallala Formation also provides water for nearby towns and cities, and irrigation water for farms. The city of Amarillo has a municipal well field starting approximately 1.6 km (1 mi) north of the Pantex Plant's supply wells.

During the 1950s, the normal direction of groundwater flow in the Ogallala aquifer beneath the plant was to the east. Subsequent pumpage from the aquifer created a large cone of depression in the water table northeast of the plant. Groundwater in the Ogallala aquifer beneath the plant now flows northeast, toward the well fields. The water table level of the Ogallala in the vicinity of Pantex is declining at a rate of approximately 0.6 m/yr (2.0 ft/yr).

All of the surface water at Pantex Plant drains into playas. Stormwater runoff may also cause a temporary increase in stage level of a playa which can result in accelerated infiltration of water into the subsurface. The playas constitute recharge zones for the Ogallala Aquifer. This focused recharge is from piston and preferential pathways in the playa basin itself. According to recent estimates, recharge rates range from 13 to 62 cm/yr (5 to 24 in/yr).

The Dockum Group aquifer is found beneath the Ogallala aquifer at Pantex and south of the plant. Water contained in the sandstone layers within the Lower Dockum Group supplies domestic and livestock wells south and southeast of Pantex. Other Dockum aquifer wells are located 16 km (10 mi) south and west of Pantex. The Dockum aquifer may not be well-connected to the overlying Ogallala aquifer because of low conductivity layers in the Ogallala and shale layers in the Dockum Group. The direction of groundwater flow in the Dockum appears to be toward the southwest.

The Ogallala aquifer supplies all water to the plant site and its estimated 3,500 employees. Adjacent to the plant is the primary groundwater supply for the City of Amarillo. This groundwater is hydraulically down gradient of the Pantex Plant.

Sensitive Environment

Three historic farmstead sites are known to exist on Pantex; however, none appear to meet the National Register of Historic Places criteria. About 50 prehistoric Indian camps are known to exist on Pantex. No archeological or paleontological sites have been excavated on Pantex; however, 23 sites have been tested. No determinations of National Register eligibility have been made.

Buffalo Lake National Wildlife Refuge, Lake Meredith National Recreation Area, Alibates National Monument, and Palo Duro Canyon State Park are within 50 miles of the Pantex Plant.

Numerous species of special concern, such as wintering and migratory bald eagles and migratory whooping cranes, are known to inhabit the Pantex Plant. Several Texas threatened or endangered species have also been observed along with several federal candidate species. Although some of the species occupy the industrialized and agricultural areas, most rely on the small patches of somewhat natural areas surrounding each of the playa wetlands.

All of the DOE owned playa wetlands and one of the DOE leased playa wetlands have been deteremined by the U. S. Corps of Engineers to be jurisdictional wetlands. Floodplains are also associated with each of the playas.

Although the Pantex Plant site is not totally included within a 100 year floodplain, a significant portion of the Plant is within 100 year floodplains associated with both on-site and off-site playas. Excluding the playas, approximately 2,650 of the Government owned acres are within 100 year floodplains. (The playas cover approximately 1,100 acres of the remaining 10,000 Government owned acres.) A floodplain delineation for the entire plant site, to be conducted by the U. S. Army Corps of Engineers, is anticipated to be completed in 1995.

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Site Fact Sheet
Hanford Site
Washington

Site Description

The Hanford Site is located northwest of the city of Richland, Washington, (Figure HS-1). The Hanford Site is bounded by the city of Richland on the southeast, the Saddle Mountains to the north, the Columbia River on the east, and on the south and west by the Yakima River and the Rattlesnake Hills. Regional road and rail services support the Hanford Site. The major road systems include Washington State Highways 24 and 240 (nearest public roadway), which connect to nearby Interstate Highway 82 and State Highways 395 and 12. Railroad service is connected to the national network south of the site. Major industrial facilities within the region include a meat packing plant, food processing facilities, a pulp and paper mill, a commercial nuclear power plant, a commercial nuclear fuel manufacturing plant, hydroelectric dams, and small manufacturing firms. Agriculture is the main land use within the region.

The Hanford Site covers approximately 1450 km^2 (560 mi^2) of treeless semiarid land (Figure HS-2). Reactor facilities (8) are located along the Columbia River in what is known as the 100 Area. Reactor fuel processing and waste management facilities are in the 200 Areas, which are located on the 200 Area Plateau approximately 11.3 km (7 mi) from the Columbia River. The 300 Area, located north of Richland, contains reactor fuel manufacturing facilities and research and development laboratories. The 400 Area, 8 km (5 mi) northwest of the 300 Area, contains the Fast Flux Test Facility, a liquid metal test reactor. Adjacent to and also north of Richland, the 1100 Area contains facilities associated with administration, maintenance, transportation, and materials procurement and distribution. The 3000 Area, between the 1100 Area and the 300 Area, contains Pacific Northwest Laboratory research and development facilities, Kaiser Engineers Hanford Company field engineering services, and other engineering and administrative offices. The 700 Area in downtown Richland, which is off-site, provides administrative buildings, health physics services, records and reproduction center, Environmental Health Sciences Laboratory, and emergency decontamination facilities.

The city of Richland (population 34,000) adjoins the southeasternmost portion of the Hanford Site boundary and is the nearest population center. The city is approximately 35 km (22 mi) from the 200 East Area, which is on the 200 Area Plateau. Estimated population within a 10-km (6.2-mi) radius from the approximate centroid of the 200 Area Plateau is 0, and within a 50-km (31-mi) radius is 230,000.

In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related facilities and activities for the production and purification of plutonium. The Hanford mission is to clean up the Hanford Site, eliminate potential risks to the public and site workers, and serve as the DOE model in environmental restoration. Employment at the Hanford Site (including the 700 Area) is approximately 18,000

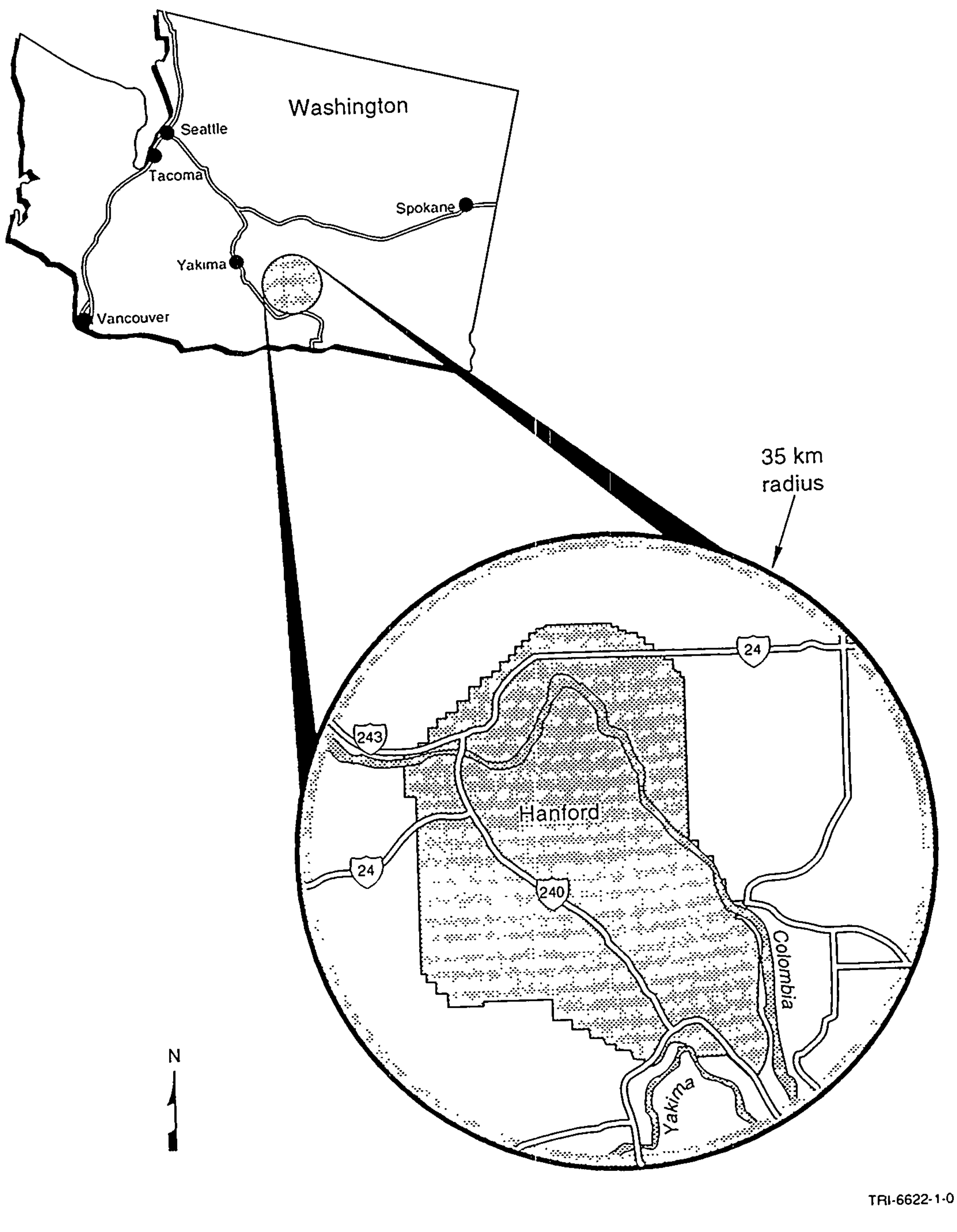

Figure HS-1. Location Map for Hanford Site

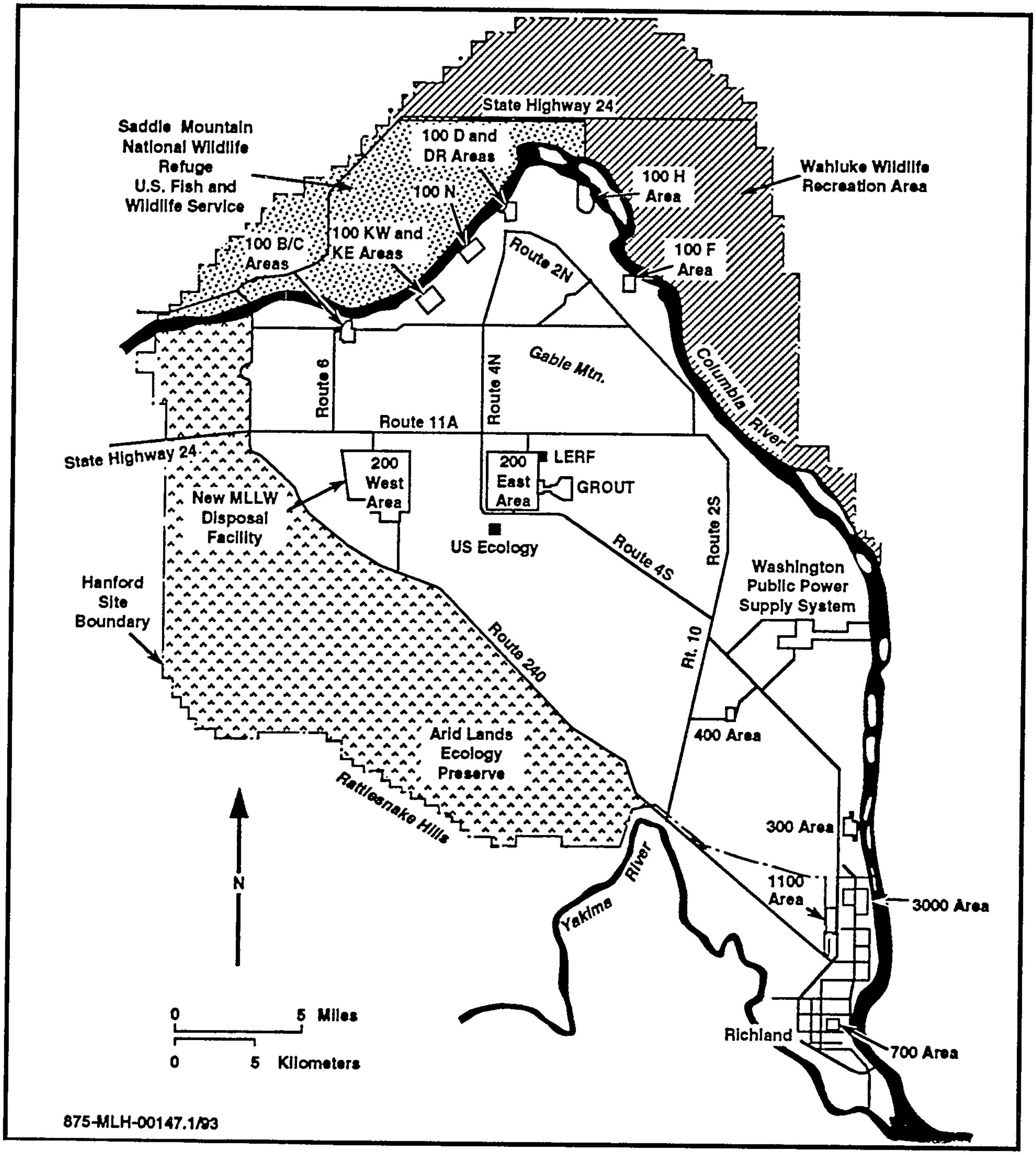

Figure HS-2. Site Map for Hanford Site

combined DOE and contractor employees. Not included in this head count are employees for commercial ventures on the Hanford Site, which includes a nuclear power plant (Washington Nuclear Plant-2) operated by the Washington Public Power Supply System, and a low-level radioactive waste burial area administered by the State of Washington and operated by U.S. Ecology.

Institutional Factors

Ownership

The Hanford Site is owned by the U.S. Government and managed by the DOE-RL. Hanford has active LLW disposal facilities. A RCRA compliant disposal facility for solid MLLW is under construction, with operations planned to start in the first quarter of Fiscal Year 1995. This new mixed waste disposal facility is located within Low Level Burial Ground 218-W-5 in trench number 31 within the 200 West Area. On-site disposal of MLLW is not generally permitted. The existing portions of the Low Level Burial Ground trenches constructed before November 23, 1987, are exempt from the liner system requirements or alternate technologies requirements as provided for in Washington Administrative Code 173-303-806(4)(h)(ii)(A). Two types of mixed waste typically considered for disposal in the pre-1987 trenches are remote-handled mixed waste (with exposures of greater than 200 mrem/hr at the container surface) and special waste. Special waste, as used here, includes unique waste that requires special handling or unusual waste such as decommissioned reactor vessels.

MLLW Storage and Generation

The estimated containerized MLLW inventory at Hanford Site is 3102 km^2. An additional 5,380 m^3 of containerized MLLW and 114,600 m^3 of MLLW Waste Water from Tank Farm evaporation processing is anticipated through 1997. The combined projected MLLW through 1997 is 119,980 m^3.*

Regulatory Considerations

The DOE in concert with Washington State Department of Ecology and the EPA have entered into a Tri-Party agreement titled the Hanford Federal Facility Agreement and Consent Order.

The Low Level Burial Grounds are not located over an EPA-designated sole source aquifer. The active burial grounds were grouped into 5 Low Level Waste Management Areas for ground water monitoring. They currently are operated under Interim Status under the Washington Administrative Code 173-303 with a Part "B" Permit application submitted pending regulatory approval.

Technical Factors

Climate

Climate at the Hanford Site is characterized by relatively cool, mild winters and warm summers. Average maximum and minimum temperatures for January, the coldest month, are 3°C and -6°C

*1994 *Mixed Waste Inventory Report*

(37°F and 22°F), respectively; for July, the warmest month, average maximum and minimum temperatures are 33°C and 16°C (91°F and 61°F), respectively. Average annual rainfall is about 16 cm (6.3 in), which supports the site vegetation of mainly sagebrush and cheatgrass. The estimated average annual evaporation rate is 134 cm (53 in). Periods of infrequent high winds of up to 128 km/h (80 mph) are possible. Prevailing wind directions are from the northwest in all months with secondary maxima from the southwest. Tornadoes are extremely rare; no destructive tornadoes have occurred in the region surrounding the Hanford Site.

Geology

The dominant features of the Hanford Site include the Columbia River, sand dunes located near the Columbia River, and the Basaltic Ridges, including the Rattlesnake Hills that rise to an elevation of greater than 1,100 m (3,600 ft). The Hanford Site lies within the semiarid Pasco Basin, which is a structural and topographic depression within the Columbia Plateau. Hanford's active solid waste disposal facilities are located on the 200 Areas Plateau. The terrain of this central portion of the site is relatively flat. The principal soils and geologic formations below these burial grounds comprise an alluvial plain that consists of interbedded sediments of sands and gravels approximately 61-91 m (200-300 ft) deep (deposited approximately 13,000 years ago). The ground level elevation of this alluvial plain in the 200 Areas ranges from 190-245 m (623-804 ft) above mean sea level. This alluvial plain is supported by multiple layers of basalt flows (greater than 3,650 m [12,000 ft] thick), that are separated by interbeds of silts, sands, and gravels (Hanford and Ringold Formations). These basalt flows are estimated to range in age from 17 to 6 million years old.

The Hanford Site is located in Seismic Risk Zone 2, which means that moderate damage could occur from earthquakes. The largest earthquake of record to occur within the Columbia Basin, the 1936 Milton-Freewater earthquake, had a magnitude of 5.75 on the Richter scale and has been designated the Hanford Regional Historical Earthquake. This Hanford Regional Historical Earthquake is assumed to have a peak horizontal ground acceleration of 0.10 times the earth's gravity.

Volcanic hazards are present from existing Cascade volcanic centers within the Cascade Range. Impacts to the Hanford Site from volcanic activity are limited to minor tephra falls (ash fall-outs).

Minor wind erosion of surface sands and silts is the only soil stability problem at the Hanford Site. Other than wind erosion, no other soil stability issues such as swelling, settlement, and slope failure are known to occur.

No known natural resources are on or near the burial ground facilities.

Hydrology

Surface waters within the Hanford Site includes the Columbia River, which flows through the northern part of the site and along the eastern boundary, small ponds and ditches from on-site process plants, and natural runoff. Water from the ponds, ditches, and natural runoff does not reach the Columbia River due to evapotranspiration and percolation into the natural alluvium.

The 200 Areas are not located within a wetland. Also, a 100-year flood from the Columbia River or flash flooding from the Cold Creek drainage area would not reach the 200 Areas.

Groundwater under the site occurs under unconfined and confined conditions. The unconfined aquifer is contained within the interbedded sediments of sands and gravels above the multiple basalt flows, with the bottom of this aquifer being the top surface of the basalt. Sources of natural recharge to the unconfined aquifer are rainfall and runoff from the higher bordering elevations, water infiltrating from small ephemeral streams, and influent river water. Groundwater is monitored routinely by Pacific Northwest Laboratory, with annually published results. Groundwater contamination plumes, in excess of drinking water standards, of tritium, uranium, nitrate, and carbon tetrachloride exist on the Hanford Site. The top of the water table (unconfined aquifer) in the 200 Areas ranges from 56 to 100 m (184-328 ft) beneath the ground surface. Flow direction of this aquifer generally is to the east and southeast toward the Columbia River.

The confined aquifer is located between the basalt layers within the interbeds of sands and gravels. The main water bearing portions of the interbed zones occur within a network of interconnecting vesicles of the flow tops or bottoms. The confined aquifer is not known to be contaminated as a result of past Hanford activities.

In general, onsite water usage is for cooling water, steam generation, fire protection, and process water, which is provided from the river. Domestic water also comes from the river through treatment facilities with the exception of domestic water to the 400 Area, which comes from wells supplied by the unconfined aquifer.

Sensitive Environment

Nine archaeological properties have been identified on the Hanford Site along the Columbia River and are listed in the National Register of Historic Places. The White Bluffs Road (which transects the 200 West Area) is proposed for listing as an Historic Place, as is B Reactor. The White Bluffs Road, which crosses through the 200 West Area, has been previously disturbed over the last 50 years.

No species of plant or animal that is federally registered as threatened or endangered is known to depend on the habitats unique to Hanford.

Three buffer zones, predominately around the 100 and 200 Areas, currently exist within the site: the Arid Lands Ecology Reserve, a 310 km^2 (120 mi^2) area to the south and west of Route 240; the Saddle Mountains National Wildlife Refuge, approximately 130 km^2 (50 mi^2) north of the Columbia River; and the Wahluke Wildlife Recreation Area, a 220 km (85 mi^2) plot to the northeast of the Columbia River.

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APPENDIX A:
Site Fact Sheet
Envirocare of Utah, Inc.
Utah

Site Description

Envirocare is a privately owned company located in central Utah. The Envirocare facility is located east of Clive, Utah, approximately 120 km (75 mi) west of Salt Lake City. The facility occupies an area of 2.6 km^2. The business of Envirocare is to treat and dispose of low level radioactive and mixed low level wastes (LLW and MLLW).

The facility is located around a 0.4 km^2 inactive uranium mill tailing site that was remediated in the 1980s as part of the DOE Uranium Mill Tailings Remedial Action (UMTRA) Program. The remediated site is still owned by DOE. Other industries near Envirocare include 2 hazardous waste incinerators and a hazardous waste landfill. The facility is situated 48 km (30 mi) from agricultural or residential activities. Envirocare is located 4.8 km (3 mi) from Interstate 80 and has its own railway spur off the nearby Union Pacific railway line.

The Envirocare facility has a license from the state of Utah to accept LLW. The facility is licensed to dispose of naturally occurring and accelerator produced radioactive materials (NORM and NARM), and 10 CFR 61 Class A LLW including source, special nuclear, and byproduct materials. In addition, Envirocare has a NRC license to dispose of 11e.(2) mill tailings. Envirocare's permit lists each isotope, the chemical or physical form, and the maximum average concentration in the waste allowed for disposal at their facility.

For MLLW, in addition to the aforementioned permits governing radioactive constituents, Envirocare has a RCRA permit from Utah to accept many types of mixed wastes. The permit requires that the hazardous constituent meet federal land disposal restriction criteria.

The Waste Acceptance Criteria (WAC), Radioactive Material License, and RCRA Part B Permit Certificate are attached.

A current contract exists between DOE and Envirocare for disposal of complex-wide DOE mixed waste. The contract term is for two years with three one-year options. Total volume available for disposal under the contract is 267,610 m^3. The following DOE sites have disposed of mixed waste at the Envirocare facility: INEL, Fernald, RMI, Pantex Plant, Portsmouth, Paducah, SNL, Santa Susana Field Laboratory, and Colonie Interim Storage Site.

ENVIROCARE

OF UTAH, INC.

