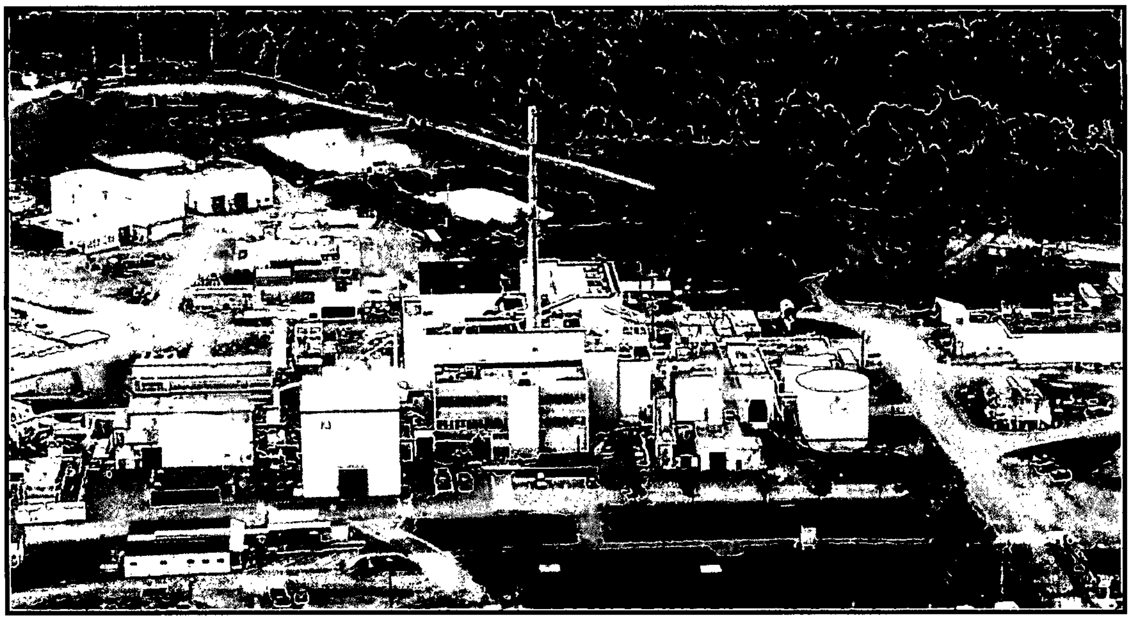
U.S. Department of Energy
West Valley Demonstration Project

Phase 1 Decommissioning Plan for the West Valley Demonstration Project

Revision 0



December 2008

Prepared by

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The proposed decommissioning approach described in this plan is based on the preferred alternative in the Revised Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center, which is referred to as the Decommissioning EIS. If changes to that document occur during the course of the National Environmental Policy Act process that affect this plan, such as changes to the preferred alternative, or if a different approach is selected in the Record of Decision, this plan will be revised as necessary to reflect the changes.

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Record of Revisions

No.	Date	Purpose
0	December 2008	Initial issue for U.S. Nuclear Regulatory Commission review.

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Note that other tables appear in the Appendix C, Attachment 1 electronic files.

NOTATION

Acronyms and Abbreviations

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
BH	bore hole
CG	cleanup goal
DCGL	derived concentration guideline level
$DCGL_W$	derived concentration guideline level, wide
$DCGL_{EMC}$	derived concentration guideline level, elevated measurement concentration
$DCGL_{scan}$	derived concentration guideline level, scan
DOE	Department of Energy
DQO	data quality objective
DSR	dose/source ratio
E	east
EIS	environmental impact statement
EMC	elevated measurement concentration
EPA	U.S Environmental Protection Agency
F	Fahrenheit
FR	Federal Register
HEPA	high-efficiency particulate air
HLW	high-level waste
ICORS	Interagency Steering Committee on Radiation Standards
K	hydraulic conductivity
K_d	distribution coefficient
KRS	Kent recessional sequence
LLW	low-level waste
LTR	License Termination Rule
LTS	Lavery till sand
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MMI	Modified Mercalli Intensity
N	north

NOTATION

ND	not detected
NDA	NRC-Licensed Disposal Area
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NPR	New Production Reactor
NRC	Nuclear Regulatory Commission
NFS	Nuclear Fuel Services, Inc.
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
PUREX	plutonium uranium refining by extraction
QA	quality assurance
QC	quality control
qtr	quarter
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual radioactivity [computer code]
RFI	RCRA facility investigation
S&G	sand and gravel
SAIC	Science Applications International Corporation
SB	subsurface soil
SD	stream bank sediment
SDA	State-Licensed Disposal Area
SPDES	State Pollutant Discharge Elimination System
SS	surface soil
THOREX	thorium uranium extraction process
TLD	thermoluminescent dosimeter
ULT	unweathered Lavery till
W	west
WLT	weathered Lavery till
WMA	waste management area
WSMS	Washington Safety Management Solutions
WVDP	West Valley Demonstration Project
WVES	West Valley Environmental Services
WVNSCO	West Valley Nuclear Services Company

NOTATION

Units

Ci	curie
cfm	cubic feet per minute
cm	centimeter
cm^2	centimeter squared
cm^3	centimeter cubed
cpm	counts per minute
dpm	disintegrations per minute
g	gram [mass]
g	acceleration due to gravity [in reference to accelerations]
h	hour
kg	kilogram
km	kilometer
L	liter
m	meter
mCi	millicurie
millirem	0.001 Roentgen equivalent man
mL	milliliter
mrem	millirem
mR	milli Roentgen
μCi	0.000001 curie
μR	micro Roentgen
μrem	micro rem
μL	0.000001 liter
pCi	10^{-12} curie
R	Roentgen
rem	Roentgen equivalent man
s	second
y	year

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EXECUTIVE SUMMARY

PURPOSE OF THIS EXECUTIVE SUMMARY

The purpose of this part of the Decommissioning Plan is to provide readers a synopsis of the plan content.

INFORMATION IN THIS SECTION

The following matters are addressed in the order given:

- The requirements of the West Valley Demonstration Project Act, the decommissioning requirements, and the proposed decommissioning approach;
- The name and address of the licensee and site owner;
- The location and address of the site;
- A brief description of the site and immediate environs;
- A summary of prior licensed activities and other activities involving radioactivity;
- The nature and extent of radioactive contamination at the site;
- The decommissioning objective;
- Decommissioning controls;
- Derived concentration guideline levels and cleanup goals;
- A summary of ALARA (as low as reasonably achievable) evaluations performed and planned;
- Planned initiation and completion dates for the proposed decommissioning; and
- A summary of post-remediation activities.

RELATIONSHIP TO OTHER PLAN SECTIONS

This summary briefly describes the content of key parts of the plan.

The U.S. Department of Energy (DOE) has prepared this plan pursuant to its statutory obligations for decontamination and decommissioning of the West Valley Demonstration Project (WVDP) under the WVDP Act of 1980, Public Law Public Law 96-368, and to satisfy commitments made to the U.S. Nuclear Regulatory Commission (NRC) in 1981 and 2003 to prepare a decommissioning plan for the project and submit it to NRC for review.

This plan addresses Phase 1 of the two phases of the WVDP proposed decommissioning. The approach for Phase 2 would be determined later after consideration of the results of additional studies and evaluations carried out during and subsequent to Phase 1. The basis for this proposed approach and the general context for the decommissioning are explained in the sidebar discussion on the next page.

The WVDP Act and the WVDP

This decommissioning project is being conducted under the WVDP Act of 1980. The WVDP Act directed DOE to carry out the following activities: (1) solidify the high-level waste (HLW) at the site, (2) develop containers suitable for permanent disposal of the solidified HLW, (3) transport the waste to a federal repository for permanent disposal, (4) dispose of low-level radioactive waste and transuranic waste produced in the solidification of the HLW, and (5) decontaminate and decommission the tanks, facilities, materials, and hardware used in the project in accordance with requirements prescribed by the NRC. The WVDP was initiated to allow DOE to carry out its responsibilities under the WVDP Act. This plan focuses on the fifth activity – decontamination and decommissioning.

Decommissioning Requirements

The NRC has prescribed the requirements in its License Termination Rule in Code of Federal Regulations 10 CFR Part 20, Subpart E to WVDP facilities and as the decommissioning goal for the entire NRC-licensed site.

The Phased Decision-Making Approach

The environmental impacts of the proposed approach described in this plan are being analyzed in the *Environmental Impact Statement on Decommissioning and/or Long-Term Stewardship of the WVDP and Western New York Nuclear Service Center*, hereafter referred to as the Decommissioning EIS. Decommissioning would not begin until the Record of Decision is issued. The decommissioning is proposed to be accomplished in two phases, with Phase 1 expected to begin in 2011. This phased decision-making approach is the preferred alternative in the Decommissioning EIS.