MATERIAL QUALIFICATION & ACCEPTANCE PROCESS

- Qualification Process for Radioactive Material
- Qualification Process for Mixed Waste
- Acceptance and Shipment Process

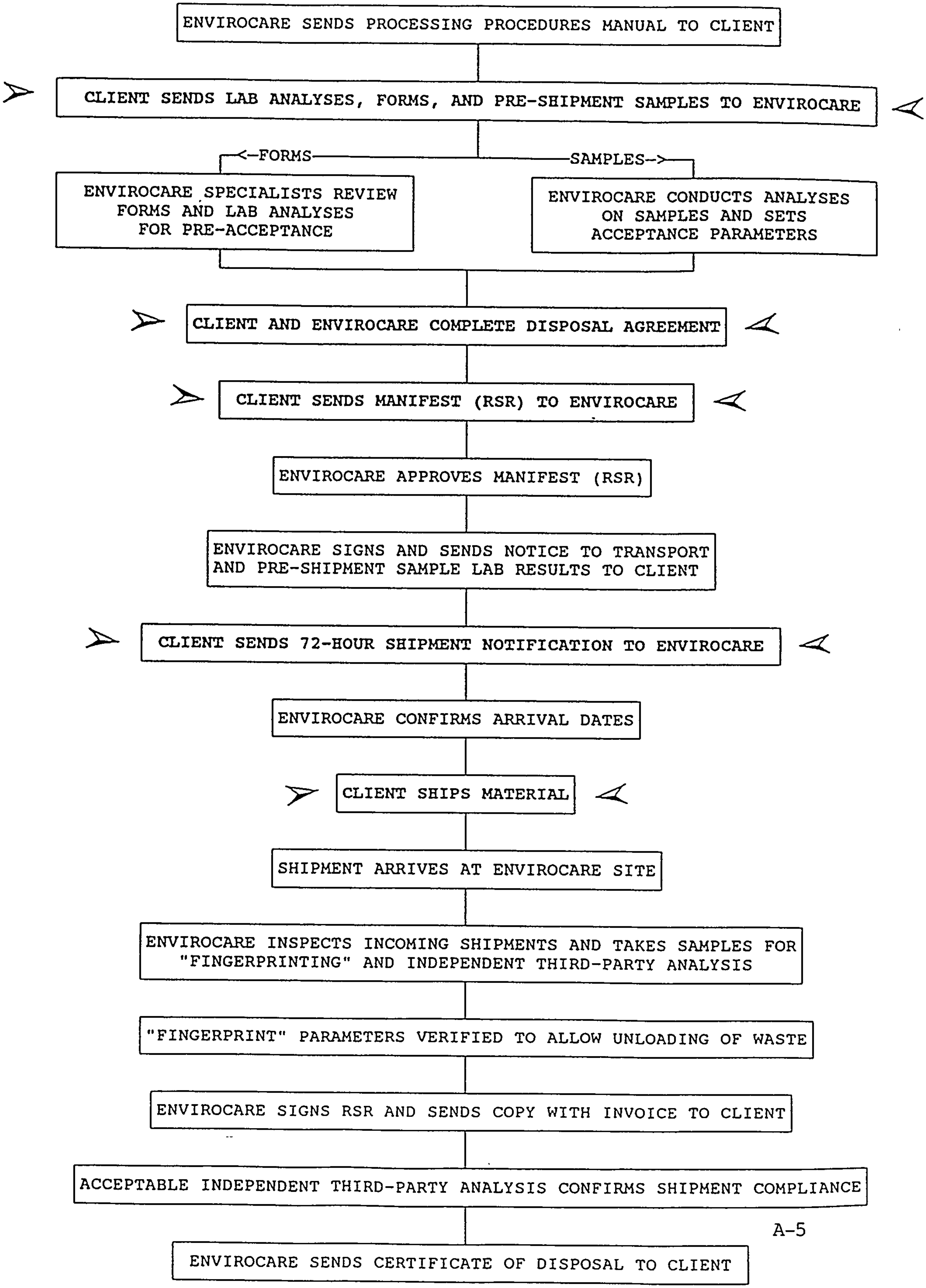
QUALIFICATION PROCESS FOR RADIOACTIVE MATERIAL

- COMPLETE LOW-ACTIVITY PROFILE (EC-0200)
- COMPLETE PHYSICAL PROPERTIES FORM (EC-0500)
- COMPLETE RADIOLOGICAL EVALUATION (EC-0650)
- ANALYSES REQUIRED (UTAH CERTIFIED LAB):
    - GAMMA SPECTROSCOPY (NATURAL & MAN-MADE ISOTOPES)
    - ISOTOPIC ANALYSIS (IF NEEDED)
    - TCLP (8 METALS / 32 ORGANICS) PLUS COPPER & ZINC
    - HYDROGEN SULFIDE
    - HYDROGEN CYANIDE
    - SOIL pH/PAINT FILTER LIQUIDS TEST
- SAMPLES REQUIRED:
    - COMPLETE PRE-SHIPMENT SAMPLE PROFILE RECORD FORM (EC-2000) TO ACCOMPANY THE FOLLOWING SAMPLES
    - SEND A MINIMUM OF 5 2-POUND DIVERSE, REPRESENTATIVE SAMPLES
    - SEND A MINIMUM OF 1 50-POUND REPRESENTATIVE SAMPLE

QUALIFICATION PROCESS FOR MIXED WASTE

- COMPLETE MIXED WASTE PROFILE (EC-0175)
- COMPLETE PHYSICAL PROPERTIES FORM (EC-0500)
- COMPLETE RADIOLOGICAL EVALUATION (EC-0650)
- ANALYSES REQUIRED (UTAH CERTIFIED LAB):
  - GAMMA SPECTROSCOPY (NATURAL & MAN-MADE ISOTOPES)
  - ISOTOPIC ANALYSIS (IF NEEDED)
  - TCLP (8 METALS / 32 ORGANICS)
  - TOX (TOTAL ORGANIC HALIDES)
  - HYDROGEN SULFIDE
  - HYDROGEN CYANIDE
  - SOIL pH/PAINT FILTER LIQUIDS TEST
- SAMPLES REQUIRED
  - COMPLETE PRE-SHIPMENT SAMPLE PROFILE RECORD FORM (EC-2000) TO ACCOMPANY THE FOLLOWING SAMPLES
  - SEND A MINIMUM OF 5 2-POUND DIVERSE, REPRESENTATIVE SAMPLES
  - SEND A MINIMUM OF 1 50-POUND REPRESENTATIVE SAMPLE

ACCEPTANCE AND SHIPMENT PROCESS



UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE

Pursuant to Section 19-3-104 of the Utah Code Annotated 1953, and the Utah Department of Environmental Quality Rules for the Control of Ionizing Radiation, and in reliance of statements and representations heretofore made by the licensee designated below, a license is hereby issued authorizing such licensee to transfer, receive, possess and use the radioactive material designated below; and to use such radioactive material for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, and orders now or hereafter in effect and to any conditions specified below.

LICENSEE		
1. Name	Envirocare of Utah, Inc.	3. License Number UT 2300249 Amendment #14, in its entirety
2. Address	46 West Broadway Suite 240 Salt Lake City, Utah 84101	4. Expiration Date February 28, 1996
		5. License Category 4-a

6. Radioactive Material (Element and Mass Number)	7. Chemical and/or Physical Form	8. Maximum Average Concentration In Waste for Disposal
A. Silver-110m	A. Volumetric bulky materials or debris	A. 5.6E+02 pCi/g
B. Americium-241	B. Volumetric bulky materials or debris	B. 2.3E+02 pCi/g
C. Americium-243	C. Volumetric bulky materials or debris	C. 1.7E+03 pCi/g
D. Beryllium-7	D. Volumetric bulky materials or debris	D. 3.8E+04 pCi/g
E. Calcium-45	E. Volumetric bulky materials or debris	E. 4.0E+08 pCi/g
F. Cadmium-109	F. Volumetric bulky materials or debris	F. 4.6E+04 pCi/g
G Cobalt-56	G Volumetric bulky materials or debris	G. 3.6E+02 pCi/g
H Cobalt-57	H. Volumetric bulky materials or debris	H. 1.9E+04 pCi/g

UTAH DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE
SUPPLEMENTARY SHEET

License # UT 2300249
Amendment #14

6. Radioactive Material (Element and Mass Number)		7. Chemical and/or Physical Form		8. Maximum Average Concentration In Waste for Disposal	
I.	Cobalt-58	I.	Volumetric bulky materials or debris	I.	1.6E+03 pCi/g
J.	Cobalt-60	J.	Volumetric bulky materials or debris	J.	3.6E+02 pCi/g
K.	Chromium-51	K.	Volumetric bulky materials or debris	K.	6.8E+04 pCi/g
L.	Cesium-134	L.	Volumetric bulky materials or debris	L.	1.2E+03 pCi/g
M.	Cesium-137	M.	Volumetric bulky materials or debris	M.	5.6E+02 pCi/g
N.	Europium-152	N.	Volumetric bulky materials or debris	N.	1.7E+03 pCi/g
O.	Europium-154	O.	Volumetric bulky materials or debris	O.	1.4E+03 pCi/g
P.	Iron-55	P.	Volumetric bulky materials or debris	P.	1.8E+06 pCi/g
Q.	Mercury-203	Q.	Volumetric bulky materials or debris	Q.	1.0E+04 pCi/g
R.	Potassium-40	R.	Volumetric bulky materials or debris	R.	1.0E+04 pCi/g
S.	Iridium-192	S.	Volumetric bulky materials or debris	S.	2.5E+03 pCi/g

UTAH DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE
SUPPLEMENTARY SHEET

License # UT 2300249
Amendment #14

6. Radioactive Material (Element and Mass Number)		7. Chemical and/or Physical Form		8. Maximum Average Concentration In Waste for Disposal	
T.	Manganese-54	T.	Volumetric bulky materials or debris	T.	5.6E+03 pCi/g
U.	Niobium-94	U.	Volumetric bulky materials or debris	U.	1.6E+02 pCi/g
V.	Nickel-59	V.	Volumetric bulky materials or debris	V.	7.0E+02 pCi/g
W.	Nickel-63	W.	Volumetric bulky materials or debris	W.	2.0E+06 pCi/g
X.	Lead-210	X.	Volumetric bulky materials or debris	X.	2.3E+05 pCi/g*
Y.	Polonium-210	Y.	Volumetric bulky materials or debris	Y.	2.0E+04 pCi/g
Z.	Radium-226	Z.	Volumetric bulky materials or debris	Z.	2.0E+03 pCi/g*
AA.	Radium-228	AA.	Volumetric bulky materials or debris	AA.	1.8E+03 pCi/g
BB.	Radium-228 1 year	BB.	Volumetric bulky materials or debris	BB.	1.2E+03 pCi/g*
CC.	Radium-228 5 years	CC.	Volumetric bulky materials or debris	CC.	6.7E+02 pCi/g*
DD	Radium-228 10 years	DD.	Volumetric bulky materials or debris	DD.	5.6E+02 pCi/g*

* Daughters are assumed to be present at same concentration in equilibrium.

UTAH DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE
SUPPLEMENTARY SHEET

License # UT 2300249
Amendment #14

6. Radioactive Material (Element and Mass Number)	7. Chemical and/or Physical Form	8. Maximum Average Concentration In Waste for Disposal
EE. Ruthenium-106	EE. Volumetric bulky materials or debris	EE. 1.9E+04 pCi/g*
FF. Antimony-124	FF. Volumetric bulky materials or debris	FF. 7.9E+02 pCi/g
GG. Antimony-125	GG. Volumetric bulky materials or debris	GG. 5.3E+03 pCi/g
HH. Tin-113	HH. Volumetric bulky materials or debris	HH. 7.3E+05 pCi/g
II. Strontium-90	II. Volumetric bulky materials or debris	II. 2.0E+04 pCi/g
JJ. Thorium-230	JJ. Volumetric bulky materials or debris	JJ. 1.5E+04 pCi/g
KK. Thorium-232	KK. Volumetric bulky materials or debris	KK. 6.8E+02 pCi/g*
LL. Uranium-234	LL. Volumetric bulky materials or debris	LL. 3.7E+04 pCi/g
MM. Uranium-235	MM. Volumetric bulky materials or debris	MM. 7.7E+02 pCi/g
NN. Uranium-236	NN. Volumetric bulky materials or debris	NN. 3.6E+04 pCi/g
OO.. Uranium-238	OO. Volumetric bulky materials or debris	OO. 2.8E+04 pCi/g

* Daughters are asumed to be present at same concentrations in equilibruim.

UTAH DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE
SUPPLEMENTARY SHEET

License # UT 2300249
Amendment #14

6. Radioactive Material (Element and Mass Number)	7. Chemical and/or Physical Form	8. Maximum Average Concentration In Waste for Disposal
PP. Uraniuum-natural	PP. Volumetric bulky materials or debris	PP. 1.8E+04 pCi/g
QQ. Uranium-depleted	QQ. Volumetric bulky materials or debris	QQ 1.1E+05 pCi/g
RR. Zinc-65	RR. Volumetric bulky materials or debris	RR. 1.1E+04 pCi/g
SS. Carbon-14	SS. Volumetric bulky materials or debris	SS. 4.0E+05 pCi/g
TT. Hydrogen-3	TT. Volumetric bulky materials or debris	TT. 2.0E+07 pCi/g
UU. Iodine-129	UU. Volumetric bulky materials or debris	UU. 3.1E+03 pCi/g
VV. Sodium-22	VV. Volumetric bulky materials or debris	VV. 7.8E+02 pCi/g
WW. Technetium-99	WW. Volumetric bulky materials or debris	WW. 1.0E+05 pCi/g
XX. Curium-242	XX. Volumetric bulky materials or debris	XX. 1.4E+06 pCi/g
YY. Curium-242	YY. Volumetric bulky materials or debris	YY. 8.1E+03 pCi/g*
ZZ. Curium-243	ZZ. Volumetric bulky materials or debris	ZZ. 1.5E+03 pCi/g

* Daughters are assumed to be present at same concentrations in equilibrium.

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6. Radioactive Material (Element and Mass Number)	7. Chemical and/or Physical Form	8. Maximum Average Concentration In Waste for Disposal
AAA. Curium-243	AAA. Volumetric bulky materials or debris	AAA. 1.3E+03 pCi/g*
BBB. Curium-244	BBB. Volumetric bulky materials or debris	BBB. 1.0E+04 pCi/g
CCC. Curium-244	CCC. Volumetric bulky materials or debris	CCC. 7.4E+03 pCi/g*
DDD. Neptunium-237	DDD. Volumetric bulky materials or debris	DDD. 2.0E+03 pCi/g
EEE. Plutonium-238	EEE. Volumetric bulky materials or debris	EEE. 1.0E+04 pCi/g
FFF. Plutonium-238	FFF. Volumetric bulky materials or debris	FFF. 8.2E+03 pCi/g*
GGG. Plutonium-239	GGG. Volumetric bulky materials or debris	GGG. 9.9E+03 pCi/g
HHH. Plutonium-240	HHH. Volumetric bulky materials or debris	HHH. 1.0E+04 pCi/g
III. Plutonium-241	III. Volumetric bulky materials or debris	III. 3.5E+05 pCi/g
JJJ. Plutonium-241	JJJ. Volumetric bulky materials or debris	JJJ. 1.1E+03 pCi/g*
KKK. Plutonium-242	KKK. Volumetric bulky materials or debris	KKK. 1.0E+04 pCi/g

* Daughters are assumed to be present at same concentrations in equilibrium.

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9. AUTHORIZED USE

Radioactive material as bulk radioactive waste may be received, stored and disposed of by land burial. The licensee shall not accept low-level radioactive waste generated outside the region comprised of the party states to the Northwest Interstate Compact on Low-Level Radioactive Waste Management ("Compact") namely Alaska, Hawaii, Idaho, Montana, Oregon, Utah and Washington, unless the provisions of Articles IV and V of the Compact are met. Prior to receiving any such shipments, the licensee shall submit to the Utah Division of Radiation Control documentation evidencing compliance with these Compact provisions.

CONDITIONS

10. Licensed material shall be used at the licensee's facility located in Section 32 of Township 1 South and Range 11 West, Tooele County, Utah.

11. The licensee shall not possess at any time, more than 300,000 cubic yards of radioactive waste material which is not disposed of in accordance with the finished design requirements. This includes all wastes in storage or active processing.

12. Pursuant to R313-12-54(1), the licensee is granted an exemption to R313-25-9, as it relates to land ownership and assumption of ownership.

13. The maximum quantity of special nuclear material which the licensee may possess, undisposed of, at any one time shall not exceed; 350 grams of U-235, 200 grams of U-233, and 200 grams Pu, or any combination of them in accordance with the following formula.

$$\frac{\text{(Grams U-235)}}{350} + \frac{\text{(Grams U-233)}}{200} + \frac{\text{(Grams Pu)}}{200} \leq 1$$

14. Licensed material specified in Item 6.A through 6.KKK shall not be placed in a disposal cell unless it has been determined that the concentration of radionuclides is approximately homogeneous within the physical form of the waste. This does not pertain to debris superficially contaminated with licensed materials.

15. A. The licensee may receive for treatment, storage, and disposal any radioactive waste as authorized by this license that is also determined to be hazardous as permitted by the "Hazardous Waste Plan Approvals" issued and modified by the Executive Secretary, Utah Solid and Hazardous Waste Control Board and "HWSA Permit" issued by the U.S. Environmental Protection Agency.

B. The licensee shall dispose of these wastes in the "mixed waste" disposal embankment only.

16. A. If a mixture of radionuclides a, b, and c are present in the waste in the concentrations C_a, C_b, and C_c and if the applicable maximum average waste concentrations from Item 8 of this license are MWC_a, MWC_b, and MWC_c respectively, then the concentration in the waste shall be limited so that the following relationship exists.

$$\frac{C_a}{MWC_a} + \frac{C_b}{MWC_b} + \frac{C_c}{MWC_c} \leq 1$$

B. If a single radionuclide is present in the waste, the maximum average concentration shall not exceed the applicable value found in Item 8 of this license.

17. Sealed sources as defined in R313-12-3(64) shall not be accepted for disposal.

18. Radioactive waste containing free liquid shall not be accepted for disposal. Such waste shall be managed in accordance with the LARW Waste Management Plan currently approved by the Executive Secretary of the Utah Radiation Control Board.

19. The licensee shall comply with the provisions of Chapter R313-18, "Notices, Instructions and Reports to Workers by Licensees or Registrants, Inspections" and Chapter R313-15, "Standards for Protection Against Radiation".

20. The licensee may transport licensed material or deliver licensed material to a carrier for transport in accordance with the provisions of R313-19-100 "Transportation".

21. Written procedures shall be maintained and available at the disposal facility for operations involving radioactive materials. The procedures shall incorporate operating instructions and appropriate safety precautions for the work. The employee training program shall include detailed review of the operating procedures applicable to the employee's assignments. The requirement for written procedures shall include establishment of procedures for conduct of the radiation safety and environmental monitoring programs, including analytical procedures and instrument calibration requirements. Written procedures and subsequent changes to the procedure shall be reviewed and approved by the Corporate Radiation Safety Officer and the Project Manager. At least annually, all procedures shall be reviewed to assure continued applicability.

22. The Corporation Radiation Safety Officer or other qualified individual designated by the Corporate Radiation Safety Officer shall perform and document weekly inspections of the facility and report any findings of non-compliance, affecting radiological safety, to the Project Manager. Items for inspection include: operating procedures, license requirements and safety practices.

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23. The licensee shall conduct contamination surveys in accordance with the following table.

ROUTINE MONITORING AND CONTAMINATION SURVEYS

Type	Location	Frequency
A. Gamma Radiation Levels	1. Perimeter of Controlled Area(s)	1. Weekly
	2. Office Area	2. Weekly
	3. Lunch/Change Area	3. Weekly
	4. Transport Vehicles	4. Upon Arrival at Site and before departure.
B. Contamination Wipes	1. Eating Area	1. Weekly
	2. Change Area	2. Weekly
	3. Office Areas	3. Weekly
	4. Railcar rollover and control shack	4. Weekly
	5. Equipment/Vehicles	5. Once before release
C. Employee/ Personnel	1. Skin & Personal clothing	1. Prior to exiting controlled area
D. Gamma Exposure	1. Administration Bldg.	1. Quarterly
	2. Security Trailer	2. Quarterly
E. Radon Concentration	1. Administration Bldg.	1. Quarterly
	2. Security Trailer	2. Quarterly

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24. The licensee shall conduct a bioassay program in accordance with letter dated July 16, 1993.

25. The use of respirators shall be controlled by a respiratory protection program in accordance with letter dated July 16, 1993, and as stipulated in R313-15-103.

26. The licensee shall calibrate air sampling equipment at intervals not to exceed six months.

27. The operational environmental monitoring program shall be conducted in accordance with revised Section 4.5.4, table 4.7, and figure 4.5 submitted in letter dated July 20, 1993.

28. A. Vehicles, containers, facilities, materials, equipment or other items for unrestricted use, except conveyances as defined in R313-19-4, used for commercial transport of radioactive waste material, shall not be released from the licensee's control if contamination exceeds the limits found in Table 28-A:

TABLE 28 - A.

Nuclide[a]	Column I Average[b,c,f]	Column II Maximum[b,d,f]	Column III Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm alpha/ 100 cm^2	15,000 dpm alpha/ 100 cm^2	1,000 dpm alpha/ 100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emissions or spontaneous fission) except Sr-90 and other noted above.	5,000 dpm beta, gamma/100 cm^2	15,000 dpm beta-gamma/100 cm^2	1,000 dpm beta-gamma/100 cm^2

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28. (con't)

a. Where surface contamination by both alpha- and beta-gamma emitting nuclides exists, the limits established for alpha- and beta-gamma emitting nuclides should apply independently.
b. As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
c. Measurements of average contaminant should not be averaged over more than one square meter. For objects of less surface area, the average should be derived for each such object.
d. The maximum contamination level applies to an area of not more than 100 cm^2.
e. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping the area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of know efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.
f. The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters shall not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

28. B. All conveyances as defined in R313-19-14 used for commercial transport of radioactive material to Envirocare will be decontaminated to the release limits set forth in the following:

TABLE 28 - B
REMOVABLE EXTERNAL RADIOACTIVE CONTAMINATION - WIPE LIMITS

Contaminant	Maximum permissible limits	Maximum permissible limits
	micro Ci/cm^2	dpm/cm^2
Beta-gamma emitting radionuclides; all radionuclides with half-lives less than ten days; natural uranium; natural thorium; uranium-235; uranium 238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical concentrates....................................	10^{-5}	22
All other alpha emitting radionuclides.......................................	10^{-6}	2.2

Each transport vehicle used for transporting radioactive materials as an exclusive use shipment... shall be surveyed with appropriate radiation detection instruments after each use. A vehicle shall not be returned to service until the average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters shall not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber, and there is no significant removable (non-fixed) radioactive surface contamination as specified in the above Table 28-B.

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9. A quarterly report shall be prepared by the Corporate Radiation Safety Officer for the Project Manager and Company President evaluating employee exposures, effluent releases and environmental data to determine:

   A. If there are any upward trends in personnel exposures for identifiable categories of workers or types of operations or in effluent releases;

   B. If exposures and effluent might be lowered under the concept of maintaining exposures and effluent as low as reasonably achievable; and

   C. If equipment for exposure and effluent control is being properly used and maintained.

0. In accordance with R313-25-33, the licensee shall submit annual reports to the Division of Radiation Control by the end of the first calendar quarter of each year for the preceding year. The reports shall include:

   A. Specification of the quantity of each of the principal contaminants released to unrestricted areas in liquid and in airborne effluent during the preceding year.

   B. The results of the environmental monitoring program;

   C. A summary of licensee disposal unit survey and maintenance activities; and

   D. A summary of the volume, radioisotopes and their activities for materials disposed of.

1. Except as provided by this condition, the licensee shall maintain the results of sampling, analyses, surveys, and instrument calibration, reports on inspections and audits, employee training records as well as any related reviews, investigations and corrective actions, for five (5) years. The licensee shall maintain personnel exposure records in accordance with R313-15-401.

2. Operations shall be conducted by or under the supervision of Vernon E. Andrews, Corporate Radiation Safety Officer, or other individuals designated by the Corporate Radiation Safety Officer upon successful completion of the licensee's training program.

3. The licensee shall staff the operations of the facility in accordance with the revised organization chart submitted in letter dated July 16, 1993. In addition the licensee shall provide an updated organization chart within 10 days from any change.

4. The licensee staff shall meet the qualifications as described in Section 8.2 and shall have the responsibilities as described in Section 8.1.2 of the license amendment application dated September 20, 1990.

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35. The licensee shall not initiate disposal operations in newly excavated areas until the Division of Radiation Control has inspected and approved the cell/embankment liner.

36. The licensee shall provide "as built drawings" of the facility, at intervals not to exceed six (6) months. Drawings shall be submitted by February 1 and August 1 of each year. The drawings shall show conditions on the site as they existed no earlier than thirty (30) days prior to the submittal of the drawings to the Division of Radiation Control. The drawings shall be certified by a Utah Licensed Land Surveyor or Professional Engineer. Drawings submitted as, "as built drawings" will be marked as such, and will be marked in the same place on each drawing. Record drawings showing approved future designs, final or finished conditions at the site may be included in the "as built drawings", but shall be marked as "record drawings".

37. Reserved.

38. For the purpose of this license, debris is defined as any radioactive waste for disposal other than soils. Compactible debris is defined as: (A) having a gradation that will pass through a four inch (4") grizzly and; (B) as having a density greater than seventy pounds per cubic foot dry weight in accordance with ASTM D-698. Contaminated materials, other than soil, not meeting either of these criteria are defined as noncompactible debris.

39. The licensee shall place bulk radioactive materials in lifts with an uncompacted thickness not exceeding twelve inches (12").

40. In-place bulk radioactive waste shall be compacted at a moisture content up to three percent (3%) above optimum as determined by the Standard Proctor Method ASTM D-698.

41. The licensee shall compact each lift to not less than ninety percent (90%) of optimum density as determined by Standard Proctor Method ASTM D-698. Sampling points for compaction testing shall include locations immediately adjacent to debris when debris is included in the lift.

42. All debris shall be less than ten inches (10") in at least one (1) dimension, and no longer than eight feet (8') in any dimension.

43. The final twenty-four inches (24") of the radioactive waste material embankment, within the side slopes and the top surface, shall be free of debris. In addition, no debris (compactable or non-compactable) shall be placed within twenty-four inches (24") of the clay liner.

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4. A lift or any portion of a lift shall be limited to less than ten percent (10%) by volume of debris and the debris shall be uniformly distributed throughout the lift. However, noncompactible debris in the form of concrete, stone or metal may be placed in the lift up to twenty-five percent (25%) by volume, of the total lift, uniformly distributed throughout, and the debris is placed to minimize void space in the lift.

5. The licensee shall excavate the disposal cell liner, consisting of native materials, to a depth of twenty-four inches (24") and replace it with clay in uncompacted lifts not to exceed nine inches (9"). Each lift shall be compacted to not less than ninety-five percent (95%) optimum density as determined by ASTM D-698 and field permeability as specified in the currently approved Engineering Drawings.

6. The licensee shall fulfill and maintain compliance with all conditions and shall meet all requirements in the currently approved Construction QA/QC Plan and currently approved Engineering Drawings.

7. The disposal cell liner and radon barrier shall be constructed with a moisture content of zero percent (0%) to plus five percent (+5%) of optimum moisture as determined by Standard Proctor Method ASTM D-698.

8. The licensee shall compact the radon barrier to not less than 95 percent of optimum density as determined by Standard Proctor Method ASTM D-698 and a field permeability as specified in the currently approved Engineering Drawings.