Phase 1 of the decommissioning would entail removal of the WVDP Main Plant Process Building, the WVDP Low-Level Waste Treatment Facility, and certain other facilities within the WVDP area, which is known as the project premises. These activities would clean up much of the project premises to standards that would not prejudice decisions on the approach for Phase 2, which would complete the decommissioning. The decision on the Phase 2 approach would be made later after evaluation of additional studies and analysis, as noted previously.

The Phase 1 Decommissioning Scope

The scope of this plan is limited to certain facilities on the north plateau area of the project premises and to removal of one major facility on the south plateau, the Radwaste Treatment System Drum Cell, a former radioactive waste storage area. This plan may be revised to provide for remediation of surface soil in certain areas and streambed sediment, depending on characterization results and available funding.

This plan does not address decommissioning of the underground waste storage tanks, the region of subsurface environmental contamination known as the north plateau groundwater plume, or the two inactive radioactive waste disposal facilities on the south plateau, the NRC-Licensed Disposal Area and the State-Licensed Disposal Area, all of which would be considered in Phase 2 of the decommissioning.

Site Owner and Site Location

Although DOE would accomplish the decommissioning for the portion of the site used by the WVDP, the entire site remains under the ownership of the New York State Energy Research and Development Authority (NYSERDA), who is the licensee. NYSERDA's main office is in Albany at the following address:

NYSERDA
17 Columbia Circle
Albany, New York 12203-6399

NYSERDA also maintains an office near the site with the following mailing address:

10282 Rock Springs Road
West Valley, New York 14171-9799

The site, which is known as the Western New York Nuclear Service Center (the Center), is located at the latter address in a rural area in Cattaraugus and Erie counties approximately 30 miles south of the city of Buffalo as shown in Figure ES-1.