9. The licensee shall record, at the time of acceptance, the date and time of day that any lift or portion of a lift has been accepted by the licensee as finished in accordance with all specifications and license conditions.

0. The licensee shall fulfill and maintain compliance with all conditions and requirements in the Waste Characterization Plan currently approved by the Division of Radiation Control.

1. The licensee shall fulfill and maintain compliance with all conditions and requirements in the LARW Waste Management Plan currently approved by the Division of Radiation Control.

2. The licensee shall utilize a manifest ("Radioactive Waste Shipment and Disposal Record," Envirocare Form E-100) containing the information required in R313-15-311(2) and (3) including:

   A. Specification of any solidification agents utilized;

   B. Waste containing more than 0.1% chelating agents by weight must be identified and the weight percentage of the chelating agent estimated. Chelating agents means amine polycarboxylic acids, hydroxyl-carboxylic acids, gluconic acids and polycarboxylic acids;

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53. The licensee shall not accept radioactive waste for storage and disposal unless the licensee has received a complete "Radioactive Waste Shipment and Disposal Record" (Form #E-100) from the shipper.

54. The licensee shall maintain copies of complete manifests or equivalent documentation until the Division of Radiation Control authorizes their disposition.

55. The licensee shall immediately notify the Division of Radiation Control or the Division's on-site representative of any waste shipment where a possible violation of applicable regulations or license conditions has been found.

56. The licensee shall require anyone who transfers radioactive waste to the facility comply with the requirements in R313-15-311(4)(a) through (h).

57. The licensee shall acknowledge receipt of the waste within one (1) week of receipt by returning a signed copy of the manifest or equivalent documentation to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the licensee. The returned copy of the manifest or equivalent documentation shall indicate any discrepancies between materials listed on the manifest and materials received.

58. The licensee shall notify the shipper (i.e., the generator, the collector, or processor) and the Division of Radiation Control when any shipment or part of a shipment has not arrived within 60 days after the advance manifest was received.

59. The licensee shall maintain a record for each shipment of waste disposed of at the site. As a minimum, the record shall include:

   A. The date of disposal of the waste;

   B. The location of waste in the disposal site;

   C. The condition of the waste packages received;

   D. Any discrepancy between the waste listed on the shipment manifest or shipping papers and the waste received in the shipment.

   E. A description of any evidence of leaking or damaged packages or radiation or contamination in excess o applicable regulatory limits: and

   F. A description of any repackaging of wastes in any shipment.

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60. In accordance with R313-25-31 the licensee shall maintain a Utah Division of Radiation Control Surety (Trust) Agreement adequate to fund the decommissioning and reclamation of the grounds, equipment and facilities. The surety shall be reviewed and updated annually and a report submitted to the Utah Division of Radiation Control within 60 days after June 1st of each year. The surety arrangement shall be updated as necessary to reflect decommissioning and reclamation costs.

61. Truck, railcar, and other equipment washdown (decontamination) facilities, including evaporation ponds, shall be controlled with fences or other approved barriers to prevent intrusion.

62. All burial embankments and waste storage areas, including immediately adjacent drainage structures, shall be controlled areas, surrounded by a six foot (6') high, chain link fence. All permanent fence shall be chain link, six feet (6') high, topped with three strand barbed wire, top tension wire and twisted selvedge.

63. The licensee shall fulfill and maintain compliance with all conditions and shall meet all compliance schedules stipulated in the Ground Water Discharge Permit, number UGW 450005, issued by the Executive Secretary of the Utah Water Quality Board.

64. One (1) year prior to the anticipated closure of the site, the licensee shall submit for approval a site decontamination and decommissioning plan. As part of this plan, the licensee shall demonstrate by measurements and/or modeling that concentrations of radioactive materials which may be released to the general environment, after site closure, will not result in an annual dose exceeding 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public.

65. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Item 6, 7, and 8 of this license and conduct site operations in accordance with statements, representations, operating procedures, and disposal criteria, heretofore made by the licensee or his authorized representative in application for and subsequent to issuance of Utah Radioactive Material License No. UT 2300249 and amendments thereto.

9/10/93
Date

William J. Sinclair
William J. Sinclair, Executive Secretary, Utah Radiation Control Board

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License # UT 2300249
Amendment #15

Envirocare of Utah, Inc.
46 West Broadway, Suite 240
Salt Lake City, Utah 84101

In accordance with submittal dated September 9, 1993, radioactive material license number UT 2300249 is amended as follows:

ITEMS 6, 7, AND 8.

****

6. Radioactive Material (element and mass number)	7. Chemical and/or physical form	8. Maximum average concentration in waste for disposal
A1. Americium-241	A1. through WW. inclusive. Volumetric bulky soil or soil-like materials or debris	A1. 2.3E02 pCi/g
A2. Americium-243		A2. 1.7E03 pCi/g
B1. Antimony-124		B1. 7.9E02 pCi/g
B2. Antimony-125		B2. 5.3E03 pCi/g
C. Barium-133		C. 4.0E03 pCi/g
D. Beryllium-7		D. 3.8E04 pCi/g
E. Cadmium-109		E. 4.6E04 pCi/g
F. Calcium-45		F. 4.0E08 pCi/g
G. Carbon-14		G. 4.0E05 pCi/g
H1. Cerium-139		H1. 2.0E03 pCi/g
H2. Cerium-141		H2. 4.0E03 pCi/g
H3. Cerium-144		H3. 4.0E03 pCi/g*

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* Daughters are assumed to be present at same concentrations in equilibrium.

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6. Radioactive Material (element and mass number)	7. Chemical and/or physical form	8. Maximum average concentration in waste for disposal
I1. Cesium-134		I1. 1.2E03 pCi/g
I2. Cesium-135		I2. 5.0E02 pCi/g
I3. Cesium-137		I3. 5.6E02 pCi/g
J. Chromium-51		J. 6.8E04 pCi/g
K1. Cobalt-56		K1. 3.6E02 pCi/g
K2. Cobalt-57		K2. 1.9E04 pCi/g
K3. Cobalt-58		K3. 1.6E03 pCi/g
K4. Cobalt-60		K4. 3.6E02 pCi/g
L. Copper-67		L. 2.0E03 pCi/g
M1. Curium-242		M1. 1.4E06 pCi/g
M2. Curium-242		M2. 8.1E03 pCi/g*
M3. Curium-243		M3. 1.5E03 pCi/g
M4. Curium-243		M4. 1.3E03 pCi/g*
M5. Curium-244		M5. 1.0E04 pCi/g
M6. Curium-244		M6. 7.4E03 pCi/g*
N1. Europium-152		N1. 1.7E03 pCi/g
N2. Europium-154		N2. 1.4E03 pCi/g
N3. Europium-155		N3. 1.7E03 pCi/g

* Daughters are assumed to be present at same concentrations in equilibrium.

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6. Radioactive Material (element and mass number)		7. Chemical and/or physical form	8. Maximum average concentration in waste for disposal	
O.	Gadolinium-153		O.	3.0E03 pCi/g
P.	Germanium-68		P.	4.0E03 pCi/g*
Q.	Gold-195		Q.	2.0E03 pCi/g
R.	Hafnium-181		R.	1.0E03 pCi/g
S.	Hydrogen-3		S.	2.0E07 pCi/g
T1.	Iodine-125		T1.	1.5E03 pCi/g
T2.	Iodine-129		T2.	3.1E03 pCi/g
U.	Iridium-192		U.	2.5E03 pCi/g
V1.	Iron-55		V1.	1.8E06 pCi/g
V2.	Iron-59		V2.	4.0E02 pCi/g
W.	Lead-210		W.	2.3E05 pCi/g*
X.	Manganese-54		X.	5.6E03 pCi/g
Y.	Mercury-203		Y.	1.0E04 pCi/g
Z.	Neptunium-237		Z.	2.0E03 pCi/g
AA1.	Nickel-59		AA1.	7.0E02 pCi/g
AA2.	Nickel-63		AA2.	2.0E06 pCi/g
BB.	Niobium-94		BB.	1.6E02 pCi/g
CC1.	Plutonium-238		CC1.	1.0E04 pCi/g

* Daughters are assumed to be present at same concentrations in equilibrium.

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6. Radioactive Material (element and mass number)		7. Chemical and/or physical form	8. Maximum average concentration in waste for disposal	
CC2.	Plutonium-238		CC2.	8.2E03 pCi/g*
CC3.	Plutonium-239		CC3.	9.9E03 pCi/g
CC4.	Plutonium-240		CC4.	1.0E04 pCi/g
CC5.	Plutonium-241		CC5.	3.5E05 pCi/g
CC6.	Plutonium-241		CC6.	1.1E03 pCi/g*
CC7.	Plutonium-242		CC7.	1.0E04 pCi/g
DD.	Polonium-210		DD.	2.0E04 pCi/g
EE.	Potassium-40		EE.	1.0E04 pCi/g
FF.	Promethium-147		FF.	4.0 E03 pCi/g*
GG1.	Radium-226		GG1.	2.0E03 pCi/g*
GG2.	Radium-228		GG2.	1.8E03 pCi/g
GG3.	Radium-228 (1 year)		GG3.	1.2E03 pCi/g*
GG4.	Radium-228 (5 years)		GG4.	6.7E02 pCi/g*
GG5.	Radium-228 (10 years)		GG5.	5.6E02 pCi/g*
HH.	Rubidium-83		HH.	1.0E03 pCi/g
II.	Ruthenium-106		II.	1.9E04 pCi/g*
JJ.	Scandium-46		JJ.	4.0E02 pCi/g
KK.	Selenium-75		KK.	1.0E03 pCi/g

* Daughters are assumed to be present at same concentrations in equilibrium.

UTAH DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE
SUPPLEMENTARY SHEET

License # UT 2300249
Amendment #15

6. Radioactive Material (element and mass number)		7. Chemical and/or physical form	8. Maximum average concentration in waste for disposal	
LL.	Silver-108m		LL.	5.0E02 pCi/g
MM.	Silver-110m		MM.	5.6E02 pCi/g
NN.	Sodium-22		NN.	7.8E02 pCi/g
OO1.	Strontium-85		OO1.	5.0E02 pCi/g
OO2.	Strontium-89		OO2.	2.0E03 pCi/g
OO3.	Strontium-90		OO3.	2.0E04 pCi/g
PP.	Sulfur-35		PP.	4.0E03 pCi/g
QQ.	Technetium-99		QQ.	1.0E05 pCi/g
RR1	Thorium-230		RR1.	1.5E04 pCi/g
RR2.	Thorium-232		RR2.	6.8E02 pCi/g*
SS.	Tin-113		SS	7.3E05 pCi/g
TT1.	Uranium-234		TT1.	3.7E04 pCi/g
TT2.	Uranium-235		TT2.	7.7E02 pCi/g
TT3.	Uranium-236		TT3.	3.6E04 pCi/g
TT4.	Uranium-238		TT4.	2.8E04 pCi/g
TT5.	Uraniuum-natural		TT5.	1.8E04 pCi/g
TT6.	Uranium-depleted		TT6.	1.1E05 pCi/g
UU.	Yttrium-91		UU.	2.0E03 pCi/g

* Daughters are assumed to be present at same concentrations in equilibrium.

UTAH DIVISION OF RADIATION CONTROL
RADIOACTIVE MATERIAL LICENSE
SUPPLEMENTARY SHEET

License # UT 2300249
Amendment #15

6. Radioactive Material (element and mass number)	7. Chemical and/or physical form	8. Maximum average concentration in waste for disposal
VV. Zinc-65		VV. 1.1E04 pCi/g
WW. Zirconium-95		WW. 5.0E02 pCi/g*

* Daughters are assumed to be present at same concentrations in equilibrium.
****

CONDITION 65.

65. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Item 6, 7, and 8 of this license and conduct site operations in accordance with statements, representations, operating procedures, and disposal criteria, heretofore made by the licensee or his authorized representative in application for and subsequent to issuance of Utah Radioactive Material License No. UT 2300249 and amendments thereto.

UTAH RADIATION CONTROL BOARD

William J. Sinclair, Executive Secretary

3/24/94
Date

STATE OF UTAH PLAN APPROVAL

Permittee:
Envirocare of Utah, Inc.
Tooele County, Utah
EPA Identification Number UTD982598898

Pursuant to the Utah Solid and Hazardous Waste Act, (the Act), 26-14-1, et. seq., Utah Code Annotated 1953, as amended and the Utah Administrative Code (UAC) (R450-1 through R450-13 and R450-50) as adopted by the Utah Solid and Hazardous Waste Committee, (the Committee), a plan approval (herein after called "permit") is issued to Envirocare of Utah, Inc. (hereafter called the "Permittee"), to operate a hazardous waste treatment and storage facility in Tooele County, Utah, at latitude 40o 41' 000" North and longitude 113o 06' 030" West. The U.S. Environmental Protection Agency (U.S. EPA) has authorized the Executive Secretary to issue such a permit under Section 3006(b) of the Resource Conservation and Recovery Act (RCRA).

The Permittee must comply with all the terms and conditions of this permit. The permit consists of the conditions contained herein (including the portions of the application attached and incorporated by reference), and the applicable portions of R450-1 through R450-13, R450-50, and R450-101 contained in the permit. Applicable rules are those which are in effect on the date of issuance of this permit.

This permit is based on the premise that the information submitted in the application dated July 22, 1987 as modified by subsequent amendments dated April 25, 1988 and July 25, 1989 (hereafter referred to as the application), is accurate and that the facility will be operated as specified in the referenced portions of the application, except as modified by the conditions herein. Portions of the application are attached and incorporated herein by reference, wherever noted, as part of this permit. Any inaccuracies or misrepresentations found in the application may be grounds for the termination or modification of this permit (see R450-3-9.). The Permittee must inform the Executive Secretary of any deviation from, or changes in the information in the application which would affect the Permittee's ability to comply with the applicable regulations or permit conditions.

UTAH BUREAU OF SOLID & HAZARDOUS WASTE

This permit is effective as of November 30, 1990 and shall remain in effect until November 30, 2000, unless revoked and reissued (R450-3-9.1(a)(b)(c)) or terminated (R450-3-9.2.), or continued in accordance with R450-3-5(d).

Signature: Dennis R. Downs   Date: 11/30/90

Dennis R. Downs
Executive Secretary
Utah Solid and Hazardous Wastes Committee

NOTE TO ENVIROCARE'S PART B PERMIT CERTIFICATE:

The Envirocare site is licensed by the Utah Bureau of Radiation Control for disposal of radioactive waste. The site is also licensed by the Utah Bureau of Radiation Control and permitted by the Utah Bureau of Solid and Hazardous Waste for disposal of "mixed" (hazardous/radioactive) waste.

Any one wishing to visit the site should contact the Permittee to make arrangements for a site tour and to determine that all safety requirements are met prior to entering the site.

Inspectors who will have extensive contact with the site should contact both the Utah Bureau of Radiation Control and the Utah Bureau of Solid and Hazardous Waste to determine that all safety requirements i.e. safety equipment, safety training, and/or physical, are met prior to entering the site.

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST

RCRA Wastes

EPA Waste No.		Hazard Code
D001	Ignitability	(I)
D002	Corrosivity	(C)
D003	Reactivity	(R)
D004	Arsenic	(E)
D005	Barium	(E)
D006	Cadmium	(E)
D007	Chromium	(E)
D008	Lead	(E)
D009	Mercury	(E)
D010	Selenium	(E)
D011	Silver	(E)
D012	Endrin (1,2,3,4,10,10-hexachloro-1,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo, endo-5,8-dimethano naphthalene)	(E)
D013	Lindane (1,2,3,4,5,6, hexa-chloro-cyclohexane, gamma isomer)	(E)
D014	Methoxychlor (1,1,1-Trichloro-2,2-bis[p-methoxyphenyl]ethane)	(E)
D015	Toxaphene ($C_{10}H_{10}Cl_8$, technical chlorinated camphene, 67-69 percent chlorine)	(E)
D016	2,4-D (2,4-dichlorophenoxyacetic acid)	(E)
D017	2,4,5-TP (Silvex) (2,4,5-trichloro-phenoxypropionic acid)	(E)
D018	Benzene	(E)
D019	Carbon Tetrachloride	(E)
D020	Chlordane	(E)
D021	Chlorobenzene	(E)
D022	Chloroform	(E)
D023	o-Cresol	(E)

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

D024	m-Cresol	(E)
D025	p-Cresol	(E)
D026	Cresol	(E)
D027	1,4-Dichlorobenzene	(E)
D028	1,2-Dichloroethane	(E)
D029	1,1-Dichloroethylene	(E)
D030	2,4-Dinitrotoluene	(E)
D031	Heptachlor (and its hydroxide)	(E)
D032	Hexachlorobenzene	(E)
D033	Hexachlorobutadiene	(E)
D034	Hexachloroethane	(E)
D035	Methyl Ethyl Ketone	(E)
D036	Nitrobenzene	(E)
D037	Pentachlorophenol	(E)
D038	Pyridine	(E)
D039	Tetrachloroethylene	(E)
D040	Trichloroethylene	(E)
D041	2,4,5-Trichlorophenol	(E)
D042	2,4,6-Trichlorophenol	(E)
D043	Vinyl Chloride	(E)

HAZARDOUS WASTE FROM NON-SPECIFIC SOURCES:

F001 The following spent halogenated solvents used in degreasing:

Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004 and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F002 The following spent halogenated solvents:

Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1.1.2-trichloro-1,2,2-triflouroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; and all spent solvent mixtures/ blends containing, before use, a total of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

F003 The following spent non-halogenated solvents:

Xylene, acetone, ethyl acetate,ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F004 The following spent non-halogenated solvents:

Cresols and cresylic acid, nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent of more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F005 The following spent non-halogenated solvents:

Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, and pyridine; benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F006 Waste-water treatment sludges form electroplating operations except from the following processed: (1) Sulfuric acid anodizing for aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum.

F007 Spent cyanide plating bath solutions from electroplating operations.

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

F008 Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process.

F009 Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process.

F010 Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process.

F011 Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations.

F012 Quenching waste water treatment sludges from metal heat treating operations where cyanides are used in the process.

F019 Waste-water treatment sludges from the chemical conversion coating of aluminum.

F024 Process wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes, from the production of cerrtain chlorinated aliphatic hydrocarbons by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to an including five, with varying amounts and positions of chlorine substitution. (This listing does not include wastewaters, wastewater treatment sludges, spent catalysts, and wastes listed in 261.31 or 261.32.)

F028 Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. F020, F021, F022, F023, F026 and F027.

F039 Multi-Source Leachate

HAZARDOUS WASTE FROM SPECIFIC SOURCES:

K011 Bottom stream from the wastewater stripper in the production of acrylonitrile.

K013 Bottom stream from the acetonitrile column in the production of acrylonitrile.

K050 Heat Exchanger Bundle Cleaning Sludge from the petroleum refining industry.

K051 API separator sludge from the petroleum refining industry.

K052 Tank bottoms (leaded) from the petroleum refining industry.

K061 Emission control dust/sludge from the primary production of steel in electric furnaces.

K069 Emission control dust/sludge from the secondary lead smelting.

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

DISCARDED COMMERCIAL CHEMICAL PRODUCTS, OFF-SPECIFICATION SPECIES, CONTAINER RESIDUES, AND SPILL RESIDUES:

P002	1-Acetyl-2-Thiourea	H
P003	Acrolein	H
P004	Aldrin	H
P005	Allyl Alcohol	H
P010	Arsenic Acid	H
P011	Arsenic Pentoxide	H
P012	Arsenic Trioxide	H
P013	Barium Cyanide	H
P014	Benzenethiol	H
P015	Beryllium Dust	H
P017	Bromoacetone	H
P020	Dinoseb	H
P021	Calcium Cyanide	H
P022	Carbon Disulfide	H
P024	p-Chloroaniline	H
P027	3-Chloropropionitrile	H
P028	Benzyl Chloride	H
P029	Copper Cyanide	H
P030	Cyanides (soluble cyanide salts), n.o.s.	H
P034	2-Cyclohexyl-4,6-Dinitrophenol	H
P037	Dieldrin	H
P039	Disulfoton	H
P046	alpha, alpha-Dimethylphenethylamine	H
P047	4,6-Dinitro-2-Methylphenol	H
P048	2,4-Dinitrophenol	H
P050	Endosulfan	H
P051	Endrin	H
P056	Fluorene	H
P059	Heptachlor	H
P060	Isodrin	H
P071	Methyl Parathion	H
P074	Nickel Cyanide	H
P075	Nicotine & Salts	H
P077	p-Nitroaniline	H
P082	N-Nitrosodimethylamine	H
P085	Octamethylpyrophosphoramide	H
P089	Parathion	H
P094	Phorate	H
P097	Famphur	H
P098	Potassium Cyanide	H
P099	Potassium Silver Cyanide	H
P101	Propanenitrile	H
P102	Propargyl Alcohol	H
P104	Silver Cyanide	H
P105	Sodium Azide	H

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

DISCARDED COMMERCIAL CHEMICAL PRODUCTS, OFF-SPECIFICATION SPECIES, CONTAINER RESIDUES, AND SPILL RESIDUES (continued):

P106	Sodium Cyanide	H
P107	Strontium Sulfide	H
P108	Strychnine & Salts	H
P111	Tetraethyl Pyrophosphate	H
P113	Thallium (III) Oxide	H
P114	Thallium Selenite	H
P115	Thallium (I) Sulphate	H
P119	Ammonium Vanadate	H
P120	Vanadium (V) Oxide	H
P121	Zinc Cyanide	H
P122	Zinc Phosphide (>10%)	H
P123	Toxaphene	H

COMMERCIAL CHEMICAL PRODUCTS, MANUFACTURING CHEMICAL INTERMEDIATES, OR OFF-SPECIFICATION COMMERCIAL CHEMICAL PRODUCTS:

U002	Acetone	I
U003	Acetonitrile	I,T
U004	Acetophenone	T
U005	2-Acetylaminoflourene	T
U007	Acrylamide	T
U009	Acrylonitrile	T
U012	Aniline	I,T
U018	Benzo(a)anthracene	T
U019	Benzene	T
U021	Benzidine	T
U022	Benzo(a)pyrene	T
U027	Bis(2-chloroisopropyl)ether	T
U028	Bis(2-Ethylhexyl) Phthalate	T
U029	Bromomethane	T
U030	4-Bromophenyl Phenyl Ether	T
U031	n-Butyl Alcohol	I
U032	Calcium Chromate	T
U036	Chlordane	T
U037	Chlorobenzene	T
U038	Chlorobenzilate	T
U039	4-Chloro-3-methyl Phenol	T
U041	Epichlorohydrin	T
U042	2-Chloroethylvinyl Ether	T
U043	Vinyl Chloride	T
U044	Chloroform	T
U045	Chloromethane	T
U047	2-Chloronaphthalene	T

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

U048	2-Chlorophenol	T
U050	Chrysene	T
U052	Cresols/Cresylic Acid	T
U056	Cyclohexane	I
U057	Cyclohexanone	I
U060	DDD	T
U061	DDT	T
U062	Diallate	T
U063	Dibenz(a,h)anthracene	T
U064	Dibenzo(a,i)pyrene	T
U066	1,2-Dibromo-3-Chloropropane	T
U067	1,2-Dibromoethane	T
U068	Dibromomethane	T
U069	Di-n-Butylphthalate	T
U070	o-Dichlorobenzene	T
U071	m-Dichlorobenzene	T
U072	P-Dichlorobenzene	T
U073	3-3′-Dichlorobenzidine	T
U074	1,4-Dichloro-2-Butene	I,T
U075	Dichlorodifluoroethane	T
U076	1,1-Dichloroethane	T
U077	1,2-Dichloroethane	T
U078	1,1-Dichloroethylene	T
U079	1,2-Dichloroethylene	T
U080	Methylene Chloride	T
U081	2,4-Dichlorophenol	T
U082	2,6-Dichlorophenol	T
U083	1,2-Dichloropropane	T
U084	1,3-Dichloropropene	T
U085	1,2:3,4-Diepoxybutane	I,T
U088	Diethylphthalate	T
U089	Diethylstilbesterol	T
U091	3,3′-dimethoxybenzidine	T
U093	Dimethylaminoazobenzene	T
U094	7,12-Dimethylbenz(a)anthracene	T
U095	3,3′-Dimethylbenzidine	T
U101	2,4-Dimethylphenol	T
U102	Dimethylphthalate	T
U105	2,4-Dinitrotoluene	T
U106	2,6-Dinitrotoluene	T
U107	Di-n-Octyl Phthalate	T
U108	1,4-Dioxane	T
U109	1,2-Diphenylhydrazine	T
U112	Ethyl Acetate	I
U115	Ethylene Oxide	I,T
U117	Ethyl Ether	I
U118	Ethyl Methacrylate	T
U119	Ethylmethane Sulfonate	T

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

U120	Fluoranthene	T
U121	Trichlorofluoromethane	T
U122	Formaldehyde	T
U123	Formic Acid	C,T
U127	Hexachlorobenzene	T
U128	Hexachlorobutadiene	T
U129	Lindane (Hexachlorocyclohexane)	T
U130	Hexachlorocyclopentadiene	T
U131	Hexachloroethane	T
U132	Hexachlorophene	T
U133	Hydrazine	R,T
U134	Hydrofluoric Acid	C,T
U135	Hydrogen Sulfide	T
U137	Indeno(1,2,3-cd)pyrene	T
U138	Iodomethane	T
U140	Isobutyl Alcohol	I,T
U141	Isosafrole	T
U142	Kepone	T
U144	Lead Acetate	T
U145	Lead Phosphate	T
U146	Lead Subacetate	T
U147	Maleic Anhydride	T
U149	Malononitrile	T
U151	Mercury	T
U152	Methacrylonitrile	I,T
U154	Methanol	I
U155	Methapyrilene	T
U157	3-Methylcholanthrene	T
U158	4,4'-Methylene Bis(2-Chloroaniline)	T
U159	Methyl Ethyl Ketone	I,T
U161	Methyl Isobutyl Ketone	I
U162	Methyl Methacrylate	I,T
U165	Naphthalene	T
U166	1,4-Naphthalenedione	T
U167	1-Naphthylenamine	T
U168	2-Naphthylenamine	T
U169	Nitrobenzene	I,T
U170	4-Nitrophenol	T
U171	2-Nitropropane	I,T
U172	N-Nitroso-di-n-butylamine	T
U174	N-Nitrosodiethylamine	T
U179	N-Nitrosopiperidine	T
U180	N-Nitrosopyrrolidine	T
U181	5-Nitro-o-Toluidine	T
U182	Paraldehyde	T
U183	Pentachlorobenzene	T
U184	Pentachloroethane	T
U185	Pentachloronitrobenzene	T

ENVIROCARE OF UTAH, INC.
HAZARDOUS WASTE LIST
(continued)

U187	Phenacetin	T
U188	Phenol	T
U190	Phthalic Anhydride	T
U191	2-Picoline	T
U192	Pronamide	T
U194	1-Propanamine	I,T
U196	Pyridine	T
U197	p-Benzoquinone	T
U201	Resorcinol	T
U203	Safrole	T
U204	Selenium Dioxide	T
U205	Selenium Sulfide	T
U207	1,2,4,5-Tetrachlorobenzene	T
U208	1,1,1,2-Tetrachloroethane	T
U209	1,1,2,2-Tetrachloroethane	T
U210	Tetrachloroethylene	T
U211	Carbon Tetrachloride	T
U212	2,3,4,6-Tetrachlorophenol	T
U214	Thallium (I) Acetate	T
U215	Thallium (II) Carbonate	T
U216	Thallium (I) Chloride	T
U217	Thallium (I) Nitrate	T
U219	Thiourea	T
U220	Toluene	T
U221	Toluenediamine	T
U223	Toluene Diisocyanate	R,T
U225	Bromoform	T
U226	1,1,1-Trichloroethane	T
U227	2-Ethoxyethanol	T
U228	Trichloroethylene	T
U230	2,4,5-Trichlorophenol	T
U231	2,4,6-Trichlorophenol	T
U232	2,4,5-T	T
U233	2,4,5-TP Silvex	T
U234	1,3,5-Trinitrobenzene	R,T
U235	Tris(2,3-Dibromopropyl) Phosphate	T
U237	Uracil mustard	T
U238	Ethyl Carbamate (Urethane)	T
U239	Xylene	I
U240	2,4-Dichlorophenoxyacetic acid	T
U242	Pentachlorophenol	T
U243	Hexachloropropene	T
U247	Methoxychlor	T
U328	2-Methyl Benzenamine	T
U359	1,1,2-Trichloroethane	T

(Note: Non-radioactive hazardous wastes must not be mixed with radioactive wastes to avoid or circumvent the land disposal restrictions.)