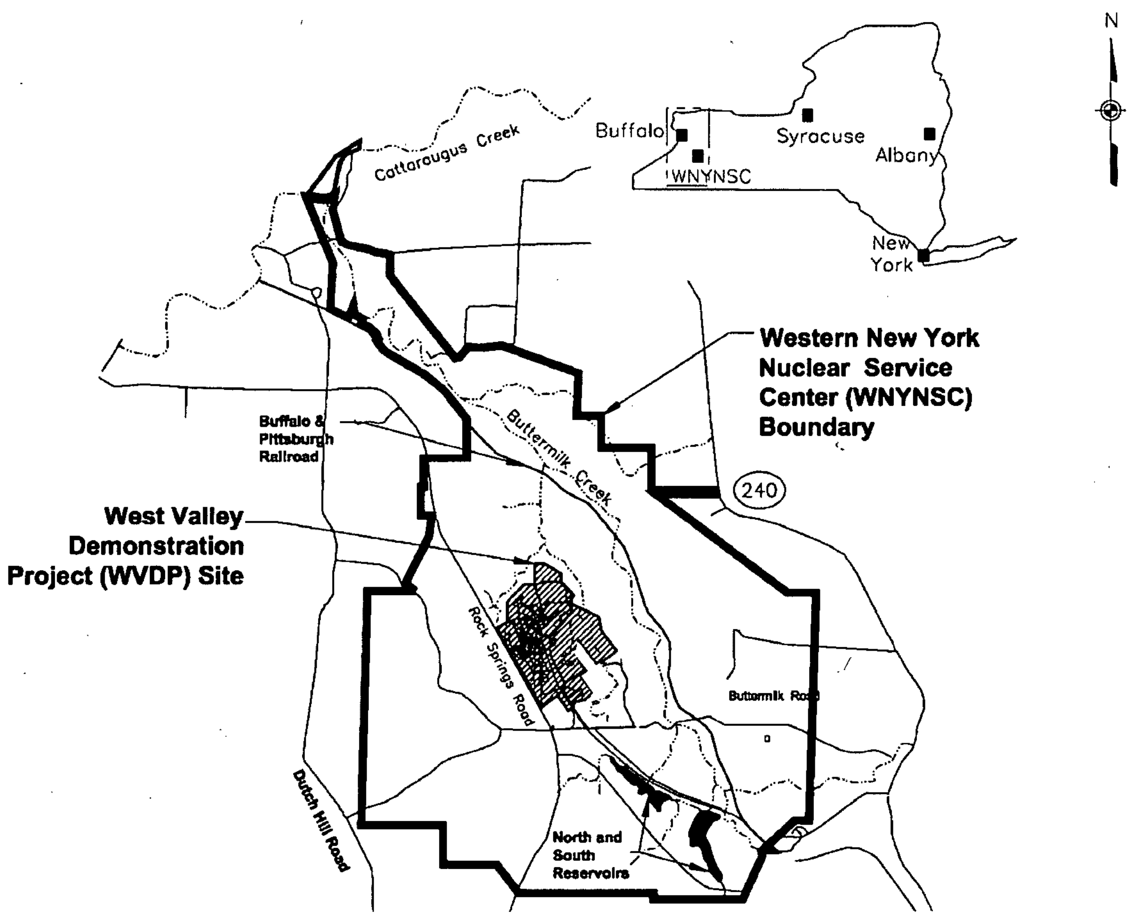

Figure ES-1. Location of the Western New York Nuclear Service Center

Description of the Site and Immediate Environs

The Center property comprises approximately 3,345 acres ranging in elevation from 1000 to 1,800 feet above mean sea level. The area of the WVDP ranges from 1,300 to 1,445 feet above sea level. The undeveloped part of the Center remains a mixture of forest, wetlands, and abandoned farmland.

The following description of the site and its environs begins with the former reprocessing plant and the WVDP facilities and then addresses the remainder of the Center property, known as the retained premises, and the surrounding area. The project premises are shown in Figures ES-1 and ES-2. Note that residual radioactivity associated with the facilities is described later in this summary under the heading "Nature and Extent of Contamination at the Site."

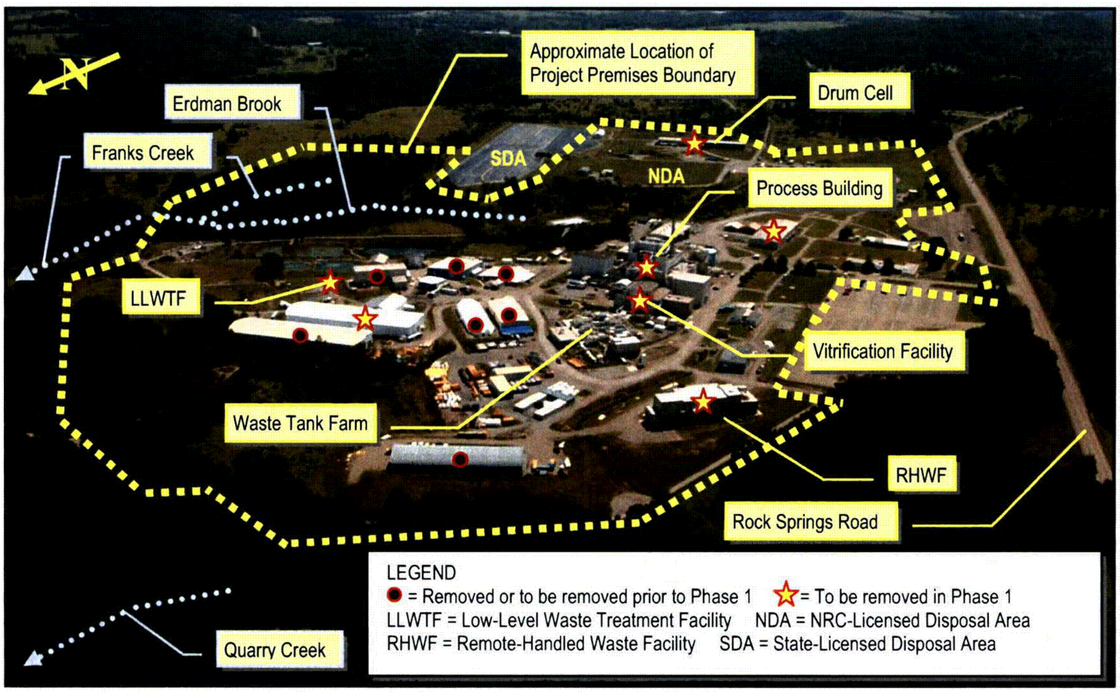

Figure ES-2. The Former Nuclear Fuel Reprocessing Plant and the WVDP in 2006

The Project Premises. At the approximate middle of the Center property lies the former nuclear fuel reprocessing plant operated by Nuclear Fuel Services, Inc. from 1966 through 1972. In 1982, control of a 156.4-acre parcel of land that included this facility and the NRC-Licensed Disposal Area was transferred to DOE for accomplishment of the WVDP[1].

Figure ES-2 shows part of the Center and the project premises as they appeared in 2006. On the right side of the photograph in Figure ES-2, one can see the Vitrification Facility and the Process Building standing just behind the Waste Tank Farm where the

[1] Control of two additional small parcels of land was transferred to DOE in 1986, bringing the total to approximately 167 acres. One parcel is located on the retained premises, which is that portion of the 3,345 acres outside of the initial 156.4 acres for which control but not ownership was transferred to DOE for accomplishment of the WVDP.

underground waste tanks are located. Dotted lines delineate the approximate location of the perimeter of the project premises and the two streams on the project premises.

At the top of Figure ES-2 can be seen the two shallow-land disposal sites for radioactive waste on the Center, the NRC-Licensed Disposal Area and the State-Licensed Disposal Area. The State-Licensed Disposal Area, which is licensed and permitted by the State and controlled by NYSERDA, lies outside of the project premises.

The approximate locations of the courses of the three named streams in the vicinity – Erdman Brook, Franks Creek, and Quarry Creek – are indicated in Figure ES-2. Erdman Brook divides the project premises into two areas known as the north plateau and the south plateau, with the Process Building standing on the north plateau.

When the Phase 1 proposed decommissioning activities begin, the project premises will be in a condition known as the interim end state. The interim end state will be the condition of the project premises at the conclusion of the waste reduction and material removal campaign currently underway. As part of this work, DOE is partially decontaminating certain facilities and removing other unneeded ancillary buildings. Several buildings shown in Figure ES-2 have been removed since the photograph was taken. These and others to be removed in establishing the interim end state are identified in the figure, along with key structures to be removed during Phase 1 of the decommissioning.

Part of the site has been divided into 12 waste management areas for remediation purposes. Nine of the waste management areas are located on the project premises and one (Waste Management Area 12) is partially within the project premises, as shown in Figure ES-3. The facilities of interest are addressed as they fall within a particular waste management area.

Waste Management Area 1, the Process Building and Vitrification Facility Area. The multi-story Process Building structure is approximately 130 feet by 270 feet in area and rises approximately 79 feet above ground at its highest point (not including the main stack). Most of the structure is reinforced concrete. Parts of the building lie as much as 27 feet below ground.

Within the Process Building are a number of shielded cells where disassembly and chemical reprocessing of nuclear fuel took place. Various rooms housed supporting activities. Aisles provided equipment for remote operations in the shielded cells and access to various plant areas.

On the east side of the building stands the Fuel Receiving and Storage Area. This steel-framed, steel-sheathed structure contains two fuel pools. The floor of the deeper pool lies 45 feet below grade at its lowest point.

The Vitrification Facility, which was constructed by the WVDP, is attached to the north side of the Process Building. The Vitrification Facility is a structural steel frame and sheet metal building housing the reinforced concrete Vitrification Cell, operating aisles, and a control room. It is approximately 91 feet wide and 150 feet long with the peak of the roof standing approximately 50 feet high. The pit in the Vitrification Cell extends 14 feet below grade.