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APPENDIX B:

HAZARDOUS AND LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY SITING REGULATIONS

Major federal and state regulations pertaining to disposal of hazardous and low-level radioactive waste are contained in this appendix. This information has been summarized from regulations regarding siting requirements of these facilities by EG&G, Idaho and MK Environmental in support of the U.S. Department of Energy Programmatic Environmental Impact Statement. The citing of the legislative or code references for many criteria related to disposal of hazardous and low-level waste are shown in the tables at the beginning of this appendix.

Table B-1(a). RCRA Derived Disposal Site Siting Criteria

LEGISLATIVE OR CODE REFERENCE

CRITERIA	U.S. EPA (40 CFR, RESOURCE CONSERVATION AND RECOVERY ACT, 1976, A, PART 260-270)	CALIFORNIA (CCR, TITLE 22, DIV. 4.5- AMENDED 12/2/92)	COLORADO (WASTE FACILITY RULES, CCR, TITLE 6-CH.1007, ART. 2, PART 2, AMENDED 3/18/92)	FLORIDA (COMP. OF RULES & REGS., TITLE 17 DEPT OF ENV. REG., CHAPTER 17-730 AMENDED 10/14/92)	IDAHO (TITLE 29, CH. 44, LAWS OF 1993, CH.154, AMENDED BY LAWS OF 1990, CH. 213)	ILLINOIS (REVISED STATUTES, CHAPTER 111½ PUBLIC HEALTH & SAFETY, ENVIRONMENTAL PROTECTION ACT, AMENDED 1/1/92)	KENTUCKY (TITLE 401, CH. 30 AND 47-49, AMENDED 7/25/91; TITLE 401, CH. 31-40, AMENDED 9/25/91)	MISSOURI (MCSR, TITLE 10, DEPT. OF NR, DIV. 25, 80 AMENDED 3/31/93 & 9/16/92)	NEVADA (CHAPTER 444, AMENDED 1/2/92)
1. SETBACKS FROM HOLOCENE FAULTS	270.18 264.18(a)(1)	66264.18(a)(1) 66270.14(b)(11)(A)1	100.41(a)(11)(A)	CFR PARTS 264, 265, 270	40 CFR	TITLE V 21 (K)1 724.118 (a)(1)	48:050 SEC.5 34:010 SEC.9(1)(a)	25-7.264	YES
2. WITHIN 100-YEAR OR OTHER FLOOD PLAIN	270.18 264.18(b)(1)	66264.18(b)(1) 66270.18(b)(11)(B)	100.41(a)(11)(B) (111)	17-701.340 (4)(b)	40 CFR	724.118 (b)(1) 811.102 (b)	34:010 SEC.9(2)(a) 48:050 SEC.2 48:050 SEC.3	25-7.265	444.8456.1
3. FREE OF TECTONIC HAZARDS		66264.18(b)(c)			40 CFR		34:010 SEC.9(2)(a)		
4. FREE OF NON-TECTONIC HAZARDS						TITLE V21 (k)(1)	48:050 SEC.1		444.8456.1
5. ABSENCE OF SPECIAL SURFACE-WATER CONDITIONS				17-701.300 (1) (9)		TITLE V21 (k)(2)	48:050 SEC.2		444.8456.1
6. ABSENCE OF SPECIAL GROUNDWATER CONDITIONS				17-701.300 (1) 17.701.300 (9) 17-701.400 (1)(a)3		TITLE V21 (k)(2) 811.302 (b)	48:050 SEC.1		444.8456.1
7. FREE OF UNIQUE ATTRIBUTES OR ADVERSE CONDITIONS						811.302 (d)(e) 811.102 (c)(d)	48:050 SEC.3		444.8456.1
8. UNIQUE STATE SPECIFIC REQUIREMENTS				17-701.340 (4)(c) 17-701.340 (5)			34:340	25-7.264	
9. SPECIFIED PERMEABILITY, THICKNESS AND CONTINUITY OF VADOSE ZONE.			2.5.3(c)			811.302 (b)	47:020 SEC.5 48:050 SEC.2	25-7.264	444.8456.1

27:SITECHT.DGN PLOT DATE 7/1/94

Table B-1(b). RCRA Derived Disposal Site Siting Criteria (con't)

CRITERIA	NEW JERSEY	NEW MEXICO	NEW YORK	OHIO	PENNSYLVANIA	SOUTH CAROLINA	TENNESSEE	TEXAS	WASHINGTON
LEGISLATIVE OR CODE REFERENCE	TITLE 7, CH. 26, DEPT. OF ENVIRON. PROTECTION BUREAU OF SOLID WASTE MNGMT., AMENDED 12/6/93	ENV. IMPROVEMENT DIV., SOLID WASTE MANAGEMENT REGS, 1/30/92; AND HAZARDOUS WASTE MANAGEMENT REGS, 3/13/91	CONS. LAW SERVICE, ENV. CONS. LAW ARTICLE 27, 71, 72, 52, COMP. OF RULE & REGS, TITLE 6	TITLE 37, CH. 3734, LAWS OF OHIO 132, H623, AMENDED 8/19/92; TITLE 3745, CH. 27, CH. 28, CH. 37, AMENDED 3/10/93	PENN. CODE TITLE 25 ENV. RESOURCES, ARTICLE VIII HAZ. WASTE MGMT., CH. 20-265,269	TITLE 44, CH. 56; SCCR, CH.61, REGS 79.124-79.270, REVISED 11/23/90; SCCR, CH.61, REG. 104	HAZARDOUS WASTE MANAGEMENT RULES, AMENDED 12/28/92; AND COMMERCIAL HAZARDOUS WASTE FACILITY RULES, AMENDED 9/13/90	INDUSTRIAL WASTE MANAGEMENT REGULATIONS, CH.335, SUBCHAPTER G, AMENDED 5/12/93	TITLE 173-303, DANGEROUS WASTE REGULATIONS, AMENDED 3/7/91
1. SETBACKS FROM HOLOCENE FAULTS		I-IX.SEC 101-902 III, 302.A.4	361.7	3745-27-07(B)(6) 3745-54-18(A)(1)	269.42 (a)	264.18(a) 61-104.IV.A.1a	1200-1-14-.03-(2)(c)	335.204(e)(13)	282(6)(a)
2. WITHIN 100-YEAR OR OTHER FLOOD PLAIN	7:26-10.3(a)1	I-IX.SEC 101-902 III, 302.A.1	360-1.14 (C)(2) 373-1.5 (a)(2)(x)(a) 360-2.14 (b)(4)	3745-54-18(B)(1) 3745-27-07(A)(3)	269.22 (a)	264.18(b) 61-104.IV.A.1a	1200-1-14-.03-(2)(a) 1200-1-11-.06-(2)(1)2	335.204(e)(1)	282(6)(c)(1)
3. FREE OF TECTONIC HAZARDS		III, 302.A	361.7			264.18(c) 61-104.IV.A.1a	1200-1-11-.06-(2)(1)3	335.204(e)(9) 335.204(e)(10) 335.204(e)(12)	282(6)(c)
4. FREE OF NON-TECTONIC HAZARDS		III, 302.A.3	361.7	3745-27-07(B)(1) 3745-27-07(B)(6)	269.44 (a) 269.42 (C)(d)	61-104.IV.A.1a 61-104.IV.C.1a	1200-1-14-.03-(2)(d)	335.204(e)(5) 335.204(e)(6) 335.204(e)(10) 335.204(e)(12)	282(6)(a)
5. ABSENCE OF SPECIAL SURFACE-WATER CONDITIONS		III, 302.A.1	360-2.13 (a)(2) 361.7	3745-27-07(B)(6)	269.21 (a) 269.29	61-104.IV.C.2a	1200-1-14-.03-(2)(g)	335.204(e)(8)	282(6)(c)(1)
6. ABSENCE OF SPECIAL GROUNDWATER CONDITIONS		III, 302.A.6; .7	27-0704.4 360-2.12 (c)(1)(I) 360-2.13d 361.7 373-2.14 (b)(2)(3)	3745-27-07(B)(1)	269.29 (a)(1)(3)	264.18(d) 61-104.IV.C.1a; C.2a and E.1a	1200-1-14-.03-(2)(f) 1200-1-14-.03-(2)(e)(2)	335.204(e)(3) 335.204(e)(4)	282(6)(c)(11) 282(7)(b) 282(7)(d)
7. FREE OF UNIQUE ATTRIBUTES OR ADVERSE CONDITIONS		III, 302.A.5	361.7 360-2.13 (e) 360-1.14 (c)(1)	3745-27-07(B)(6)	269.23-269.28 269.42 (b)(e)(g)	61-104.IV.D.1a 61-104.IV.D.2a 61-104.IV.E.1a	1200-1-14-.03-(2)(b), (2)(h),(2)(I) and (2)(j)	335.204(e)(2) 335.204(e)(11)	282(6)(c)(11) 282(7)(b) 282(6)(c) 282(7)(e)
8. UNIQUE STATE SPECIFIC REQUIREMENTS		III, 302.A.8; .9; .10	27-0704.4 27-0704.5 373-2.14 (b)(5)		269.45a 269.25	61-104.IV.D.2a			282(6)(e)
9. SPECIFIED PERMEABILITY, THICKNESS AND CONTINUITY OF VADOSE ZONE.	7:26-10.6(c)1.viii 7:26-10.6(b)1.viii	III, 302.A.2	373-2.14 (b)(1)	3745-27-07(B)(6)		61-104.IV.C.2a	1200-1-14-.03-(2)(e)5	335.204(e)(4)	282(6)(c)(11)

Table B-2(a). AEA Derived Disposal Site Siting Criteria

CRITERIA	U.S. NRC	U.S. DOE	CALIFORNIA	COLORADO	FLORIDA	IDAHO	ILLINOIS	KENTUCKY	MISSOURI
LEGISLATIVE OR CODE REFERENCE	NUREG 902, NUREG 1199 10 CFR 61		SB 342, APPENDIX, LOW LEVEL RADIOACTIVE WASTE SITING CRITERIA	RULES AND REGULATIONS PERTAINING TO RADIATION CONTROL, 12/30/85	RADIATION PROTECTION ACT CHAPTER 404	ADOPTED 10 CFR 61	LOW LEVEL RADIOACTIVE WASTE MANAGEMENT ACT AMENDED BY P.A. 87-891, P.A. 87-1244, 87-1267	SEC. 902 KAR 100:022	
1. 61 METERS FROM ACTIVE FAULT					NO SPECIFIC REGULATIONS				NO REGULATIONS PROMULGATED
2. OUTSIDE 100-YEAR FLOOD PLAIN	NUREG 902 10CFR61 SEC 61.50	ORDER 6430.1A.SEC.0285-3.2.5	7	14.23.1.4				22(5)	
3. 2 KM WITHIN INSTALLATION BOUNDARIES	NUREG 902								
4. 10 KM FROM CITIES OF LESS THAN 10,000 POPULATION	NUREG 1199, SEC 2.1-2								
5. 50 KM FROM CITIES OF MORE THAN 10,000 POPULATION	NUREG 1199, SEC 2.1-2								
6. FREE OF TECTONIC HAZARDS		ORDER 5820.2A,CH.III,SEC.31(7)(c) ORDER 6430.1A,SEC.0285-2.2.3	6	14.23.1.8				22(9)	
7. FREE OF NON-TECTONIC HAZARDS	NUREG 1199 SEC 2.3-1	ORDER 5820.2A,CH.III,SEC.31(7)(c) ORDER 6430.1A,SEC.0285-2.2.3	6,7	14.23.1.4; 14.23.1.9; 14.23.1.15				22(10)	
8. FREE OF HAZARDOUS NATURAL MATERIALS									
9. ABSENCE OF SPECIAL SURFACE-WATER CONDITIONS	NUREG 1199 SEC 2.4-1	ORDER 6430.1A,SEC.0276	7	14.8.4; 14.23.1.5; 14.23.1.4				22(5)	
10. ABSENCE OF SPECIAL GROUNDWATER CONDITIONS	NUREG 902	ORDER 5820.2A,CH.III,SEC.31(7)(c) ORDER 6430.1A,SEC.0285-2.2.2	8.(a), 8.(c)	14.23.1.6; 14.23.1.7				22(7), 22(8)	
11. FREE OF UNIQUE ATTRIBUTES OR ADVERSE CONDITIONS		ORDER 6430.1A,SECS 0285-2.2.2; 0285-2.2.5,0285-2.2.7;0285-3.2.5; 0150-1	1,2,3, 4,5,9, 10,12, 13,14	14.7.8; 14.19;14.20; 14.23.1.2; 14.23.1.3; 14.23.1.10; 14.25.1.8	NO SPECIFIC REGULATIONS		20/8 (g)(2)	22(3); 22(4); 22(11)	NO REGULATIONS PROMULGATED

Table B-2(b). AEA Derived Disposal Site Siting Criteria (con't)

CRITERIA / LEGISLATIVE OR CODE REFERENCE	NEVADA	NEW JERSEY	NEW MEXICO	NEW YORK	OHIO	PENNSYLVANIA	SOUTH CAROLINA	TENNESSEE	TEXAS	WASHINGTON
	ADMIN. CODE 459 DISP. OF RADIOACTIVE MAT'L. 2/92	NJSA13:1E-177, REGIONAL LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY SITING ACT AND EBASCO INC., 4/90 REPORT	PART 13, RADIATION PROTECTION REQUIREMENTS 3/10/89	6NYCRR PART 382	DEPT. OF HEALTH RADIATION PROTECTION RULES, OHIO ADMIN. CODE, 10/82	TITLE 25- ENV. RESOURCES, ENV. QUALITY BOARD, CH. 236 AMENDED 10/17/89	DEPT. OF HEALTH AND ENVIRON. CONTROL REG 61-63, RADIOACTIVE MAT'LS (TITLE A), 6/90	STATE REGS FOR PROTECTION AGAINST RADIATION, AMENDED 3/12/93	CONSIDERATIONS FOR SITE SELECTION, 82	ADMIN. CODE, CH. 246-250 RADIOACTIVE WASTE LICENSING LAND DISPOSAL, 8/91
1. 61 METERS FROM ACTIVE FAULT						125				
2. OUTSIDE 100-YEAR FLOOD PLAIN	8105	YES	13-2200.A			126	7.22.1.4	1200-2-11-.17(1)(e)	1	300
3. 2 KM WITHIN INSTALLATION BOUNDARIES										
4. 10 KM FROM CITIES OF LESS THAN 10,000 POPULATION										
5. 50 KM FROM CITIES OF MORE THAN 10,000 POPULATION										
6. FREE OF TECTONIC HAZARDS	8105	YES	13-2200.A	382.21 (a)(7)		126 128	7.22.1.8	1200-2-11-.17(1)(i)	8	300
7. FREE OF NON-TECTONIC HAZARDS	8105	YES	13-2200.A; 13-700.D				7.22.1.7; 7.22.1.9	1200-2-11-.17(1)(j)	9	300
8. FREE OF HAZARDOUS NATURAL MATERIALS										
9. ABSENCE OF SPECIAL SURFACE-WATER CONDITIONS	8105	YES	13-2200.A			126	7.22.1.4; 7.22.1.5	1200-2-11-.17(1)(e) 1200-2-11-.17(1)(f)	1,2	300; 320
10. ABSENCE OF SPECIAL GROUNDWATER CONDITIONS	8105	YES	13-2200.A	382.22 (b)(2)		128	7.22.1.6; 7.22.1.7	1200-2-11-.17(1)(g) 1200-2-11-.17(1)(h)	3,4,5,18	300
11. FREE OF UNIQUE ATTRIBUTES OR ADVERSE CONDITIONS	810; 8105	YES	13-700.D; 13-2100; 13-2200.A; 13-2300.A; 13-2700.A	382.22 (c)(1) 382.21 (a)(1) 382.22 (b)(2)		122 124 127 128	7.22.1.2; 7.22.1.3; 7.22.1.10	1200-2-11-.17(1)(c) 1200-2-11-.17(1)(d) 1200-2-11-.17(1)(k) 1200-2-11-.16(3)	2,6,7,10, 11,12,13, 14,15,16, 17,18,19, 20,21,22, 23	180; 200;320

HAZARDOUS WASTE DISPOSAL FACILITY SITING REGULATIONS

Regulations contained in herein are a compilation of siting requirements for hazardous waste facilities. The siting requirements are taken from U.S. EPA RCRA requirements and from state regulations that are RCRA authorized and/or have developed state-specific regulations. The review also includes general regulations relative to siting any type of landfill, in which the landfill regulations may be applicable for siting a hazardous waste facility.

B-1 U.S. EPA

The federal EPA's regulations for hazardous waste are contained in 40 CFR. The *Solid Waste Disposal Act* as amended by the *Resource Conservation and Recovery Act of 1976*, (RCRA) is divided into the following: Part 124, Procedures for Decision Making; Part 260, an overview with definitions; Part 261, Identification and Listing of Hazardous Waste; Part 262, Standards Applicable to Generators of Hazardous Waste; Part 263, Standards Applicable to Transporters of Hazardous Waste; Parts 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities; Part 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities; Part 266, Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities; Part 267, Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities; Part 268, Land Disposal Restrictions; Part 269 (Reserved); Part 270, the EPA Administered Permit Programs: the Hazardous Waste Permit Program; Parts 271 and 272, Requirements for Authorization of State Hazardous Waste Programs and Approved State Hazardous Waste Management Plans.

Subpart A, Part 270.1(a)(3) Technical Regulations. The RCRA permit program has separate additional regulations that contain specific technical requirements to be followed. The requirements are used by permit issuing authorities to determine what must be addressed in permits, if issued. These separate regulations are also in 40 CFR 264, 265, and 267.

270.1(b)... A RCRA permit application consists of two parts, Part A (§270.13) and Part B (§270.14) and applicable sections (270.15-270.29). For existing waste management facilities, the requirement to submit an application is satisfied by submitting only Part A, which is a description of the hazardous waste facility, the type of wastes handled, and a compilation of permits under which the facility currently operates.

270.14(b)(11)(ii) If the facility is proposed to be located in an area listed in Appendix VI of Part 264, the owner/operator shall demonstrate compliance with the seismic standard. Compliance may be demonstrated by using either published geologic data or data obtained from site-specific field investigations.

270.14(b)(11)(ii)(A) No faults which have had displacement in Holocene time are present, or lineations which suggest the presence of a fault within 3,000 ft of a facility.

270.14(b)(11)(ii)(B) If faults have had displacement in Holocene time are present within 3,000 ft of a facility, no faults pass within 200 ft of the portions of the facility where treatment, storage, or disposal of hazardous waste will be conducted.

27014(b)(11)(iii) Provide identification whether a facility is located in a 100-year floodplain. (The owner/operator of a facility must demonstrate the waste facility is sufficiently engineered to withstand inundation, a breach of the containment facility, or failure by erosion due to flood waters without the release of hazardous wastes to the environment. If this can not be done, the owner operator has the option of preparing an emergency response plan that shows how and where wastes will be removed before inundation by flood waters.)

B-2 RCRA AUTHORIZED STATES

B-2.1 California

California's hazardous waste and disposal facility siting regulations are contained in: *California Code of Regulations, Title 22, Division 4.5-Environmental Health Standards for the Management of Hazardous Waste*; amended December 2, 1992.

Section 25120.2 "RCRA Hazardous Waste", means all waste identified as a hazardous waste in Part 261 of Subchapter 1, of Chapter 1 of the Title 40 of the Code of Federal Regulation and appendixes.

Section 25150(d) Standards or regulations promulgated by the department will be as or more stringent than corresponding requirements adopted by the EPA pursuant to RCRA, 1976.

Chapter 14, Article 1-General; 66264.18(a)(1) Portions of new facilities or facilities undergoing substantial modifications where transfer, treatment, storage or disposal of hazardous wastes will be conducted shall not be located within 61 m (200 ft) of a fault which has had displacement in Holocene time.

66264.18(b)(1) a facility located in a 100-year floodplain or within the maximum high tide shall be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood or maximum high tide, unless the owner or operator can meet certain conditions.

66264.18(c) The placement of any noncontainerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited.

66270.14(b)(11)(A)1. No faults which have had displacement in Holocene time are present, or lineation which suggest the presence of a fault within 3,000 ft of the facility. If faults are present, no faults pass within 200 ft of portions of the facility where treatment, storage or disposal of hazardous waste will be conducted.

66270.14(b)(11)(B) owners and operators of all facilities shall provide an identification whether the facility is located within a 100-year floodplain.

B-2.2 Colorado

Colorado's hazardous waste and disposal facility siting regulations are contained in: *Colorado Waste Facility Siting Rules, Code of Colorado Regulations, Title 6-Department of Health, Chapter 1007-Waste Management Division, Article 2- Solid and Hazardous Waste Disposal Sites and Facilities, Part 2-Requirements for Siting of Hazardous Waste Disposal Sites*; amended March 18, 1992. In addition, Colorado has adopted 40 CFR Parts 260-268 for the definition and management of their hazardous waste program.

2.4.1 to 2.4.4 Sites intended for use as landfills, surface impoundments and land treatment facilities shall be located and designed to assure long-term protection of human health and the environment; prevent adverse effects on groundwater quality; prevent adverse effects on surface water quality, and; prevent long-term adverse effects on public health and the environment due to migration of waste constituents in the surface and subsurface environment.

2.5.1 The siting and design of each hazardous waste disposal site shall demonstrate the minimum design performance criteria contained in Section 2.4 will be satisfied after site construction and implementation of proposed design.

2.5.3 The geological and hydrological conditions of a hazardous waste disposal site shall be such assure that wastes are isolated within the designated disposal area of the site and away from the natural environmental pathways that could expose the public for 1,000 years, or some demonstrated shorter period in which the wastes are transformed to an innocuous condition.