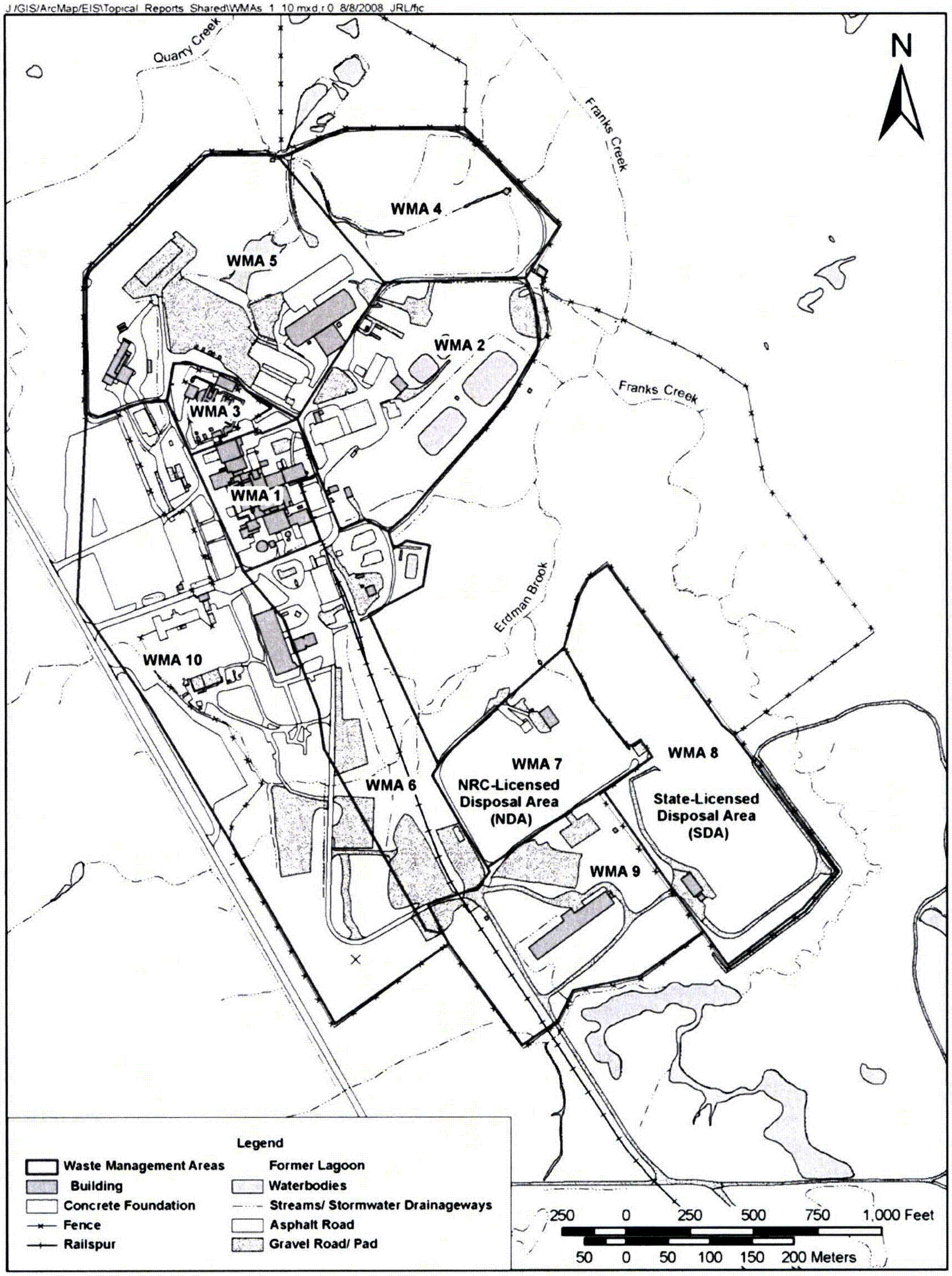

Figure ES-3. Waste Management Areas 1-10. (The State-Licensed Disposal Area is not within the scope of this plan.)

The steel-framed, steel-sheathed Load-In/Load-Out Facility connects to the west side of the Process Building as does the concrete block Plant Office Building. The 60-foot tall concrete and steel frame 01-14 Building stands at the southwest corner of the Process Building.

On the south side is the concrete-block Utility Room, with an addition known as the Utility Room Expansion, and the Laundry, which will be removed before decommissioning begins. The Fire Pump House and a large water storage tank stand south of the Process Building and an electrical substation is located on the east side.

All of the Waste Management Area 1 facilities are within the scope of this plan.

Waste Management Area 2, the Low-Level Waste Treatment Facility. This facility, located east of the Process Building, includes five lagoons used to manage radioactive wastewater, including Lagoon 1, which was removed from service in 1984. It also includes the LLW2 Building that contains liquid waste treatment equipment, two in-ground concrete interceptor tanks, the small underground concrete Neutralization Pit, and underground pipelines connecting these facilities. All of these facilities are within the scope of this plan, along with several concrete slabs, the Maintenance Shop leach field, and the inactive Solvent Dike.

Waste Management Area 3, the Waste Tank Farm Area. Located just north of the Vitrification Facility, this area contains two 750,000-gallon carbon steel underground waste tanks, designated Tanks 8D-1 and 8D-2, and two 15,000-gallon stainless steel underground waste tanks, designated 8D-3 and 8D-4. These tanks are housed in concrete vaults, with Tanks 8D-3 and 8D-4 sharing a common vault. Only Tanks 8D-2 and 8D-4 were used to store HLW during reprocessing operations; Tank 8D-1 was subsequently exposed to HLW during the WVDP. All four tanks will be empty with a tank and vault drying system in operation in the interim end state.

Also in this area are the Supernatant Treatment System Support Building and the Permanent Ventilation System Building, both built by the WVDP, several smaller structures, and the HLW transfer trench that contains piping that was used to transfer waste to the Vitrification Facility.

The following facilities in Waste Management Area 3 are within the scope of this plan: the Equipment Shelter and the associated condensers, the Con-Ed Building, the HLW mobilization and transfer pumps in the underground waste tanks, and the piping and equipment within the HLW transfer trench.

Waste Management Area 4, the Construction and Demolition Debris Landfill Area. This 10 acre area contains the 1.5 acre landfill, which was used to dispose of non-radioactive waste, and is located north of the Low-Level Waste Treatment Facility. No facilities in this area are within the scope of Phase 1 of the decommissioning.

Waste Management Area 5, the Waste Storage Area. This area, which is located west of Waste Management Area 4, will contain two structures when the interim end state is reached, both of which are within the scope of this plan. One is Lag Storage Addition 4, a clear span, steel frame, metal sheathed building with an attached steel frame, metal sheathed shipping depot. The other is the Remote-Handled Waste Facility. This steel sided building contains concrete cells and rooms and is currently being used by the WVDP for processing and packaging high-activity radioactive waste. Several concrete floor slabs and gravel pads in this area are also within plan scope.

Waste Management Area 6, the Central Project Premises. This area is located west of the NRC-Licensed Disposal Area and south of the Process Building. Facilities in this area, all of which are within plan scope, are the Sewage Treatment Plant, the south Waste Tank Farm Test Tower, an equalization basin, a concrete equalization tank, and two demineralizer sludge ponds, along with several asphalt and gravel pads and the concrete Cooling Tower basin.

Waste Management Area 7, the NRC-Licensed Disposal Area. In this area, which is identified in Figures ES-2 and ES-3, lies the 400-foot by 600-foot radioactive waste burial ground, which is no longer used for radioactive waste disposal. Only remaining concrete and gravel pads in this area are within plan scope.

Waste Management Area 8, the State-Licensed Disposal Area. This radioactive waste disposal area covers approximately 15 acres. It is no longer used for radioactive waste disposal and is not within the scope of the Phase 1 proposed decommissioning activities.

Waste Management Area 9, the Radwaste Treatment System Drum Cell Area. This area, which is located on the south plateau, contains one building, the Drum Cell, a former radioactive waste storage area identified in Figure ES-3. The Drum Cell has a concrete block foundation and concrete shield walls and is enclosed by a pre-engineered metal building 375 feet long, 60 feet wide, and 26 feet high. It is within the scope of this plan, as are several asphalt, concrete, and gravel pads.

Waste Management Area 10, the Support and Services Area. The remaining concrete slabs and gravel pads in this area are within the scope of this plan, as is the New Warehouse, which is located south of the Process Building. This area borders Rock Springs Road.

Waste Management Area 11, the Bulk Warehouse and Hydrofracture Test Well Area. This area is located on the retained premises south and east of the project premises. There are no facilities in this area within the scope of this plan.

Waste Management Area 12, the Balance of the Site. Only the small portion of this area within the project premises is within plan scope and that only for characterization of contaminated soil and streambed sediment and possible remediation of surface soil and steambed sediment.

Underground Piping and Equipment. Fifty-seven lines or portions of lines beneath the Process Building carried radioactive liquid, along with other lines near the Process Building and at the Low-Level Waste Treatment Facility. Three underground stainless steel wastewater tanks near the Process Building contain radioactivity. The three wastewater tanks are within the scope of this plan, as are the underground lines within Waste Management Area 1 and some of the underground lines within Waste Management Area 2.

Site Geomorphology. Streams in the area are at a relatively young stage of development and are characterized by steep profiles, vee-shaped cross sections, and little or no flood plains. Erosion within the drainage basin has been dominated by slump block formation along the stream valley walls. Gullies tend to form along the stream banks during thaws and after heavy rain.

Surface Hydrology. The WVDP watershed is drained by Quarry Creek, Franks Creek, and Erdman Brook. Most surface water runoff from the project premises funnels into a single stream channel at the confluence of Franks Creek and Erdman Brook located just inside the perimeter of the project premises east of the lagoons as shown in Figure ES-3.

These waters flow into Buttermilk Creek, which runs through the retained premises east and north of the project premises. Buttermilk Creek enters Cattaraugus Creek at the north end of the Center; Cattaraugus Creek eventually flows into Lake Erie. Figure ES-1 shows both creeks.