2.5.3(c) The geologic strata surrounding the site combined with engineered barriers included in the design shall provide a minimum permeability of 10^{-7} cm/s or equivalent of sufficient thickness shall isolate any materials between the disposal location and the nearest domestically or agriculturally useable aquifer.

2.5.6 The location of any hazardous wastes treatment or disposal facility shall be within a distance controlled by the owner/operator to prevent adverse effects on the public health.

100.41(a)(11)(A) No faults which have had displacement in Holocene time are present, or no lineations which suggest the presence of a fault shall be present within 3,000 ft of the facility.

100.41(a)(11)(B) If faults are present within 3,000 ft of a facility, portions of hazardous waste treatment, storage or disposal facilities shall not be within 1,000 ft of the fault.

100.41(a)(11)(B)(iii) Owners and operators of all facilities shall provide an identification whether the facility is located within a 100-year floodplain or show that the design, construction, or operation of the facility can withstand washout from a 100-year flood.

B-2.3 Florida

Florida hazardous waste and disposal facility siting regulations are contained in: *Official Compilation of Rules and Regulations of the State of Florida, Title 17-Department of Environmental Regulation, Chapter 17-730-Hazardous Waste Rules*; amended October 14, 1992. Florida defines radioactive wastes in *Florida Administrative Code, Chapter 10D-91, Control of Radiation Hazard Regulations*, effective July 17, 1985, amended May 12, 1993. The Florida Department of Environmental Regulation has established standards applicable to generators and transporters of hazardous waste and to owners and operators of hazardous waste facilities. The rules are substantively identical to federal EPA regulations in 40 CFR Parts 262, 263, 264, 265, 266, 267, 268 and 270. Florida has adopted by reference the permitting provisions of 40 CFR 262-270 as well as the following for all landfill facilities:

Section 10D-91.422. Classification of Low Level Radioactive Waste for Near-Surface Land Disposal, Labeling and Manifest Requirements. This discusses LLW which may contain waste that is hazardous due to other properties. It outlines requirements for proper treatment and packaging for waste transport and includes provisions to render the LLW as noncorrosive or nonreactive, nontoxic, and to stabilize without the presence of free liquids.

17-701.300(1) General Prohibitions; Sections 17-701.300(1) to 17-701.300(9) no disposal where geological formations or other subsurface features will not provide support for the facility; areas where the absence of geological formations or subsurface features would allow for the unimpeded discharge of waste or leachate to ground or surface water; within 500 ft of an existing approved shallow water supply well unless permitted disposal takes place before the shallow supply well was in existence; in any natural or artificial body of water, including ground water; within 200 ft of any natural or artificial body of water including wetlands within the jurisdiction of the Department, except bodies of water contained completely within the property boundaries of the disposal site, which do not discharge for the site to surface waters.

17-701.340(4)(b) A landfill or solid waste disposal unit shall not be located in the 100-year floodplain where it will restrict the flow, reduce the temporary water storage capacity of the floodplain, or result in a washout of solid waste.

17-701.340(4)(c) The minimum horizontal separation between the landfill property boundary shall be 100 ft as measured from the toe of the proposed final cover slope.

17-701.340(5) The zone of discharge [about a landfill] shall not exceed 100 ft from the edge of those solid waste disposal units.

17-701.400(1)(a)3. The bottom of the liner system shall not be subjected to fluctuations of the groundwater that adversely impacts the integrity of the liner system.

The additional minimum criteria for locating a hazardous waste disposal facility as found in 40 CFR Parts 264, 265, and 270, requires that it (1) be at least 200 ft from a fault shown to be active in Holocene time, and; (2) the placement of any noncontainerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited.

B-2.4 Idaho

Idaho hazardous waste and disposal facility siting regulations are contained in: *Idaho Code, Title 39-Health and Safety, Chapter 44-Hazardous Waste Management; Enacted by Laws of 1983, Chapter 154*; last amended by Law of 1990, Chapter 213. The Idaho legislature finds that they cannot conveniently or advantageously set forth all of the requirements of all the regulations which have been or will be established under RCRA. To implement RCRA, Idaho promulgates rules and regulations which are consistent with RCRA and the federal regulations

No unique siting requirements for solid waste or hazardous waste landfills are found in the Idaho codes. The three minimum criteria for locating a hazardous waste disposal facility as found in 40 CFR Parts 264, 265, and 270, requires that it (1) be at least 200 ft from a fault shown to be active in Holocene time; (2) outside of a 100-year floodplain, and; (3) the placement of any non-containerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited.

B-2.5 Illinois

Illinois hazardous waste and disposal facility siting regulations are contained in: *Illinois Revised Statutes, Chapter 111½-Public Health and Safety, Environmental Protection Act*; effective July 1, 1970; last amended January 1, 1992. Illinois has promulgated a set of siting criteria for hazardous waste disposal facilities as well as incorporating the minimum siting requirements from Standards for Owners and Operators, Parts 264 and 265. Illinois has incorporated 40 CFR Parts 260 through 266 for the definition and management of hazardous waste operations

Title V: Section 21 Acts Prohibited; 21(k)(1) Locate a hazardous waste disposal site above an active or inactive shaft or tunneled mine or within 2 miles of an active fault. In counties of population less than 225,000 no hazardous waste disposal shall be located; (1) within 1½ mi of the corporate limits as defined on June 30, 1978; (2) within 1,000 ft of an existing private well or the existing source of a public supply measured from the boundary of the actual active permitted site.

811.102(b) The facility shall not restrict the flow of a 100-year flood, or reduce the temporary water storage capacity of a 100-year floodplain.

811.102(c) The facility shall not be located where it may pose a threat of harm or destruction to features of irreplaceable historic or archaeological sites.

811.102(d) The facility shall not be located where it may jeopardize the continued existence of any endangered species, result in the destruction or adverse modification of critical habitats, or cause or contribute to the taking of any threatened or endangered species.

811.302(b) No part of a unit shall be located within the recharge zone or within 366 m (1,200 ft), vertically or horizontally, of a sole-source aquifer designated by the EPA pursuant to Section 1424(e) of the Safe Drinking Water Act (42 U.S.C. 300f et seq.) unless there is stratum between the bottom of the waste disposal unit and the top of the aquifer that meets the following: (1) the stratum has a minimum thickness of 15.2 m (50 ft); (2) the maximum hydraulic conductivity in both the horizontal and vertical directions is 1×10^{-7} cm/s; (3) there is no indication of continuous sand or silt seams, faults, fractures or cracks within the stratum; (4) water percolating downward through the relatively impermeable stratum is no faster than 15.2 m (50 ft) in 100 years.

811.302(d) No part of a facility shall be located closer than 152 m (500 ft) from an occupied dwelling, school, or hospital that was occupied at the date when the operation first applied for the permit.

811.302(e) No part of a facility shall be located closer than 1525 m (5,000 ft) of any runway used by piston type aircraft or within 3,050 m (10,000 ft) of any runway used by turbojet aircraft.

724.118(a)(1) New treatment, storage or disposal facilities of hazardous waste must not be located within 61 m (200 ft) of a fault which has had displacement in Holocene time.

724.118(b)(1) A facility located in a 100-year floodplain must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood.

724.118(C) The placement of any non-containerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited.

B-2.6 Kentucky

Kentucky's hazardous waste and disposal facility siting regulations are contained in: KRS 224.46-520, KRS 224.46-810 to 870, KRS 224.40-310, *Kentucky Administrative Regulations, Title 401-Natural Resources and Environmental Protection Cabinet, Division of Waste Management, Chapters 30-40*; amended September 25, 1991. The hazardous waste laws are contained in *Kentucky Administrative Regulations, Title 401-Natural Resources and Environmental Protection Cabinet, Division of Waste Management, Chapters 31 through 40*; amended September 25, 1991.

Chapter 31, 401 KAR 31:010. General provisions for hazardous wastes; Section 11. Radioactive mixed wastes are wastes that contain both hazardous wastes subject to KRS Chapter 224 and radioactive wastes subject to the Atomic Energy Act of 1954 (42 U.S.C.A. §§2011-2394). Radioactive mixed wastes are subject to all the requirements of 401 KAR Chapters 30 through 40 and the Atomic Energy Act.

401 KAR 34:340. If the proposed hazardous waste site or facility is within McCracken county, compliance with Section 9(1) of 401 KAR 34:020 must be demonstrated unless otherwise prescribed (401 KAR 30:020, Section 2).

401 KAR 47:020. Section 2. No solid waste site or facility shall restrict the flow of the 100 year flood, reduce the temporary water storage capacity of the flood plain, or be placed likely to result in washout of waste.

401 KAR 47:020. Section 3. No facility shall (1) cause or contribute to the taking of any endangered species or threatened species of the Endangered Species Act of 1973; (2) result in the destruction of adverse modification of the critical habitat of endangered or threatened species or candidate species.

401 KAR 48:050. Section 1. Wastes shall not be placed: (1) within 250 ft of an intermittent or perennial stream unless a 401 water quality certification has been issued; (2) within the zone of collapse of deep-mine workings or within the critical angle of draw of such workings; (3) within 250 ft of a feature of karst terrain; (4) within 250 ft of a property line; (5) within 250 ft of a residence; (6) within 50 ft of a gas, sewer, or water line; (7) within 250 ft of a plugged well.

Section 2.(1) The lowest point of the bottom liner of new units of a landfill shall be at least four ft above the seasonal high water table; (2) wastes that leach heavy metals in concentration exceeding the primary drinking water standards should be placed no closer than five ft above the seasonal high water table.

Section 3.(1) No person shall be issued a permit to construct a new landfill in the 100-year floodplain.

Section 4.(1) No new contained landfill shall be located within 10,000 ft of any airport runway used by turbojet aircraft or within 5,000 ft of any airport used by only piston-type aircraft.

Section 5.(1) Waste cells shall not be located within 200 ft of a fault that has had displacement in Holocene time.

Chapter 34; 401 KAR 34:010; Section 9.(1)(a) Portions of new hazardous waste facilities must not be located within sixty-one (61) m of a fault which has had displacement in Holocene time.

Section 9.(2)(a) a facility located within a 100-year floodplain must be designed, constructed, operated, maintained and refitted if necessary, to prevent washout of any hazardous waste and to protect the facility from inundation by waters of the 100-year flood throughout the active life of the facility, closure, and for disposal facilities, post-closure ...

Section 9.(3) The placement of any noncontainerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited.

B-2.7 Missouri

Missouri's hazardous waste and disposal facility siting regulations are contained in: *Missouri Code of State Regulations, Title 10, Department of Natural resources, Division 25-Hazardous Waste Management Commission*: adopted September 7, 1978, last amended March 31, 1993, and; *Missouri Code of State Regulations, Title 10, department of Natural Resources, Division 80-Solid Waste Management Program;* adopted November 28, 1973, last amended September 6, 1992.

Chapter 2-General Provisions for Solid Waste Facilities. 10 CSR 80-2.010 states that all waste disposal facilities shall be located, designed and operated in conformity with the regulations. There are no restrictions in 10 CSR 80-2.010 through 80-5.010 prohibiting waste disposal in unsuitable areas. The suitability of a hazardous waste facility is determined upon the completion of a permit application. The site must have a characterization of surface water and groundwater conditions, surrounding land uses, financial assurances, and operational and closure plans.

The hazardous waste management commissions regulations contained in 10 CSR 25 adopt the Federal Regulations pertaining to hazardous waste management in 40 CFR 260-270 by reference.

10 CSR 25-7.264(2)(N)1.A.II. and III. State specific location standards for hazardous waste landfills are contained in this regulation. A site for hazardous waste landfill must have at least 30 feet of soil or other material with a coefficient of permeability less than 1 x 10(-7) between the lowest artificial or soil liner and the uppermost regional aquifer. As an alternative, a landfill which receives only waste generated by its operator, may demonstrate that a site would retard hazardous constituents as described in the regulation.

10 CSR 25-7.264(2)(N)1.A.IV. No landfill shall be located in the following areas: 1) Wetland; 2) Within 200 feet of a fault with surface displacement in Holocene time; 3) In a 100 year floodplain; 4) In an area of unstable soil deposits or area(s) containing landslides; or 5) In an area subject to catastrophic collapse.

10 CSR 25-7.264(2)(N)2.D. There must be at least 300 feet between the facility property line and the permitted area.

10 CSR 25-7.270(2)(B)4. The seismic evaluation requirements in 40 CFR 270.14(b)(11)(i) and (ii) are not incorporated into the state regulations. An applicant for a hazardous waste

management facility permit shall design and construct the facility to withstand stresses due to earthquake loading or certify that the existing facility is able to withstand stresses due to earthquake loading.

B-2.8 Nevada

Nevada's hazardous waste and disposal facility siting regulation are contained in: *Nevada Administrative Code, Chapter 444-Sanitation: Facilities for the Management of Hazardous Waste*; effective July 22, 1987; amended January 2, 1992. Nevada has also incorporated by reference RCRA regulations found in Parts 260 through 272 for the definition, management and disposal of hazardous wastes.

444.8456.1. A stationary facility for the management of hazardous waste must not be constructed within: (a) 1 mi of: (1) dwelling, school, church or community center; (2) area zoned solely for residential use; (3) public park; (4) wildlife management area; (5) area identified by the department of wildlife as a key habitat for wildlife or habitat of an endangered or threatened species; (6) area where surface water or wetlands occur; (7) natural or man-made geologic hazard which provides a potential for the conveyance of hazardous constituents to surface waters or groundwater; (8) existing well which supplies public drinking water; (b) area identified by the division of historic preservation and archaeology of the state department of conservation and natural resources as an historical or archeological site; (c) 100-year floodplain; (d) area where the water table seasonally rises to within 150 ft of the surface of the ground.

Additionally, the minimum criteria for locating a hazardous waste disposal facility as found in 40 CFR Parts 264, 265, and 270, requires that it (1) be at least 200 ft from a fault shown to be active in Holocene time; (2) outside of a 100-year floodplain, and; (3) the placement of any non-containerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited.

B-2.9 New Jersey

New Jersey's Solid and Hazardous Waste Management Regulations are contained in *New Jersey Administrative Code, Title 7, Department of Environmental Protection, Chapter 26 – Bureau of Solid Waste Management; Adopted effective July 1, 1974; last amended December 6, 1993.* Hazardous waste facilities are specifically exempt from the siting regulations for nonhazardous solid waste facilities. By definition New Jersey's hazardous waste regulations may include mixed waste.

Subchapter 8. Hazardous Waste Criteria, Identification and Listing; 7:26–8.1 Definition of hazardous waste.

7:26–8.1(a) A solid waste, as defined in N.J.A.C. 7:26–1.6, is a hazardous waste if: 1. it is not excluded from regulation as a hazardous waste under N.J.A.C. 7:26–8.2; and; 2. it meets the criteria of N.J.A.C. 7:26–8.2.i. - N.J.A.C. 7:26–8.2.(d)4.

7:26–8.2 Exclusions (a) materials not regulated as hazardous for the purposes of this subchapter; 1.i.4. Source, special nuclear, or by-product material as defined by the A.E.A. of 1954, as amended.

Subchapter 10. Additional Operations and Design Standards for Hazardous Waste Facilities; 7:26–10.3 Location standards for new hazardous waste facilities.

7:26–10.3(a)1. A facility located in a 100-year floodplain must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood unless the owner can demonstrate to the Department that the waste to be removed safely before floodwaters can reach the facility.

7:26–10.6(b)1.ii.-viii. Surface impoundments and 7:26–10.8(c)1.i.- Hazardous waste landfills. The liner system shall consist of two or more liners to cover all earth likely to be in contact with waste or leachate and with a leachate collection system between the liners. The primary liner shall be 30-40 mils (0.03-0.04 inches) thick and designed to prevent the flow of liquid. The liner shall have properties to ensure the prevention of the flow of liquids for the active life of the facility, including closure and post-closure periods. The secondary liner shall be at least five feet thick with a maximum hydraulic conductivity of 1×10^{-7} cm/sec; or be of synthetic materials 30-40 mils thick. The primary and secondary liners shall be 12 inches apart and filled with permeable material. The base of the secondary liner shall be no less than 5 feet above the seasonally high water table.

Subchapter 12. 7:26–12.2 Public participation in the permit process; 7:26–12.2.(e)13 A topographic map showing a distance of 1,000 feet around the facility with a map scale and contour interval to show sufficient detail. The map should show (ii.) 100-year flood-plain; (iii.) surface waters; (iv.) surrounding land uses; (v.) wind rose; (vii.) legal boundaries of the hazardous waste management facility site; (ix.) injection and withdrawal wells; (xiv.) identification of zoning restrictions, actual uses and all public buildings within 1 mile radius.

7:26–12.2.(e)15 Identification of whether the facility is located within a 100-year floodplain; Parts (e)15.i.-iii.(3)(E) lists the requirements which must be fulfilled if a facility is located within a 100-year floodplain.

7:26–12.2.(f)5. For facilities that dispose of hazardous waste in a landfill, the owner or operator shall submit detailed plans and specifications accompanied by an engineering report which shall collectively include information itemized in (f)5i through xi. For new hazardous waste landfills, the plans and specifications shall be in sufficient detail to provide complete information to build the facility. These include: (i.) design drawings and specifications of liners and leachate detection, collection and removal system; (ii.) landfill run-on and run-off controls; (iii.) run-on and run-off collections facilities; (iv.) controls for wind dispersal of particulates; (v.) liner installation instructions; (vi.) list of hazardous wastes to be placed in each cell; (vii.) plans and engineering report describing final cover applied to landfill at closure and maintenance and monitoring activities; (viii.) methods of landfilling containerized waste.

B-2.10 New Mexico

New Mexico's hazardous waste and disposal facility siting regulations are contained in: *New Mexico Environmental Improvement Division, Solid Waste Management Regulations*; adopted April 14, 1989, amended January 30, 1992, and: *New Mexico Environmental Improvement Division, Hazardous Waste Management Regulations*; last amended March 13, 1991.

Part III Section 302.A. Except in Subsection B of this section, no landfill shall be located in the following areas: [1]. floodplains, within 500 ft of wetlands, or 200 ft of water courses; [2.] where depth to seasonal high water table will be closer than 100 ft to the bottom of the fill; [3.] where subsurface mines are considered to be a problem or in areas subject to sink holes; [4.] within 200 ft of a fault that has had displacement in Holocene time, unless all structures are designed to resist the maximum horizontal acceleration in lithified material for the site; [5.] within historically or archaeologically significant sites, unless in compliance with the Cultural Properties Act and the Prehistoric and Historic Sites Preservation Act; [6.] within 1,000 ft of a public water supply well or private well that pumps 100 gallons per minute or more; [7.] within 350 ft of a public water supply well or private well that pumps less than 100 gallons per minute; [8.] within the distance to an airport set by the FAA; [9.] within at least 50 ft from the property boundaries, and at least 500 ft from the nearest residence, school, hospital, institution, or church in existence at the time of application; [10.] in an active alluvial fan, i.e., those currently being aggraded by their permanent or intermittent streams.

Part I-IX, Sections 101-902. Adoption of 40 CFR: Except as provided, the regulations of the EPA set forth in 40 CFR Parts 260, 261, 262, 263, 264, 265, 266, 268, and 270, are hereby incorporated as parts of the New Mexico Hazardous Waste Management Regulations. By reference, the minimum criteria for locating a hazardous waste disposal facility requires that it (1) be at least 200 ft from a fault shown to be active in Holocene time; (2) outside of a 100-year floodplain, and; (3) the placement of any non-containerized or bulk liquid hazardous waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited.

B-2.11 New York

New York's hazardous waste and disposal facility siting regulations are contained in: *New York Consolidated Law Service, Environmental Conservation Law, Article 27-Collection, Treatment and Disposal of Refuse and Other Solid Waste; Article 71-Enforcement, and Article 72-Environmental Regulatory Program Fees*; enacted by laws of 1972, last amended by laws of 1992: *New York Environmental Conservation Law, Article 52-Implementation of Environmental Quality Bond Act or 1986*; enacted by laws of 1986, amended by laws of 1990: *New York Compilation of Rules and Regulations, Title 6, Chapter 361-Siting of Industrial Hazardous Waste Facilities*; approved December 14, 1981, amended March 4, 1985: *New York Compilation of Rules and Regulations, Title 6, Chapter 373-1-Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements*; adopted May 14, 1985, last amended January 31, 1992: *Codes, Rules and Regulations of the State of New York, Title 6-Department of Environmental Conservation Chapter IV-Quality Services, Subchapter B, Subpart 373-2-Final*

Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities; adopted May 14, 1985, last amended January 2, 1992. The form, meaning and basic content of the EPA's RCRA requirements are contained in New York's solid waste and hazardous waste laws, Sections 360, 370, 371, 372 and 373.

Section 371.1(e)(1) defines by exclusion certain materials which are not solid wastes for New York's identification of hazardous waste. Section 371.1(e)(1)(iv) is radioactive materials which are source, special nuclear, or by-product materials as defined by the Atomic Energy Act of 1954 (42 U.S.C.A. §§2011-2394), amended 1984.

Section 27-0704.4. On or after the effective date of this section, no person shall commence operation of a new landfill or an expansion to an existing landfill, which is located in the county of Nassau or Suffolk outside of deep flow recharge areas unless it is determined the landfill will not pose a threat to groundwater quality; the owner or operator has posted a financial guarantee; the landfill is underlain by two or more natural and/or synthetic liners each with provisions for leachate collection, removal, treatment and disposal system.

Section 27-0704.4.e. The landfill is prohibited from accepting industrial, commercial or institutional waste that is hazardous.

Section 27-0704.5. Within seven years of the effective date of this section, no person shall operate a landfill existing on the effective date of this section in the counties of Nassau and Suffolk

Section 27-0704.5.d. The landfill does not accept industrial, commercial or institutional waste that is hazardous.

Section 360-1.14(c)(1) No permit shall be issued to construct or to operate a new solid waste management facility or a lateral expansion of an existing one if land consists predominantly of agricultural soil group 1 or 2 and is within a district formed pursuant to the Agricultural and Markets Law.

Section 360-1.14(c)(2) New solid waste facilities must not be constructed or operated on flood plains.

Section 360-1.14(c)(3) Solid waste management facilities must not be constructed or operated which causes or contributes to the taking of any endangered or threatened species of plants, fish or wildlife; or to the destruction or adverse modification of their critical habitat.

Section 360-1.14(c)(4) New solid waste management facilities must not be constructed or operated within the boundary of a regulated wetland.

Section 360-2.12(c)(1)(i) Except in Nassau and Suffolk counties, and except as provided in subparagraph (ii) of this paragraph, no new landfill and no lateral expansion of an existing landfill may be constructed over primary supply aquifers, principal aquifers, or within public water supply wellhead areas.

Section 360-2.13(a)(2) The required horizontal separation between waste and any surface waters must be adequate to preclude contravention of State surface water standards in the surface water body or flooding of the landfill from the surface water body. In no case can solid waste be deposited closer than 100 ft from the mean high water elevation of any surface water body.

Section 360-2.13(d) A minimum separation of 5 ft must be maintained between the base of the constructed liner system and the seasonal high groundwater table. The 5 ft minimum separation may be waived if it can be demonstrated that the underlying soils are homogenous and have a representative permeability of less than 5×10^{-6} cm/s and exhibit a minimum thickness of 10 ft.

Section 360-2.13(e) A minimum of 10 ft vertical separation must be maintained between the base of the constructed liner and bedrock.

Section 361.7 [Hazardous Waste] Facility Siting Criteria; (a) general considerations: located in area of low population density, i.e., less than 150 persons per square mile; low population density along haul routes; available transportation modes which have a low associated accident rate; the length of and the accident rate on waste transport routes; proximity to incompatible structures, i.e., schools, hospitals, residences, commercial centers; proximity to airports; proximity to utilities; consistency with local plans and regulations; contamination of ground water and surface water; hydrogeological conditions; surface water supply impacts; natural topography; emergency services; air quality and meteorology; areas of mineral exploitation; preservation of endangered species; conservation of historic and cultural resources; and impacts on open space and recreational resources.

Section 373-1.5(a)(2)(xi)(*a*) Owners or operators must provide identification of whether the facility is located within a 100-year floodplain.

Section 373-2.14(b)(1) The soil beneath the facility shall have a hydraulic conductivity of 10^{-5} cm/s or less as determined by in situ tests; (2) no waste shall be closer than 10 ft to an aquifer or bedrock; (3) no facility shall be located over groundwater recharge areas serving public water supplies; (4) facilities shall be located at an elevation not less than 5 ft above a floodplain unless provisions have been made to prevent encroachment of flood waters; (5) all fill areas or excavations shall terminate no closer than 50 ft from the boundary line of the property.

B-2.12 Ohio

Ohio's hazardous waste and disposal facility siting regulations are contained in: *Ohio Revised Code, Title 37, Safety and Morals, Chapter 3734-Solid and Hazardous Wastes; enacted by Laws of Ohio 132, H 623*, effective December 14, 1967; last amended by *Laws of Ohio 1992, S 130* effective August 19, 1992; *Ohio Administrative Code, Title 3745-Environmental Protection Agency, Chapter 27-Solid Waste Disposal Regulations, Chapter 28-Disposal Fees, Chapter 37-Solid Waste Disposal Licenses*; adopted July 29, 1976, last amended March 10, 1993.

Sections 3734.01(J)(2) Hazardous waste includes any substance identified by regulation as hazardous waste under [RCRA] and does not include any substance that is subject to the Atomic Energy Act of 1954 (42 U.S.C.A. §§2011-2394).

3745-51-03(A)(2)(d) [Definition of hazardous waste] It is a mixture of hazardous wastes as defined in paragraphs (A)(2)(a) to (A)(2)(c) of this rule and source material, special nuclear material, or by-product material as defined by the Atomic Energy Act of 1954 (42 U.S.C.A. §§2011-2394), or other radionuclides. However, only the hazardous components of the mixture are subject to regulation for purposes of this chapter.

3745-27-07(A)(3) The disposal facility is not located in a floodway.

3745-27-07(B)(1) The landfill facility is not located in a sand or gravel pit where the sand or gravel deposit has not been completely removed; (2) the landfill facility is not located in a limestone quarry or sandstone quarry, unless deemed acceptable; (3) the limits of the waste placement are not located in: (a) national park or recreation area; (b) candidate ares for potential inclusion in the national park system; (c) state park or established state park purchase area; (d) any property that lies within the boundaries of a national park or recreation area but has not been acquired by or is not administered by the secretary of the United States department of the interior; (4) the landfill facility is not located within the surface and subsurface area surrounding a public water supply well; (5) the landfill facility is not located above an aquifer declared by the federal government under the "Safe Drinking Water Act" to be a sole source aquifer prior to the date of receipt of the permit to install application by the Ohio EPA.

3745-27-07(B)(6) Unless the permit to install application was received by the Ohio EPA prior to the effective date of this rule, the limits of solid waste placement are not to be located within 1,000 ft of the following: (a) areas designated by the Ohio department of natural resources as state nature preserve, state wildlife area, or a state scenic river; (b) areas designated, owned and managed by the Ohio historical society as a nature preserve; (c) areas designate by the United States forest service as national wildlife refuge or a national scenic rivers; (d) area designated as either a special interest area or research natural area in Wayne national forest; (e) stream segments designated by the Ohio EPA as state resource water or, cold water habitat or exceptional warm water habitat; (7) the limits of the waste placement are not located within 200 ft of a fault that has shown displacement in Holocene time; (8) not located within an area of potential subsidence due to an underground mine in existence on the date of receipt of the permit; (9) not located above an unconsolidated aquifer capable of sustaining a yield of 100 gpm for a 24-hour period to a water supply well located within 1,000 ft of the limits of solid waste placement; (10) not located in a regulatory floodplain; (11) not located within 1,000 ft of a water supply well or developed spring in existence on the date of receipt of the permit application; (12) not located within 300 ft of the property line; (13) not located within 1,000 ft of a domicile; (14) not located within 200 ft of a stream, lake, or natural wetland: (15) the isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner is not less that 15 ft of in situ or added geologic material.

3745-54-18(A)(1) Portions of new facilities where treatment, storage, or disposal of hazardous waste will be conducted must not be located within 61 m (200 ft) of a fault which has shown displacement in Holocene time.

3745-54-18(B)(1) A facility in a 100-year floodplain must be designed, constructed operated and maintained to prevent washout of any hazardous waste by a 100-year flood unless the owner or operator can demonstrate (sic) it is otherwise acceptable.

B-2.13 Pennsylvania

Pennsylvania's hazardous waste and disposal facility siting regulations are contained in *Pennsylvania Code, Title 25-Environmental Resources, Article VII-Hazardous Waste Management-Chapters 20 through 265*; adopted effective August 2, 1980, amended December 10, 1988, recodified February 10, 1990, and; *Pennsylvania Code, Title 25-Environmental Resources, Article VII-Hazardous Waste Management, Chapter 269-Siting*; adopted September 21, 1985 amended and recodified February, 1990.

Section 260.2. Hazardous Waste(ii) The term does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (42 U.S.C.A. §§2011-2394).

Section 269.1. Phase I exclusionary criteria are established in §§269.21-269.29 and prohibit the siting of a hazardous waste treatment or disposal facility in an excluded area delineated under these criteria. The Department will deny any permit application if the proposed facility is located in an excluded area.

Section 269.14. The distance from a facility to a feature or structure described in these criteria shall be measured for the perimeter of the facility.

Section 269.21.(a) Facilities may not be sited in the following locations: (1) within ½ mile of a well or spring used for a community water supply; (2) within ½ mile of either side of a stream or impoundment for a distance of 5 stream miles upstream of a surface water intake for a community water supply; (3) within ½ mile of an offsite private or noncommunity public well or spring used as an active water supply, unless prior to operation of the facility the applicant demonstrates the availability of an acceptable permanent alternative supply of like quantity, yield and quality to the existing supply.

Section 269.22.(a) Facilities may not be sited in the 100-year floodplain or a larger area that the flood of record has inundated; (b) Treatment and incineration facilities may not be cited in the 100-year floodplain unless the industrial use on the proposed site was in existence as of October 4, 1978, which is the effective date of the Flood Plain Management Act (32 P.S. §§679.101-679.601).

Section 269.23. Facilities may not be sited in wetlands.

Section 269.24. Facilities may not be sited over active or inactive oil and gas wells or gas storage areas located within of beneath the facility.

Section 269.25. Facilities may not be sited over limestone or carbonate formations, where the formations are greater than 5 ft in thickness and present at the topmost geologic unit. Areas mapped by the Pennsylvania Geologic Survey as underlain by these formations shall be excluded [unless demonstrated otherwise.]

Section 269.26. Facilities may not be sited within National Natural Landmarks designated by the National Park Service or historic sites listed on the National Register of Historic Places.

Section 269.27. Facilities may not be sited on lands in public trust, including State, county or municipal parks, units of the National Parks system, State forests and game lands, the Allegheny National Forest, property owned by the Historical and Museum Commission, a national wildlife refuge, national fish hatchery or national environmental center.

Section 269.28. Facilities may not be sited in agricultural areas established under the Agricultural Area Security Law (3 P.S. §§901-915) or in farmlands identified as Class I agricultural land identified by the Soil Conservation Service.

Section 269.29. Facilities may not be sited in watersheds of exceptional value waters.

Section 269.42.(a) Facilities may not be located within 1 mi or less of a major structural feature [fault or lineament] unless the applicant otherwise demonstrates compatibility with the designed structure and faults in the area; (b) the bedrock shall be a depth of 15 ft or greater from the base of a surface impoundment, landfill or land treatment unit; (c) slopes shall be less than 15%; (d) shall be located outside of landslide prone areas; (e) shall be located away from abandoned oil and/or gas wells; (g) shall not be located in areas of coarse unconsolidated deposits, such as well sorted valley fill deposits and heavily fractured bedrock.

Section 269.44.(a)(1) The applicant must own the mineral rights within the area of the proposed facilities and must not be in an area that has been previously mined; (a)(2)(b) the applicant must demonstrate that underlying previously deep mined areas will not cause failure of the facilities due to subsidence.

Section 269.45.(a) The facilities shall be located in an area that is designated for industrial use by existing municipal zoning or in officially adopted county or municipal comprehensive plans or land use maps.

B-2.14 South Carolina

South Carolina's hazardous waste and disposal facility siting regulations are contained in *Code of Laws of South Carolina, Title 44, Health, Chapter 56-South Carolina Hazardous Waste Management Act*, enacted 1978 through 1991; *South Carolina Code of Regulations, Chapter 61-Department of Health and Environmental Control, Regulations 79.124 through 79.270-Hazardous Waste Management*; adopted June 22, 1984 last revised November 23, 1990; *South Carolina Code of Regulations, Chapter 61-Department Health and Environmental Control, Regulation 104-Hazardous Waste Management Location Standards*, adopted February 22, 1991.

Section 44-56-20.(6)b. Hazardous waste is any waste, or combination of wastes which because of its characteristics may be in the judgment of the Department to be hazardous. The definition does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954.

Section 264.4(a) The following materials are not solid wastes for the purpose of this part: (4) Source, special nuclear or byproduct materials as defined by the Atomic Energy Act of 1954, 42 U.S.C. 2011 et seq.

Section 264.18(a)(1) Portions of new hazardous wastes facilities must not be located within 61 m (200 ft) of a fault which has shown displacement in Holocene time; (b)(1) if located in a floodplain, must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood; (c) placement of any noncontainerized waste in any salt dome formation, salt bed formation, underground mine or cave is prohibited; (d)(1) portions of new hazardous waste facilities, except as specified, must not be located within the recharge zone of an aquifer.

Section 61-104.IV.A.1.a. New and expanding units shall not be located within a minimum of 200 ft of a fault where displacement during the Holocene Epoch has occurred; [2.a.] New and expanding units and appurtenances shall not be located in a 100-year floodplain or in the historical migration zone of coastal marine, lacustrine,or braided or meandering fluvial system; [3.] The placement of any hazardous waste in any underground mine or cave is prohibited; [B.1.a.] not located in karst terrane unless the owner or operator demonstrates that the site is historically stable or there is a satisfactory engineering solution; [B.2.a.] not located in areas of poor foundation conditions; [B.3.a.] not located in areas susceptible to mass movement unless the owner/operator can demonstrate a satisfactory engineering solution.

Section 61-104.IV.C.1.a.(1) New and expanding units are prohibited in areas where the owner or operator cannot demonstrate that (a) the site is underlain by a clay unit at least five ft thick with hydraulic conductivity of not more than 1×10^{-6} cm/s and extends 200 ft upgradient, 500 ft sidegradient and is continuous from below the site to the point where shallow groundwater is discharging to the nearest surface water body and (b) not located in an area where the hydrogeological conditions allow the migration of groundwater in shallow geologic units into deeper units; (c) a minimum ten foot separation maintained between the base of the waste management unit and the high water table as it exists naturally, or through long-term, permanent and maintenance-free methods; (d) a minimum of fifteen foot vertical separation between naturally occurring or engineered material be maintained between the base of the constructed liner and bedrock; (e) not located over an area where a stratum of limestone exhibiting secondary permeability with an average thickness of greater than five ft lies within 50 ft of the base of the unit; [C.1.b.](1)(a) prohibited in areas that the hydrogeologic properties of the site cannot be adequately characterized; [C.1.c.](1) shall not be located over Class GA groundwater or over the recharge area for Class GA groundwater as designated by the Department, over a sole source aquifer, or over the recharge area of a sole source aquifer as designated by the Department.

Section 61-104.IV.C.2.a. New and expanding units shall not be prohibited in the following areas (1) within 1,000 ft of any navigable waters; (2) within that portion of the drainage basin included in a one-half mile radius, at a minimum, on the upstream side of a public drinking water supply intake from a river or stream; (3) within that portion of the drainage basin which is a one-half mile, at a minimum, of a lake, pond, or reservoir used as a source of public drinking water supply.

Section 61-104.IV.C.3.a. New and expanding units shall not be located in an EPA designated non-attainment area unless the owner or operator demonstrates, prior to operation, that the unit will be in compliance with the Department's Air Pollution Control Requirements for non-attainment areas.

Section 61-104.IV.D.1.a. New units shall be prohibited in or adjacent to wetlands; [b.] expansion of existing units shall be prohibited in wetlands; [c.] expansions of existing units shall be prohibited adjacent to wetlands unless the owner or operator can demonstrate (1) that the expansion will be a minimum of 500 ft from a wetland (2) demonstrate that the long-term integrity of the unit will not affect the surface water, groundwater, fauna and flora, etc.

Section 61-104.IV.D.2.a. New and expanding units shall be prohibited in the following areas; (1) on prime farmland; (2) in areas that would adversely impact an archaeological site or a historic site; (3) within a minimum of one-half mile from national or state parks, national wildlife refuges, major water impoundments of 100 acres or larger, state heritage preserves, designated wilderness areas for a national forest, and areas of special national or regional natural, recreational, scenic, or historic value, or other significant environmentally sensitive areas.

Section 61-104.IV.E.1.a. Owners and operators of new, expanding, and existing units shall establish a dedicated buffer zone of at least but not necessarily limited to 200 ft, between the unit and the facility property boundary; [2.a.] For new and expanding units, the owner or operator shall meet the following setback distances; (1) not be located within 2,000 ft of any existing church, school, hospital, or any other structure under routine occupancy; (2) not located within a minimum of 1,000 ft in the downgradient direction, a minimum of 1,500 ft in the sidegradient direction and at any distance upgradient of any well used as a sources of water for human or animal consumption and/or bathing or irrigation that is in a hydrologic unit, potentially impacted by the [disposal] unit.

B-2.15 Tennessee

Tennessee's regulations pertaining to siting disposal facilities for hazardous waste are in *Tennessee Hazardous Waste Management Rules*, amended December 28, 1992 and *Tennessee Commercial Hazardous Waste Facility Rules*, amended September 13, 1990.

1200-1-11-.06 (2)(i)2. No new facility shall be in a 100-year floodplain unless that location is demonstrated to not significantly aggravate upstream or downstream flooding. A facility in a 100-year floodplain shall be built to prevent washout of any hazardous waste, unless procedures are in effect which will cause the waste to be removed safely before flood waters can reach the facility or no adverse effects on human health or the environment will result if washout occurs.

1200-1-11-.06 (2)(i)3. Placement of non-containerized or bulk liquid hazardous waste in any salt dome formation, salt bed, underground mine, or cave is prohibited.

1200-1-14-.03 (2)(a). No facilities shall be in a 100-year floodplain.

1200-1-14-.03 (2)(b). Facilities shall be prohibited in or adjacent to wetlands.

1200-1-14-.03 (2)(c). Facilities shall be no closer than 200 ft to a fault along which movement during the Holocene has occurred. For facilities that will be within 3000 ft of a lineament, it must be demonstrated that no faults along which movement during the Holocene has occurred is present within 200 ft.

1200-1-14-.03 (2)(d). Where poor foundation conditions, land susceptible to mass movement, or karst terrain exist at, beneath, adjacent to, or in the area of the facility, it shall be demonstrated that the problem conditions can or will be mitigated.

1200-1-14-.03 (2)(e)1. Unless exemption requirements are met, facilities are prohibited in areas where it cannot be demonstrated that: the hydrogeology can be adequately characterized, compliance with the ground-water monitoring requirements can be achieved, and technical practicability of a corrective action program could practicably achieve ground-water remediation.

1200-1-14-.03 (2)(e)2. Facilities in vulnerable hydrogeologic settings overlying high resource value ground water or the recharge zone of high resource value ground water is prohibited unless certain conditions are met.

1200-1-14-.03 (2)(e)3. A dedicated buffer zone between the facility and the property boundary shall be adequate to ensure that ground water time of travel (measured along a flow line at least 100-ft long and originating at the base of the facility) allows adequate time to implement the corrective action necessary to remedy a hazardous-waste release to ground water and to mitigate, contain, or eliminate the release within the facility property boundary.

1200-1-14-.03 (2)(e)5. Facilities shall be located such that there is a buffer layer between the bottom of the unit's liner system and the seasonally high water elevation in the uppermost saturated zone underlying the unit that is 2- to 10-ft thick depending, in part, on the saturated hydraulic conductivity.

1200-1-14-.03 (2)(f). The facility shall be located: outside of the lateral limits of the theoretical cone of depression for any drinking-water supply well which withdraws water from the uppermost aquifer or any underlying aquifer which is hydraulically connected to the uppermost aquifer within this cone of depression; two times the corrective action buffer-zone distance from private drinking-water supply wells and from certain stream segments; five times the corrective action buffer-zone distance from public water supply wells; at least 500 ft from any private drinking-water supply well; 1000 ft from any public water supply well; and 500 to 1000 ft upgradient from certain stream segments.

1200-1-14-.03 (2)(g). Facilities shall be set back from streams, lakes, ponds, reservoirs and other surface water by a distance at least equal to the corrective action buffer-zone distance. Facilities shall be at least 200 ft (measured upgradient) from streams, lakes, ponds, reservoirs, and other surface water.

1200-1-14-.03 (2)(h). Facilities shall be screened from sight, or at sufficient distance as to be indistinguishable from the surroundings, when located near scenic, cultural, or recreational areas.

1200-1-14-.03 (2)(i). Facilities shall be located in such a manner that it does not cause or contribute to taking of any endangered or threatened species of plants, fish, or wildlife, or result in destruction or adverse modification of critical habitat.

1200-1-14-.03 (2)(j). Facilities shall be screened from sight or be a sufficient distance from structures such as hospitals, nursing homes, schools, child-care centers, residences, churches, service structures, and commercial retail buildings.

B-2.16 Texas

Texas' regulations pertaining to siting disposal facilities for hazardous waste are in *Subchapter G of Chapter 335, Texas Industrial Waste Management Regulations*, amended May 12, 1993.

335.204(e)(1). Facilities shall not be located in a 100-year floodplain unless the flood depth is less than 3 ft or the facility design will prevent the transport of any hazardous waste.

335.204(e)(2). Facilities shall not be located in wetlands.

335.204(e)(3). Facilities shall not be located on the recharge area of a sole-source aquifer.

335.204(e)(4). A facility shall not be located in areas overlying regional aquifers unless (A) the average annual evaporation exceeds the average annual rainfall by more than 40 inches and the depth to the aquifer is greater that 100 ft from the base of the structure, or (B) the aquifer is separated from the base of the structure by a minimum of 10 ft of material with a hydraulic conductivity toward the aquifer not greater than 10^{-7} cm/sec or a thicker interval of more permeable material which provides equivalent or greater retardation to pollutant migration.

335.204(e)(5). A facility may not be located in areas where soil units within 5 ft of the containment structure have a Unified Soils Classification of GW, GP, GM, GC, SW, SP, or SM or a hydraulic conductivity greater that 10^{-5} cm/sec, except under certain conditions.

335.204(e)(6). Facilities shall not be within 1,000 ft of a residence, church, school, day-care center, surface water body used for public drinking water, or a dedicated public park.

335.204(e)(8). A facility may not be in areas of direct drainage within 1 mi of a lake at its maximum conservation pool level, if the lake is used to supply public drinking water through a public water system, unless features of the facility will prevent adverse effects.

335.204(e)(9). A facility may not be located in areas of active geologic processes unless the features of the facility will prevent adverse effects.

335.204(e)(10). A facility may not be within 1,000 ft of an area subject to active coastal shoreline erosion, if protected by a barrier island or peninsula, unless the features of the facility will prevent adverse effects resulting from storm surge and erosion or scouring. If unprotected by a barrier island or peninsula, a separation distance from the shoreline to the facility must be at least 5,000 ft, unless the features of the facility will prevent adverse effects.

335.204(e)(11). A facility may not be located in the critical habitat of an endangered species unless the features of the facility will prevent adverse effects.

335.204(e)(12). A facility may not be located on a barrier island or peninsula.

335.204(e)(13). A facility may not be located within 30 ft of the upthrown side or 50 ft from the downthrown side of a fault that has been shown to displace shallow Quaternary sediments (within 100 to 300 ft) or human-made structures unless the features of the facility will prevent adverse effects.

B-2.17 Washington

Washington's regulations pertaining to siting disposal facilities for hazardous waste are in *WAC Title 173-303, Washington Dangerous Waste Regulations*, amended March 7, 1991.

WAC 173-303-282(6)(a). Facilities shall be located such that the unit boundary is at least 500 ft from a fault which has had displacement in Holocene times. No facility shall be within an area of subsidence. The unit shall not be within an area of slope or soil instability, nor in the areas affected by unstable slope or soil conditions.

WAC 173-303-282(6)(c)(i). Facilities shall not be located: within a 500-year floodplain; in areas subject to seiches or coastal flooding; within 1/4 mi from a perennial surface-water body; in a watershed identified by WAC 248-54-225(3); or within 1/4 mi from the nearest surface-water intake for domestic water.

WAC 173-303-282(6)(c)(ii). Seek sites with natural characteristics which are capable of providing ground water resources protection, such as low permeability soils and substrata, relatively simple geologic formations, and high rates of evapotranspiration in relation to seasonal precipitation. There will not be less than 50 ft of vertical separation between the lowest point of the unit and the seasonal high water level of the uppermost aquifer of beneficial use. No facilities shall be over an area identified as a sole-source aquifer. The unit boundary will be at least 1/4 mi from the nearest ground water intake for domestic water. Facilities shall not be located within ground water special protection areas designated by ecology.

WAC 173-303-282(6)(d). The unit boundaries will be at least 1/4 mi from wetlands, designated critical habitat, natural area preserves, and designated wildlife refuges, preserves or bald eagle protection areas.

WAC 173-303-282(6)(e). Facilities shall not be located in areas having a mean annual precipitation greater that 100 inches.

WAC 173-303-282(7)(a). The unit boundary shall be at least 500 ft from the nearest point of the facility property line.

WAC 173-303-282(7)(b). Facilities shall not be located within the viewshed of users on designated wild and scenic rivers. The unit boundary shall be at least 1/4 mi from designated parks, recreation areas, national monuments, wilderness areas, and prime farmland.

WAC 173-303-282(7)(c). The unit boundary shall be at least 1/4 mi from residences or public gathering places.

WAC 173-303-282(7)(d). Owners/operators of non-preempted facilities shall conform with local land use zoning designation requirements.

WAC 173-303-282(7)(e). No facility shall be located in a designated archeological or historic site.

WAC 173-303-665(1). No landfill shall be permitted to dispose of extremely hazardous waste, except for the Hanford facility.

WAC 173-303-806(4)(a)(xxi)(A). The contingent ground water protection program shall be based on a sufficient understanding of site geology, hydrology, and other factors to allow evaluation of its adequacy.

LOW LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY SITING REGULATIONS

This appendix presents extracts from the regulations regarding LLW promulgated by regulatory agencies. They consist of the site-selection criteria and the site-specific requirements. Data requirements are considered implied site-selection criteria. Most of the following regulations are summarized rather than quoted.

B-3 DEPARTMENT OF ENERGY

B-3.1 DOE Order 5820.2A

Chapter III, Section 3i(7)(c). The disposal site must have hydrogeologic characteristics that, in conjunction with the planned waste-confinement technology, protect the ground-water resource.

Chapter III, Section 3i(7)(c). Consider the potential for natural hazards, such as floods, erosion, tornadoes, earthquakes, and volcanoes in site selection.

Chapter III, Section 3i(7)(c). Address the impact on current and projected populations, land-use resource-development plans and nearby public facilities, accessibility to transportation routes and utilities, and the location of waste generation.

B-3.2 DOE Order 6430.1A

DOE Order 6430.1A, 12/25/87, specifies general design criteria for all types of DOE facilities.

Section 0111-2.7. Determine earthquake loads in accordance with the Uniform Building Code and UCRL 15910. An outside consultant must make an independent review of seismic design where there is the potential for risk to life or economic loss.

Section 0111-2.8.2. Design structures to resist earth pressures, including those imposed by high ground-water levels.

Section 0111-2.8.4. Design structures to account for rise and fall in temperature.

Section 0111-2.8.5. Design structures to account for stresses induced by creep and shrinkage.

Section 0111-3.4. Design foundations to resist frost heave, expansive soils, differential settlement, and the bearing abilities of the soil.

Section 0111-99. Protect against man-made problems, such as missiles, discharges, accidents, aircraft. Protect against natural phenomena, such as earthquakes, tornadoes, wind, and floods. This section gives minimum design parameters for earthquakes and tornadoes.

Section 0150-1. Re-establish natural flora or minimize erosion. Do not disturb archaeological, cultural, or historical sites.

Section 0150-4. Control erosion, dust, exhaust emissions, noise. Construct bridges or culverts over drainages.

Section 0200-1. In siting the facility, consider topography; geology; cultural, historic and archeological resources; endemic plant and animal species; health, safety, and environmental protection requirements; indoor air quality (e.g., radon); possible accidents in adjacent facilities; natural hazards, including seismic activity, wind, hurricane, tornado, flood, hail, volcanic ash, lightning, and snow; wave action, in accordance with CERC Shore Protection Manual; security and safeguard requirements; adequacy of existing of planned support and service facilities, including utilities, roads, and parking areas; aesthetics; and energy conservation requirements. Avoid building in floodplains, wetlands, or areas subject to flash floods.

Section 0200-1.2. The maximum calculated dose to off-site individuals must not exceed 25 rem to the whole body, 300 rem to the thyroid, 300 rem to the bone surface, or 75 rem to the lung or any other organ. Where multiple organs receive doses from the same exposure, the summed risk from all organ doses must not exceed 25 rem effective dose equivalent when using specified weighting factors.

Section 0200-2. In siting new buildings, consider architectural and functional compatibility with the environment; operational and service functional relationships; topographic and geologic conditions; existing cultural, archeological, and historic resources; endemic plant and animal species; availability of existing utility services; building setback requirements; availability of existing road systems; traffic volume, refuse handling and loading zone requirements; adequacy for parking, future expansion, and other land-use requirements; health, safety, and environmental-protection requirements; indoor air quality (e.g., radon); and security and safeguard requirements.

Section 0200-99. Consider meteorology data, such as wind, atmospheric stability, temperature, atmospheric water vapor, and mean joint temperature and specific humidity, to estimate dispersal of effluent under normal and accident conditions; hydrology data, such as flooding, rainstorms, ground-water levels, tsunamis, dam failures, ice loading from water bodies, and potential transport of contaminants; and seismology data, including dynamic loading, surface faulting, liquefaction, vibratory ground motion, and seismic-wave amplification.

Section 0201. Analyze for settlement, shrinkage, expansion properties, slope stability, seismic activity, frost depth, corrosive materials, gas, slope and excavation instability, and construction problems caused by subsurface conditions.

Section 0270-2. With regard to stormwater management, consider such factors as topography, requirements for future expansion, outfall location, existing drainage systems, certain storm parameters, drainage area, soil cover, stream gauge data, and snowmelt.

Section 0276. Executive Order 11988 and Executive Order 11990 mandate that federal agencies avoid development on floodplains and wetlands where practical alternatives exist. Construction in such areas must comply with 10 CFR 1022 and the National Environmental Policy Act and implementing regulations.

Section 0285-2. In selecting sites for treatment, storage, and disposal facilities for LLW, consider existing ground water and surface-water conditions; soils, geologic, and topographic features; social, geographic, and economic factors; and aesthetic and environmental impacts.

Section 0285-2.2.2. Give lowest siting priority to wetlands, areas within a 500-year floodplain, permafrost areas, critical habitats of endangered species, recharge zones of sole-source aquifers, and watersheds for domestic water supply.

Section 0285-2.2.3. Avoid seismic zones and karst terrain.

Section 0285-2.2.4. Consider construction costs, including reclamation costs.

Section 0285-2.2.5. Do not locate disposal facilities on sites traversed by buried utility conduits unless the relocation or protection of these utilities is economically feasible.

Section 0285-2.2.6. Consider the characteristics and availability of on-site soil cover with respect to site operation and performance requirements, including vehicle maneuverability.

Section 0285-2.2.7. Sites must be accessible to service and refuse collection vehicles by all-weather road extensions from primary road systems.

Section 0285-2.2.8. Consider adverse effects on other facilities with regard to vehicular traffic, noise, litter, bird strike, vectors, and other nuisances.

Section 0285-3.2.3. To determine potential impacts on ground-water resources, consider initial (background) quality of water resources in the saturated zone, depth to ground water and the direction and rate of flow, potential interactions of solid waste with water resources, and site hydrogeology.

Section 0285-3.2.4. Determine the quality, quantity, source, and seasonal variations of surface waters in the vicinity of the solid-waste system to serve as the basis for design of surface water protection and monitoring systems.

Section 0285-3.2.5. Protect against 100-year and 500-year floods.

Section 0285-3.2.6. Plans must include land use and zoning within 400 m (1/4 mile) of the site, including the location of all residences, buildings, public and private wells, water courses, rock outcrops, and roads; location of all airports within 3.2 km (2 miles) of the site; location of all utilities within 150 m (500 ft) of the site; temporary and permanent all-weather access roads; sedimentation control plans; and projected use of the reclaimed site.

Section 0290-2. Take into account availability and accessibility of irrigation water; visual factors; climatic data, including extreme wind; existing vegetation; soils; microclimate; hydrology, including flood-flow frequency; geology and seismology; revegetation and restoration of disturbed areas; topography; noise factors; utilities; security requirements; and erosion and runoff control.

B-4 NUCLEAR REGULATORY COMMISSION

B-4.1 NUREG 902

The U.S. NRC issued NUREG-902 in 1982 as a technical position paper on site-suitability requirements, the site-selection process, and site-characterization activities for a near-surface disposal facility, based on the then-proposed rule for 10 CFR 61. These are a summary of the NRC interpretations from the 10 CFR 61 proposed rule. A detailed breakdown of the site-suitability requirements are found in U.S. NRC NUREG 1199 and NUREG 1200.

The proposed site should be geologically and hydrologically simple. Site conditions should be such that well-documented analytical solutions or computer codes are available and applicable for modeling site performance. Natural processes affecting the site should be occurring at consistent and definable rates such that modelling of the site will represent both the present and anticipated site conditions after closure.

Population growth is to be evaluated for potential eventual uses in areas surrounding a proposed disposal site. Disposal sites should be located in an area that has a low population density and limited population growth potential. Disposal sites should be at least 2 km from the property limits of the closest population centers. Consideration should be given to the potential for future land-use activities and limitations on surrounding lands that could adversely affect the disposal site. These include such uses as residential housing, industry, agriculture, recreation; land ownership and zoning restrictions should be considered.

The presence of known natural resources must be evaluated. These include mineral, coal, or hydrocarbon deposits, geothermal energy, timber, and water resources. The requirements apply to resource recovery that could occur at the ground surface, in the hydrogeologic units used for disposal or isolation, and at greater depths requiring excavation or drilling through the disposal units. The primary concern with the presence of natural resources is the possibility of inadvertent intrusion by a resource exploiter after active institutional control ends.

The surface-water effects related to a proposed site must be evaluated. Drainage across the site must be limited and mainly is related to the post-construction facilities. The site must be outside of the 100-year floodplain (as defined by Executive Order 11988, *Floodplain Management Guidelines*) and away from areas prone to flash floods. The site must be free of wetlands, seasonal or perennial ponding water, or other indications of high ground water.

The drainage basin upstream of the proposed site should be of limited area. This consideration relates to the potential of the site lying in a 100-year floodplain or where high water flow could affect facility performance. Engineering modifications or diversions of the natural drainage to lessen the impacts upon a facility might be acceptable if ongoing active maintenance of these modifications is not required. The impact upon the facility by others should be evaluated with regard to potential modification of upstream drainage by road building, deforestation, dam building, or agriculture.

The proposed facility should be located in unsaturated soils. At sites where disposal will be above the water table, seasonal fluctuations of the water table and capillary fringe before and after waste disposal must be considered. The bottoms of the disposal units must be, at all times, above the saturated zone, in order to limit water contacting the wastes, notwithstanding the small amount of water that infiltrates through covers in disposal areas. Accumulation of water in the disposal unit must be avoided. Disposal units located below the water table, i.e., the hydrogeologic unit used for disposal, should have hydraulic properties that essentially preclude ground-water flow.

The hydrologic unit used for disposal must not discharge ground water to the surface within the disposal site. Surface-water features (bogs, marshes, seeps, springs, ephemeral streams) sustained by ground-water discharge should not be present at the site. This requirement will result in a travel time for most dissolved radionuclides at least equal to the travel time of the ground water from the disposal area to the site boundary. This allows sufficient space and time within the buffer zone to implement remedial measures, if needed, to control releases of radionuclides before discharge to the ground surface.

Tectonic and geomorphic factors must be evaluated to ensure long-term stability of the site. Natural processes affecting the disposal site should be occurring at consistent and definable rates. In addition, these processes should not occur at a frequency, rate, or extent that can significantly change the stability of the site or its ability to isolate LLW during the duration of the radiological hazard (approximately 500 years). The impacts include ground deformation due to seismic events (such as liquefaction, ground rupture, and faulting), changes in the water table and disruption of utilities, non-tectonic processes (such as soil instability, frost heave, hydrocompaction, and land subsidence due to water or hydrocarbon extraction), and geomorphic processes, such as mass wasting and landsliding, karst subsidence, and surface erosion by wind or water.

Potential impacts of the proposed disposal site on its surroundings and of the surroundings on the disposal site must be evaluated. The evaluation must address potential impacts to the site from the use of natural resources, such as dam construction on nearby rivers, agriculture, and mining, the impact to performance from nearby industries, population growth patterns and community interests, safety, transportation, land values, and risks.

B-4.2 NUREG 1199

Section 2.1.1. Determine whether potential mineral or natural-resource removal will affect facility performance. Determine whether the site is adjacent to or within areas of special land-use designations, such as parks, recreation areas, or scenic areas.

Section 2.1.2. Determine whether growth patterns will affect facility performance. Evaluate towns or cities with population $\leq$ 10,000 individuals within a 10-km radius and towns or cities with population $\geq$ 10,000 individuals within a 50-km radius.

Section 2.2. Determine extremes in temperature, storm conditions, wind conditions (tornadoes, hurricanes, thunderstorms), air pollution (temperature inversions), and snow or ice loading.

Section 2.3.1. Consider effects of folding, faulting, seismic events or volcanism due to tectonics and the regional stress regime. Conduct geomorphic studies to evaluate landforms for data on site stability. The site should be located away from significant subsurface features, such as karst terrain, fractures, or jointing that would cause settlement or shifting. The site should have a low potential for settlement due to liquefaction. Site stratigraphy and bedrock geology should be easily characterized, and ground-water conditions should be easily modelled.

Section 2.4.1. Determine the extent of the 100-year floodplain. Demonstrate that upstream drainage areas are minimized. Avoid failure by high flood waters or construction that could cause high flood waters. Avoid areas that have coastal hazards or are prone to flooding or ponding.

Section 2.4.2. Site must be capable of being characterized, modeled, and monitored. The ground surface must be sufficiently above the perennial water table or seasonal fluctuations of ground water. Determine whether site ground water discharges offsite.

Section 2.5.1. Characterize soil and rock layering to determine soil conditions with regard to cover designs and borrow material and the potential for erosion, infiltration, and differential settlement.

Section 2.7. Consider future land uses that would create opportunities for inadvertent intrusions into wastes or disrupt cover upon removal of active institutional controls. Determine whether extractive mineral uses impact the site or water-resource exploitation could result in failure to meet performance objectives.

Section 2.8. Consider special habitats, presence of plant communities, and presence of invertebrate and vertebrate terrestrial or aquatic species that would prohibit construction of a facility.

B-4.3 10 CFR 61

Section 61.12. Determine whether temporary storage structures will be subjected to high snow or ice loading.

Section 61.12. Evaluate whether the site will be subjected to temperature extremes, extreme storms, extreme wind conditions (tornadoes, hurricanes thunderstorms), or extreme air pollution (temperature inversions). The site must be capable of being characterized, modeled, and monitored. Determine whether perennial or fluctuating ground water could come in contact with wastes. Determine whether mineral or natural-resource removal could affect facility performance. Evaluate whether future land uses could create opportunities for inadvertent intrusions into wastes or disrupt cover upon removal of active institutional controls.

Section 61.41. The disposal facility must not expose people to annual radiation levels exceeding 25 millirem to the whole body, 75 millirem to the thyroid, and 25 millirem to any other organ.

Section 61.50. Determine whether the site is within a 100-year floodplain, is affected by upstream drainage areas, is in a coastal high-hazard area, or is prone to flooding or ponding. Evaluate whether extractive mineral uses could impact the site and whether water-resource exploitation could result in failure to meet performance objectives. Evaluate growth patterns that could affect facility performance. Evaluate whether effects of folding, faulting, seismic events, or volcanism due to tectonics and the regional stress regime will occur on the site. Evaluate whether the area is susceptible to mass wasting, rapid erosion, slumping, landslides, rockslides or severe Conduct geomorphic studies to evaluate landforms for data on site stability. Stratigraphy and bedrock geology must be capable of being characterized, and ground-water conditions must be capable of being accurately modelled.

B-5 COMPACTS

The compacts have not set forth any regulations pertaining to disposal of LLW and MLLW.

B-6 NRC AGREEMENT STATES

B-6.1 California

California's requirements pertaining to disposal of LLW and MLLW are contained in Appendix B, *Low-Level Radioactive Waste Siting Criteria*, to SB 342.[1]

1. Disposal facilities should be located away from large expanding population centers.

2. The waste disposal facility shall be selected with consideration given to land use and resource development and not located where recovery of subsurface minerals or ground-water resources could result in increased erosion or significant changes in the hydrogeologic system. Areas containing critical habitats of endangered species or cultural resources should be avoided.

3. Economic impact analysis of proposed sites should be undertaken using acceptable procedures (such as those offered by the State of California, Office of Planning and Research). Use of compensatory mechanisms should be considered.

4. Disposal sites shall be accessible by all-weather roads.

5. The site shall demonstrate acceptable exposure limits in modeling simulations of facility performance as delineated in 10 CFR 61.41.

6. The site shall not be located over zones of active faulting where seismically induced phenomena would jeopardize the ability of the facility to meet performance objectives. Similarly, the site shall not be located near zones of igneous or volcanic activity that will jeopardize the ability of the facility to meet performance objectives.

7. The waste disposal facility shall not be located in a coastal high-hazard area or wetland, 100-year flood plain, dry wash, area of poor drainage, area within the upstream or downstream influence of man-made dams, regulatory floodway, down gradient from mountain canyons where flash flooding is likely, or in an area with conditions conducive to flooding.

8. A suitable site must meet the following general hydrologic criteria: (a) maximum fluctuations of the water table and associated capillary fringe should not intrude across the proposed lower boundary of the disposal units (16 m), (b) the hydrologic setting of the proposed site should be fully characterized in accordance with methods presented by NRC (1982) and EPA (1974), (c) the disposal site should not be located in areas where it would degrade ground-water quality, and (d) excavated soil shall be evaluated for appropriateness as backfill and trench cap material.

9. Areas where wind or water erosion processes may present a significant potential to jeopardize facility performance should be avoided.

10. A semi-arid to arid climate is optimal for siting. The site should demonstrate a low frequency of extreme weather events during the short term to ensure site operation integrity.

11. The natural attributes of the site shall allow full characterization, modeling, monitoring, and analysis of geologic, meteorologic, hydrologic, and radiologic factors.

12. The facility should be located where utilities can be made available.

13. The low-level waste disposal facility should not be located so remotely as to impair the administration of security and fire services.

14. The disposal site should be able to meet the performance objectives outlined in 10 CFR 61 throughout the projected 500-year hazardous interval of the waste. The selected site must be able to meet the volume requirements predicted for the facility service life.

B-6.2 Colorado

Colorado's regulations pertaining to disposal of LLW and MLLW are contained in *Rules and Regulations Pertaining to Radiation Control*, December 30, 1985.

Section 14.7.1. Specific technical information shall include a description of the natural and demographic disposal site characteristics as determined by disposal site selection and characterization activities. Description shall include geologic, geotechnical, geochemical, ecologic, archaeologic, hydrologic, meteorologic, climatologic, and biotic features of the disposal site and vicinity.

Section 14.7.2. Specific technical information shall include features related to infiltration of water, integrity of covers for disposal units, structural stability of backfill, wastes, and covers, contact of wastes with standing water, disposal site drainage, disposal site closure and stabilization, inadvertent intrusion, adequacy of the size of the buffer zone for monitoring, and potential mitigative measures.

Section 14.7.4. Specific technical information shall include a description of the design-basis natural events or phenomena.

Section 14.7.8. Specific technical information shall include identification of the known natural resources whose exploitation could result in inadvertent intrusion.

Section 14.8.1. Pathways shall be analyzed in demonstrating protection of the general population from releases of radioactivity, including air, soil, ground water, surface water, plant uptake, and exhumation by burrowing animals. Demonstrate that there is reasonable assurance that the exposures to humans from the release of radioactivity will not exceed the limits set forth in 14.19.

Section 14.8.4. Analyses of the long-term stability of the disposal site shall be based on analyses of active natural processes, such as erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site.

Section 14.19. Concentrations of radioactive material that may be released to the general environment in ground water, surface water, air, soil, plants, or animals, shall not result in an annual dose exceeding an equivalent of 25 millirems (0.25 mSv) to the whole body, 75 millirems (0.75 mSv) to the thyroid, and 25 millirems (0.25 mSv) to any other organ of the any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluent to the general environment as low as is reasonably achievable.

Section 14.20. Ensure protection of any individual inadvertently intruding into the disposal site.

Section 14.23.1.1 The disposal site shall be capable of being characterized, modelled, analyzed, and monitored.

Section 14.23.1.2. Select a disposal site so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of this part.

Section 14.23.1.3. Areas shall be avoided having known natural resources that, if exploited, would result in failure to meet the performance objectives of this part.

Section 14.23.1.4. The disposal site shall be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year flood plain, coastal high-hazard area, or wetland.

Section 14.23.1.5. Upstream drainage areas shall be minimized.

Section 14.23.1.6. Provide sufficient depth to the water table. In no case will waste disposal be permitted in the zone of fluctuation of the water table.

Section 14.23.1.7. The hydrogeologic unit used for disposal shall not discharge ground water to the surface within the disposal site.

Section 14.23.1.8. Areas shall be avoided where tectonic processes, such as faulting, folding, seismic activity, or volcanism, could occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives.

Section 14.23.1.9. Areas shall be avoided where surface geologic processes, such as mass wasting, erosion, slumping, landsliding, or weathering occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives.

Section 14.23.1.10. The disposal site must not be located where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives.

Section 14.25.1.8. A buffer zone of land shall be maintained between any buried waste and the disposal site boundary and beneath the disposed waste. The buffer zone shall be of adequate dimensions to carry out the environmental monitoring.

Section 14.26.1. Obtain information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the disposal site. For those characteristics that are subject to seasonal variation, data must cover at least a 12-month period.

B-6.3 Florida

Florida's regulations for LLW and the siting of a LLW disposal site are contained in *Florida Radiation Protection Act, Chapter 404*. The existing act is to be repealed by October 1, 1994. The act is scheduled to be reviewed in advance of the date of repeal.

Florida is a party state to the Southeast Interstate Low-Level Radioactive Waste Management Compact, as described in Section 404.30, Article I. Due to the reliance upon the Compact, Florida has not promulgated siting regulations outside of a set of procedural requirements. These requirements are contained in Section 404.0617, *Siting of commercial low-level radioactive waste management facilities*. The requirements outline procedures to follow and the applicant for a waste disposal license must show that a disposal facility will protect human health and the environment, but the section does not contain specific regulatory constraints that must be followed.

B-6.4 Idaho

The state of Idaho follows 10 CFR 61 to regulate the disposal of LLW in that state.

B-6.5 Illinois

Section 20/8(g)(2) Any license issued by the Department to operate any facility for the disposal of low-level radioactive wastes away from the point of generation shall be revoked as a matter of law to the extent that the license authorizes disposal if, the county in which the facility is located passes an ordinance ordering the license revoked, or the facility is located within a municipality or within 1 1/2 miles of the boundary of a municipality, that municipality passes an ordinance ordering the license revoked.

B-6.6 Kentucky

Kentucky's regulations for the disposal of LLW are in Section 902 KAR 100:022 of *Kentucky Administrative Regulations*.

Section 22(2). The disposal site shall be capable of being characterized, modelled, analyzed, and monitored.

Section 22(3). The disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of this part.

Section 22(4). Areas shall be avoided having known natural resources which, if exploited, would result in failure to meet the performance objectives of this part.

Section 22(5). The disposal site shall be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year flood plain, coastal high-hazard area of wetland, as defined in Executive Order 11988.

Section 22(6). Upstream drainage areas shall be minimized to decrease the amount of runoff which could erode or inundate waste-disposal units.

Section 22(7). The disposal site shall provide sufficient depth to the water table that groundwater intrusion, perennial or otherwise, into the waste will not occur. In no case shall waste disposal be permitted in the zone of fluctuation of the water table.

Section 22(8). The hydrogeologic unit used for disposal shall not discharge groundwater to the surface within the disposal site.

Section 22(9). Areas shall be avoided where tectonic processes, such as faulting, folding, seismic activity, or volcanism, may occur.

Section 22(10). Areas shall be avoided where surface geologic processes, such as mass wasting, erosion, slumping, landsliding, or weathering, occur.

Section 22(11). The disposal site shall not be located where nearby facilities or activities could adversely impact the ability of the site to meet performance objectives or mask the environmental monitoring program.

B-6.7 Missouri

Missouri has not set forth regulations regarding disposal of LLW.

B-6.8 Nevada

Nevada's regulations pertaining to disposal of LLW are in Chapter 459 of Nevada's Administrative Code 459, *Disposal of radioactive material*, February 1992.

Section 807. Applicant must have collected data on the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the area. For those characteristics that are subject to seasonal variation, the data must cover at least a 12-month period.

Section 808. Submit a description of the natural and demographic characteristics of the disposal area, including geologic, geotechnical, hydrologic, meteorologic, climatologic, and biotic features of the disposal area and its vicinity. For disposal near the surface, include features related to the infiltration of water, integrity of covers for disposal units; structural stability of backfill, wastes, and covers; contact of wastes with standing water; drainage; closure and stabilization; elimination, to the extent practicable, of long-term maintenance; prevention of inadvertent intrusion; exposure of employees to radiation; detection of radiation in the disposal area; and adequacy of the size of the buffer zone for detection and prevention of the migration of radionuclides. Describe natural events or phenomena on which the design is based.

Section 8085. Applicant must submit analyses of pathways of migration of radionuclides by way of air, soil, ground water, surface water, vegetative growth, and exhumation by burrowing animals; analyses of the protection of individuals who inadvertently intrude; and analyses of the long-term stability of the disposal area and the need for active maintenance after closure, which must be based on analyses of active natural processes such as erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils and the surface drainage of the disposal area.

Section 810. A disposal area must be so located, designed, operated, closed, and controlled after closure as reasonable to ensure that any exposures of individuals to radiation are within the limits established, and that an individual is protected who inadvertently intrudes into and occupies the disposal area or comes into contact with the waste at any time after active governmental control over the disposal area is removed.

Section 8105. A proposed disposal area must be capable of being characterized, modeled, analyzed, and observed. Projected growth of the population and other future development within the region where the disposal area is to be located are not likely to affect the capability of the disposal are to meet objectives. Geographic areas must be avoided that contain valuable natural resources that are known to exist and that, if exploited, would result in the eventual failure of the disposal area to meet objectives. The disposal area must be well drained and free of flooding or frequent ponding. No siting is allowed in a 100-year floodplain, coastal area with a high risk of flooding, or wetland. Upstream drainage areas must be minimized to decrease the amount of runoff that could erode or inundate the disposal unit. Waste, when buried, must be sufficiently above the water table so that the intrusion of ground water, perennial or otherwise, into the waste will not occur. The disposal of waste will not be allowed in the zone of fluctuation of the water table. The hydrogeologic unit in which the site is located must not discharge ground water to the surface within the disposal area. Disposal is not allowed in areas of faulting, folding, seismic activity, or volcanism. Disposal is not allowed in areas of mass wasting, erosion, slumping, landsliding, or weathering. Disposal must not be located where nearby facilities or activities could adversely affect the capability of the area to meet the objectives.

B-6.9 New Jersey

New Jersey's regulations regarding disposal of LLW are in NJSA 13:1E-177, *Regional Low-Level Radioactive Waste Disposal Facility Siting Act*, which created a radioactive-waste disposal siting board. The law requires the board to develop criteria and guidelines for the siting an LLW disposal facility. The firm EBASCO was commissioned to develop the criteria, which EBASCO presented in a report from April 1990. EBASCO based their criteria on 10 CFR 61, NUREG 0902, Regulatory Guide 4.19 (*Guidance for Selecting Sites for Near-Surface Disposal of Low-Level Radioactive Waste*), draft NRC/EPA siting guidelines for disposal of mixed low-level radioactive and hazardous waste, Executive Order 11990, and other federal and state regulations. Their nineteen criteria are as follows:

The disposal site should be well drained and free of areas of flooding or frequent ponding, and must be outside of any 100-year floodplain, high-hazard coastal area, or wetland.

The disposal facility must be located where upstream drainage areas contributing to flow across the site are minimized.

The disposal facility must be located where ground-water intrusion into the waste can be prevented, and must be located outside the zone of fluctuation of the water table.

The hydrogeologic setting of the disposal facility must be such that ground-water flow can be characterized, modelled, analyzed, and monitored.

The hydrogeologic unit used for disposal must not discharge ground water to the surface within the disposal site.

The disposal facility should be located where tectonic processes such as faulting, earthquakes, folding, or volcanism will not occur with significant frequency and extent.

The disposal facility selection should be located where surface and near-surface geologic processes such as erosion, mass wasting, weathering, slumping, landsliding, or the development of karst will not occur with significant frequency and extent.

The disposal facility must be located where disruption of existing land use is limited and the present population and land use in the area are not likely to affect the ability of the disposal facility to meet performance objectives and technical requirements.

The disposal facility must be located where projected population growth and future developments in the area are not likely to affect the ability of the disposal facility to meet performance objectives and technical requirements and are not likely to significantly interfere with the environmental monitoring system.

The disposal site selection process must consider all applicable federal and state regulations, statutes, and laws that refer to specific land areas or land uses within the State of New Jersey.

The disposal facility should be located away from areas where facilities or activities could adversely impact performance objectives or technical requirements of the facility or significantly mask the environmental monitoring system.

The disposal facility should be located where the construction, operation, or closure of the facility will not adversely impact the quality or quantity of presently available or projected public drinking-water supplies. Specifically, the disposal facility must be located where maximum dose limits established by 40 CFR 141 and 10 CFR 61.41 would not be exceeded.

In addition to surface water and ground water, the disposal site selection process must consider other potential transport mechanisms for radionuclides, including biotic and airborne. The disposal site must be located where maximum dose limits established by 10 CFR 61.41 will not be exceeded.

The disposal facility must not be located within federally protected lands set aside for the preservation of natural and cultural resources. Specifically, the disposal facility must not be located within national parks, national forests, national wildlife refuges, federally designated wild and scenic rivers, federally designated wilderness areas, national recreation areas, Pinelands National Reserve, or certain federally designated wetlands.

The disposal facility must not be located within state-protected lands set aside for preservation of natural and cultural resources. Specifically, the disposal facility must not be located within the Delaware and Raritan Canal State Park, Hackensack Meadowlands District, state pinelands, state-designated natural areas, or state-designated wild and scenic rivers.

The disposal facility should not be located in areas that are meaningful to people because of historic, cultural, religious, ethnic, or racial heritage.

The disposal facility should not be located in known habitats of federal- or state-designated rare, threatened, or endangered species.

The disposal site selection should not be located in areas of known natural resources that, if exploited, would result in failure to meet performance objectives or technical requirements.

The disposal site selection process must consider the potential impacts of transportation of waste to the facility.

B-6.10 New Mexico

New Mexico's regulations pertaining to disposal of LLW are set forth in Part 13 of New Mexico's *Radiation Protection Requirements*, March 10, 1989.

Section 13-700D. Analyses of long-term stability of the site and need for active maintenance shall be based on analyses of natural processes, such as erosion, mass wasting, slope failure, and surface drainage.

Section 13-2100. The disposal facility shall be sited to achieve long-term stability and to eliminate, to the extent practical, the need for active maintenance following closure.

Section 13-2200.A. The disposal site shall be capable of being characterized, modeled, analyzed, and monitored. The site should be selected in an area where population growth and development will not affect the ability of the facility to meet performance objectives. The site shall be well drained, free of frequent ponding, and not in a 100-year flood plain, coastal high-hazard area, or wetland. The depth to the water table shall be deep enough that ground-water intrusion will not occur and that waste disposal will not be in the zone of fluctuation. The hydrologic unit used for disposal shall not discharge ground water to the surface within the disposal site. Areas shall be avoided where tectonic processes, mass wasting or weathering may occur with such frequency and extent to significantly affect the ability of the disposal facility to meet performance objectives or preclude any defensible modeling and prediction of long-term impacts.

Section 13-2300.A. The disposal site shall be designed to complement and improve the ability of the disposal site's natural characteristics to ensure that the performance objectives will be met.

Section 13-2400.A. Class C wastes will be disposed of so that the top of the waste is at least 5 m below the top surface of the cover or with intrusion barriers that are designed to protect against an inadvertent intrusion for at least 500 years. A buffer zone shall be maintained between the buried waste and the disposal site boundary, and beneath the disposed waste, of adequate dimensions to conduct environmental monitoring and, if needed, mitigation.

Section 13-2700.A. Disposal of waste received from other persons may be permitted only on land owned in fee by the federal or a state government.

B-6.11 New York

New York's regulations pertaining to disposal of LLW are contained in 6 NYCRR Part 382. Many of New York state's regulations on siting disposal facilities for low-level radioactive waste mimic those contained in 10 CFR 61. New York's more stringent regulations are presented below.

Section 382.21(a)(1). The site must not be located at the Western New York Nuclear Service Center in West Valley, New York. (Criterion dictated by the New York Low-Level Radioactive Waste Management Act)

Section 382.21(a)(7). The facility must not be located where existing radioactive material, including but not limited to naturally occurring radioactive material, could mask the monitoring program.

Section 382.22(b)(2). The site must not be located immediately above the Long Island Aquifer; any primary public water supply aquifer; or a principal aquifer designated by the department.

Section 382.21(c)(1). The site must not be located in an area where past, present or future exploration or exploitation of natural resources could adversely affect the land disposal facility's ability to meet the performance objectives of Subpart C of this part.

B-6.12 Ohio

Ohio's regulations regarding disposal of radioactive materials are in *Ohio Department of Health Radiation Protection Rules, Ohio Administrative Code*, October 1982.

Section 3701-38-26. Each application, where appropriate, should include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures. The director shall not approve any application to receive radioactive material from other persons for disposal on land not owned by the state or federal government.

Section 3701-38-28. No registrant shall dispose of radioactive material by burial in soil unless (a) the total quantity of radioactive materials buried at any one location and time does not exceed, at the time of burial, 1,000 times the amount specified in division H of rule 3701-38-20, (b) burial is at a minimum depth of 4 feet, and (c) successive burials are separated by distances of at least 6 feet and not more than twelve burials are made in any year.

Section 3701-38-29. No registrant shall incinerate radioactive material for the purpose of disposal or preparation for disposal except as specifically approved by the director pursuant to rule 3701-38-16 and rule 3701-38-26 of the Ohio Administrative Code.

B-6.13 Pennsylvania

Pennsylvania's regulations regarding disposal of LLW are contained in *Title 25 -- Environmental Resources, Environmental Quality Board, [25 PA. Code CH.236], Low-Level Radioactive Waste Management and Disposal*, amended October 17, 1989.

Section 122. Disposal facilities may not be located where nearby facilities, activities, population or development will mask monitoring of the disposal site or affect the disposal site's compliance with performance objectives. Mineral rights, rights-of-way, and liens could place conditions on land ownership. Siting must be compatible with county and municipal plans for zoning, land use, projected population distribution, and growth.

Section 123. Consider potential hazards along transportation routes, residential dwellings per mile, and travel distance between suitable points of exit and existing highways.

Section 124. Avoid locations with extreme climatic conditions with regard to temperature, freeze-thaw, historical trends of airflow, and the potential for severe weather phenomena.

Section 125. Disposal facilities may not be sited within 1 mile of an active fault.

Section 126. Disposal facilities may not be sited within limits of 100-year floodplains, within coastal floodplains, below dams that could pose a threat of dam failure, where erosion or mass movements are likely, in areas with slope gradients greater than 15%, or in areas of surface-water features, including wetlands, springs, and ponds that are sustained by ground water.

Section 127. Disposal facilities may not be located where limestone or other predominantly carbonate lithologic units greater than 5 feet thick crop out or are present within 50 feet of the surface. Disposal facilities may not be located in areas with the potential for subsidence or areas that exhibit evidence of past subsidence.

Section 128. Disposal facilities may not be located within ½ mile of spring or well used as public water supply, within ½ mile of either side of stream or impoundment for a distance of 5 stream miles upstream of a surface water intake for public water supply, or within ½ mile of an existing important wetland. Disposal facilities may not be located within national parks, national forests, national landmarks designated by the National Park Service, national wildlife refuges, national fish hatcheries, national wild and scenic river systems, including study rivers, national trail systems, national wilderness preservation systems, exceptional-value wetlands, national historic sites, state, county, or municipal park systems, land owned by the Historical and Museum Commission, lands protected by the wild and scenic rivers programs, designated natural and wild areas, state forests or state game lands (unless given authority), areas over active or inactive oil and gas wells or gas-storage areas, on agricultural land established under the agricultural-area security law, or areas over active or inactive mines that are identified and substantiated in public records.

B-6.14 South Carolina

South Carolina's regulations on disposal siting in *State of South Carolina, Department of Health and Environmental Control, Regulation 61-63, Radioactive Materials (Title A)*, July 1990.

Section 7.6.1. The application shall include a description of the natural and demographic disposal site characteristics, including geologic, geochemical, geotechnical, hydrologic, ecologic, archaeologic, meteorologic, climatologic,and biotic features of the site and vicinity.

Section 7.6.8. The application shall identify known natural resources.

Section 7.7.1. The application shall include an analysis of pathways, including air, soil, ground water, surface water, plant uptake, and exhumation by burrowing animals.

Section 7.7.4. The application shall include an analysis of active natural processes, such as erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration, and surface drainage.

Section 7.18. Concentrations of radioactive material that may be released to the environment shall not result in an annual dose exceeding an equivalent of 25 millirems (0.25 mSv) to the whole body, 75 millirems (0.75 mSv) to the thyroid, and 25 millirems (0.25 mSv) to any other organ of the any member of the public.

Section 7.22.1.1. The disposal site shall be capable of being characterized, modelled, analyzed, and monitored.

Section 7.22.1.2. The disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of this part.

Section 7.22.1.3. Areas shall be avoided having known natural resources which, if exploited, would result in failure to meet the performance objectives of this part.

Section 7.22.1.4. The disposal site shall be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year flood plain, coastal high-hazard area or wetland, as defined in Executive Order 11988.

Section 7.22.1.5. Upstream drainage areas shall be minimized to decrease the amount of runoff which could erode or inundate waste-disposal units.

Section 7.22.1.6. The disposal site shall provide sufficient depth to the water table that ground-water intrusion, perennial or otherwise, into the waste will not occur.

Section 7.22.1.7. The hydrogeologic unit used for disposal shall not discharge ground water to the surface within the disposal site.

Section 7.22.1.8. Areas shall be avoided where tectonic processes, such as faulting, folding, seismic activity, or volcanism, may occur.

Section 7.22.1.9. Areas shall be avoided where surface geologic processes, such as mass wasting, erosion, slumping, landsliding, or weathering, occur.

Section 7.22.1.10. The disposal site must not be located where nearby facilities or activities could adversely impact the ability of the site to meet performance objectives or mask the environmental monitoring program.

B-6.15 Tennessee

Tennessee's regulations regarding disposal of LLW are contained in *State Regulations for Protection Against Radiation*, amended March 12, 1993.

1200-2-11-.08 (3)(a)(1). Specific technical information must include a description of the natural and demographic disposal site characteristics as determined by disposal site selection and characterization activities. The description must include geologic, geotechnical, hydrologic, meteorologic, climatologic and biotic features of the disposal site and vicinity.

1200-2-11-.08 (4). An identification of the known natural resources at the disposal site, the exploitation of which could result in inadvertent intrusion into the low-level waste after removal of active institutional control.

1200-2-11-.08 (13)(b)(1). Pathways analyzed in demonstrating protection of the general population from releases of radioactivity must include air, soil, ground water, surface water, plant uptake and exhumation by burrowing animals.

1200-2-11-.08 (13)(b)(4)(b). Where the proposed disposal site is on land not owned by the federal or a state government, the applicant must submit evidence that arrangements have been made for assumption of ownership in fee by the federal or state government before the department issues a license.

1200-2-11-.16 (2) Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 mrems to the whole body, 75 mrems to the thyroid and 25 mrems to any other organ of any member of the public. Reasonable effort shall be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable.

1200-2-11-.16 (3). Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed.

1200-2-11-.17 (1)(b). The disposal site shall be capable of being characterized, modeled, analyzed and monitored.

1200-2-11-.17 (1)(c). Within the region where the facility is to be located, a disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of 1200-2-11-.16.

1200-2-11-.17 (1)(d). Areas must be avoided having known natural resources which, if exploited, would result in failure to meet the performance objectives of 1200-2-11-.16.

1200-2-11-.17 (1)(e). The disposal site must be generally well drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year floodplain or wetland, as defined in Presidential Executive Order 11988.

1200-2-11-.17 (1)(f). Upstream drainage areas must be minimized to decrease the amount of runoff which could erode or inundate waste disposal units.

1200-2-11-.17 (1)(g). The disposal site must provide sufficient depth to the water table that ground-water intrusion, perennial or otherwise, into waste will not occur.

1200-2-11-.17 (1)(h). The hydrogeologic unit used for disposal shall not discharge ground water to the surface within the disposal site.

1200-2-11-.17 (1)(i). Areas must be avoided where tectonic processes such as faulting, folding, seismic activity or vulcanism may occur with such frequency and extent to affect the ability of the disposal site to meet the performance objectives of 1200-2-11-.16 or may preclude defensible modeling and prediction of long-term impacts.

1200-2-11-.17 (1)(j). Areas must be avoided where surface geologic processes such as mass wasting, erosion, slumping, landsliding or weathering occur with such frequency and extent to affect the ability of the disposal site to meet the performance objectives of 1200-2-11-.16, or may preclude defensible modeling and prediction of long-term impacts.

1200-2-11-.17 (1)(k). The disposal site must not be located where nearby facilities or activities could impact the ability of the site to meet the performance objectives of 1200-2-11-.16 or mask the environmental monitoring program.

B-6.16 Texas

Most of Texas's regulations on disposal siting are in *Considerations for Site Selection*, 1982.

1. Disposal sites shall not be located in the 100-year floodplain, coastal high hazard zone, or wetlands.

2. The site should be located so that upstream drainage is minimal and drainage is easily manageable. This generally indicates an area with an existing grade of 5 percent or less.

3. Sufficient depth to the water table should be present so that ground water intrusion, perennial or otherwise, into the waste will not occur. It is the desire of the Authority to locate the disposal site so that all disposal shall occur in the unsaturated zone. Further, it is desirable to locate the site in an area where at no time will the water table rise to within 50 feet of the trench bottom assuming that the site will be a conventional shallow land burial operation.

4. Any ground-water discharge to the surface within the disposal site shall not originate within the hydrogeologic unit used for disposal. It is desirable that the site be located where naturally occurring ground water discharge is not present.

5. The site shall not be located on the recharge zone of the major or minor aquifers of Texas.

6. The disposal site shall not be located in an area where future population growth or development are likely to affect the ability of the site to meet its performance objectives. In general, an exclusion zone of at least 25 miles from the limits of a SMSA should be maintained.

7. Disposal site shall not be located in a county which has a population density above 400 individuals per square mile (major metro areas).

8. Areas must be avoided where tectonic processes, such as faulting, folding, seismic activity, or volcanism occur with such frequency and extent to significantly affect site performance.

9. Areas should be avoided where surface geological processes such as mass wasting, erosion, slumping, landsliding, or weathering occur with such frequency and severity as to adversely affect site performance.

10. The site shall not be located in an area where severe meteorological conditions such as tornadoes, excessive winds, or thunderstorms occur with sufficient frequency as to adversely affect site performance.

11. The disposal site shall not be located where nearby facilities or activities could adversely impact the site's ability to meet performance objectives.

12. The site should not be located within or adjacent to national or state parks, monuments, or wildlife management areas.

13. The site should be located in an area of minimal archaeological significance and should not be located adjacent to a historic site designated by the State Historical Commission.

14. The site should not be located in an area where disposal operations could adversely affect the habitat of endangered or protected species (list is lengthy and easily obtained).

15. Areas should be avoided which have economically significant, recoverable, natural resources, which, if exploited would result in the failure of the site to meet performance objectives.

16. The site should have no recorded easements upon it. These include but are not limited to, pipeline and utility easements.

17. The proposed site should be readily accessible to state highways.

18. The site should be located where calcareous or low-permeability soils occur.

19. The site should preferably be located on existing state or federally owned land to minimize the site acquisition problems and cost.

20. It would be desirable to locate the site on land where an EIS has been previously prepared.

21. Site should be located in an area of net evaporation or evapotranspiration.

22. Site should be located such that transportation problems from major radioactive waste generators are minimized.

23. The site should preferably be located in an area where there is little public opposition.

24. Site should be capable of being characterized, modeled, analyzed, and monitored.

The Texas Low-Level Radioactive Waste Disposal Authority Act, 1989, contains one section pertaining to disposal of LLW:

Section 402.089 (b). The board may not select a disposal site that is within 20 miles upstream or up-drainage from the maximum elevation of the surface of a reservoir project that has been constructed, is under construction, or has been approved for construction.

B-6.17 Washington

Washington's regulations regarding disposal of LLW are contained in Washington Administrative Code, Chapters 246-250, *Radioactive waste -- licensing land disposal*, August 1991.

Section 050. The specific technical information must be in the form of an environmental report, which the department can use to independently evaluate the project under the provisions of the State Environmental Policy Act. The report must describe natural and demographic disposal site characteristics as determined by disposal-site selection and characterization activities, including geologic, geochemical, geotechnical, hydrologic, ecologic, archaeologic, meteorologic, climatologic, and biotic features of the disposal site and vicinity. The report must describe design features related to infiltration of water, integrity of covers, structural stability of backfill, contact of waste with standing water, site drainage, closure and stabilization, elimination of long-term maintenance, and inadvertent intrusion. The report must identify known natural resources at the disposal site, whose exploitation could result in inadvertent intrusion into the wastes after removal of active institutional control.

Section 060. The specific technical information must also include the following analyses needed to demonstrate that the performance objectives of this chapter will be met. Pathways analyzed in demonstrating protection of the general population from releases of radioactivity must include air, soil, ground water, surface water, plant uptake, and exhumation by burrowing animals. Analyses of long-term stability must be based upon analyses of active natural processes such as erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site.

Section 170. Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals, must not result in an annual dose exceeding an equivalent of 25 millirems (0.25 mSv) to the whole body, 75 millirems (0.75 mSv) to the thyroid, and 25 millirems (0.25 Msv) to any other organ of any member of the public.

Section 180. Ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the facility are removed.

Section 200. The facility must be sited, designed, used, operated, and closed to achieve long-term stability of the site and to eliminate the need for ongoing active maintenance of the site following closure so that only surveillance, monitoring, or minor custodial care is required.

Section 300. The site must be capable of being characterized, analyzed, and monitored. The facility must be sited such that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives. Avoid known natural resources which, if exploited, would result in failure to meet performance objectives. Select a site that is well drained, free of flooding or frequent ponding. Do not site disposal facilities in a 100-year flood plain, coastal high-hazard area, or wetland, as defined in Executive Order 11988. Upstream drainage areas must be minimized to decrease erosion and inundation. Provide sufficient depth to the water table so that ground water intrusion, perennial or otherwise, into the waste will not occur. In no case will waste disposal be permitted in the zone of fluctuation. The hydrogeologic unit used for disposal must not discharge ground water to the surface, except for ground water monitoring operations. Avoid faulting, folding, seismic activity, or volcanism. Avoid mass wasting, erosion, slumping, landsliding, or weathering.

Section 320. Surface features must direct surface water drainage away from disposal units. Minimize contact of water with waste during and after disposal.

DISTRIBUTION:

1 Keith Asmussen
General Atomics
3550 General Atomics Court
San Diego, CA 92121-1194

1 Janie Benton
DOE/NE-33
Room A269
19901 Germantown Road
Germantown, MD 20585

1 Jerry Boese
Ross and Associates, Ltd.
1218 Third Avenue, Suite 1207
Seattle, WA 98101

1 Rick Bower
Tech Reps, Inc.
5000 Marble NE
Albuquerque, NM 87110

1 Patty Bubar, EM-323
DOE Trevion II Bldg.
19901 Germantown Road
Germantown, MD 20874-1290

1 Joel Case
DOE/ID
785 DOE Place
Idaho Falls, ID 83401-1562

1 John Chamberlain
West Valley Nuclear Services Co.
Rock Springs Road
P.O. Box 191
West Valley, NY 14171

1 Dennis Claussen
DOE/Richland
2355 Stevens Dr.
Richland, WA 99352

1 Al Collins
SAIC
20201 Century Blvd., 3rd Floor
Germantown, MD 20874

1 Rick DiSalvo
DOE/Rocky Flats
Highway 93, T124A
Rocky Flats, CO 80401

1 Alex Dong
DOE/Oakland
1301 Clay Street, 700-N
Oakland, CA 94612

1 Gerry Gaylord
Energy Technology Engineering Center
6633 Canoga Avenue, MS-T038
Canoga Park, CA 91304

1 Mary Ellen Giampaoli
DOE/Nevada
2753 South Hiland Dr.
Las Vegas, NV 89109

1 Bill Gilbert
US Department of Energy
200 Administration Road
Oak Ridge, TN 37831-8620

1 Mike Godwin
MK Corporation
180 Howard St.
San Francisco, CA 94105

1 Jerry Granzen
DOE/Brookhaven Area Office
52 Bell Avenue, Bldg. 464
Uptown, NY 11973

1 Donna Green
DOE/Argonne Area Office
9800 South Cass Avenue
Argonne, IL 60439

1 David Gregg
Lawrence Livermore National Labs
East Avenue, MS L-546
Livermore, CA 94550

1 Scott Harrington
Raytheon Services
1551 Hillshire
Las Vegas, NV 89128

1 James Henderson
RSN
1551 Hillshire
Las Vegas, NV 89128

1 Jou Hwang
SAIC
20201 Century Blvd.
Germantown, MD 20874

1 James Johnson
DOE/Dayton Area Office
1 Mound Road
Miamisburg, OH 45343-3000

1 Dan Kapsch
EG&G/Mound Applied Technologies
P.O. Box 3000
Miamisburg, OH 45343-3000

1 Keith Kelson
William Lettis & Associates
1000 Broadway, Suite 612
Oakland, CA 94607-4041

1 Mike Klimas
DOE/Chicago
7800 South Cass Ave.
Argonne, IL 60439

1 Don Lee
Oak Ridge National Laboratory
Bethel Valley Rd.
Bldg. 4500 N, MS-6185
Oak Ridge, TN 37831-6185

1 Martin Letourneau
DOE Trevion II Bldg./EM-33
19901 Germantown Road
Germantown, MD 20874-1290

1 Paul Liebendorfer
Bureau of Federal Facilities
Div. of Environmental Protection
123 W. Nye Lane
Carson City, NV 89710

1 John Loughead
Roger & Associates
1850 Old Pecos Trail, Suite H
Santa Fe, NM 87501

1 Claude Magnuson
DOE Trevion II Bldg./EM-431
19901 Germantown Road
Germantown, MD 20874-1290

1 Elizabeth Matthews
DOE/West Valley
10282 Rock Springs Road
West Valley, NY 14171

1 Lance Mezga
MME/Oak Ridge, Bldg. K-1037
Highway 58, K-25 Site
Oak Ridge, TN 37831-7357

1 Mark Monaco
Knolls Atomic Power Lab-Kesselring
P.O. Box 1072, F3-1
Schenectady, NY 12301

1 Elmer Naples
Department of the Navy
Naval Sea System Command
Naval Propulsion Dir., Code 08U
NCB#2, Rm 3W62
2521 Jeff Davis Highway
Arlington, VA 22242-5160

1 Sue Nielson
DOE/Chicago Operations Office
9800 South Cass Avenue
Argonne, IL 60439

1 Michael O'Rear
DOE/Savannah River
Road 1-A
Aiken, SC 29802

1 Dave Osugi
DOE/Oakland
1303 Clay Street, 700-N
Oakland, CA 94612

1 Tom Pauling
DOE/WSSRAP
7295 Highway 94 S.
St. Charles, MO 63304

1 Roger Piscitella
EG&G
765 Lindsey Blvd.
Idaho Falls, ID 83415

1 Don Plowman
WHC/RL
2355 Stevens Dr.
Richland, WA 99352

1 Caroline Polanish
DOE/Brookhaven Area Office
52 Bell Avenue, Bldg. 464
Uptown, NY 11973

1 Melda Rafferty
DOE/Portsmouth
3930 US Rte 23, Perimeter Rd.
Piketon, OH 45661

1 Karen Reed
DOE/WSSRAP
7295 Highway 94 S.
St. Charles, MO 63304

1 Jay Rhoderick, EM-321
DOE Trevion II Bldg.
19901 Germantown Road
Germantown, MD 20874-1290

1 Susan Rice
Envirocare of Utah, Inc.
46 West Broadway, Suite 240
Salt Lake City, UT 84101

1 Sherri Ross
DOE/Savannah River
Road 1-A
Aiken, SC 29802

1 Jim Sage
U.S. Department of Energy
Pittsburgh Naval Reactors Office
P.O. Box 109
West Mifflin, PA 15122-0109

1 Jennifer Sands, EM-321
DOE Trevion II Bldg.
19901 Germantown Road
Germantown, MD 20874-1290

1 John Sattler
DOE/Fernald
7400 Wiley Road
Fernald, OH 45030

1 Gary Schmidtke
DOE/Pinellas Area Office
11400 South Belcher Rd
Largo, FL 34643

1 Dave Shropshire
EG&G
465 Lindsey Blvd.
Idaho Falls, ID 83401-2420

1 Mickey Sizemore
DOE/Paducah
5600 Hobbs Road
West Paducah, KY 42086

1 Ed Skintik
DOE/Fernald
7400 Wiley Road
Fernald, OH 45030

1 Tim Sloan
LANL TA-54 Area L
Mesita del Buey Road
Los Alamos, NM 87545

1 Stacey Sorg
DOE/Nevada
2765 South Hiland
Las Vegas, NV 89109

1 John Starmer
ERM/PMC
7926 Jones Branch Dr., Suite 210
McLean, VA 22101

1 Joanne Steingard
BDM Federal
20300 Century Blvd.
Germantown, MD 20874

1 Marilyn Stone, EM-35
DOE Trevion II Bldg.
19901 Germantown Road
Germantown, MD 20874-1290

1 Dan Sullivan
DOE/West Valley
10282 Rock Springs Road
West Valley, NY 14171

1 Linda Suttora, EM-431
656 Quince Orchard Road
Gaithersburg, MD 20878

1 Glen Todzia
DOE/Brookhaven Area Office
52 Bell Avenue, Bldg. 464
Uptown, NY 11973

1 Mike Torbert, EM-321
DOE Trevion II Bldg.
19901 Germantown Road
Germantown, MD 20874-1290

1 Dean Triebel
DOE/Amarillo Area Office
Highway 60, FM Road 2373
Pantex Plant, TX 79120

1 Jim Turi, EM-32
DOE Trevion II Bldg.
19901 Germantown Road
Germantown, MD 20874-1290

1 John Thomasian
444 N. Capital St., Suite 267
Washington, DC 20001

1 Barbara Yoerg
DOE/Nevada
2753 South Hiland Dr.
Las Vegas, NV 89109

1	MS0720	Charles Massey, 6626
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