Subsurface Conditions. Underlying the north plateau and the south plateau is more than 500 feet of Pleistocene-age glacial tills. From the surface downward, the following layers are encountered:

- The surficial sand and gravel unit – with an average composition of 55 percent gravel, 20 percent sand, and 25 percent clay – with thickness ranging from 41 feet near the Process Building to a few feet near the northern, eastern, and southern margins of the north plateau. This unit is not present on the south plateau.
- The Lavery till – a silty-clay glacial till that contains lenses of sand, silt, and clay-silt laminations, with an average composition of 50 percent clay, 30 percent silt, 10 percent sand, and 10 percent gravel – with thickness ranging from a few feet at its western margin to more than 130 feet near Buttermilk Creek. On the south plateau, the upper three to 16 feet is weathered, with fractures and root tubes, and is known as the weathered Lavery till.
- The Lavery till-sand unit – a lenticular-shaped silty, sandy layer – located on the north plateau immediately south of the Process Building. It is up to 10 feet thick and lies within the upper 20 feet of the unweathered Lavery till.
- The Kent recessional sequence – with both lacustrine and kame delta deposits – underlies the Lavery till on both the north and south plateaus. It is 30 to 60 feet thick in the WVDP area.
- Shale bedrock underlies the Lavery till and other geological units on both the north and south plateaus.

Groundwater Hydrology. The depth of groundwater in the sand and gravel unit on the north plateau ranges from the surface to 16 feet below the surface. The groundwater flows generally northeastward toward Franks Creek. Near the northwestern margin of the sand and gravel until, flow is toward Quarry Creek and, at the southeastern margin, toward Erdman Brook. Groundwater seeps to the surface in places along stream banks and the edges of the north plateau.

The Surrounding Area. The nearest incorporated village is Springville, 3.5 miles to the north of the WVDP. The hamlet of West Valley lies 3.4 miles to the southeast. The communities of Riceville and Ashford Hollow also lie within a five-mile radius of the site. The closest major highway is U.S. Route 219, located 2.6 miles to the west.

Population Distribution. A 2002 demographic survey showed 1,056 people living within a 3.1-mile radius of the WVDP. The nearest residence was 0.76 miles away. The 2000 U.S. census showed 83,955 people living in Cattaraugus County. A 2002 study predicted a decrease in Cattaraugus County population in coming decades, down to 80,996 in 2030.

Summary of Licensed Activities

Provisional Operating License Number CSF-1 was issued on April 19, 1966 by the U.S. Atomic Energy Commission to Nuclear Fuel Services and the New York State Atomic and Space Development Authority to operate a spent fuel reprocessing and radioactive waste disposal facility at the Center. This Part 50 license provided possession limits for nuclear fuel of 21,000 kilograms (about 46,000 pounds) of U-235, 3,200 kilograms (about 7055 pounds) of U-233, and 4,000 kilograms (about 8800 pounds) of plutonium. Possession limits for unirradiated source material were 50,000 pounds of natural uranium, 100,000 pounds of uranium depleted in U-235, and 50,000 pounds of thorium. The license specified typical limits for radioactivity used for standards, measurements, and calibration purposes.

From 1966 to 1972, Nuclear Fuel Services reprocessed under this license more than 600 metric tons (600,000 kilograms or about 1,320,000 pounds) of spent nuclear fuel and generated approximately 600,000 gallons of liquid HLW as a result. The facility shut down in 1972. In 1976, without restarting, Nuclear Fuel Services withdrew from the reprocessing business and returned control of the facilities to NYSERDA, the successor to the New York State Atomic and Space Development Authority. Figure ES-4 shows the plant in the early years.

Figure ES-4. The Plant During the Early Years (The lagoons appear in the foreground. The Process Building can be seen in the background.)

Fuel received for reprocessing came from the N-Reactor at the Atomic Energy Commission's Hanford site and from nine commercial reactors. Reprocessing took place in the Process Building.

The first step in reprocessing entailed disassembling and sectioning the fuel. The pieces of fuel were dissolved in concentrated nitric acid. The resulting aqueous stream underwent a five-stage solvent extraction process. After further purification, the uranium and plutonium product solutions were concentrated, packaged, and eventually shipped off site. The process utilized is known as the PUREX process for plutonium uranium refining by extraction.

Aqueous waste generated was reduced in volume by evaporation, neutralized, and stored in 750,000-gallon Tank 8D-2. The neutralization process caused most fission products (not including cesium) to precipitate out and form sludge on the tank bottom. The remaining radionuclides were retained in the supernatant liquid.

Fuel received included thorium-enriched uranium, which was reprocessed using the THOREX (thorium reduction extraction) process. The resulting 12,000 gallons of liquid HLW, which was not neutralized to avoid precipitating out the thorium, was stored in 15,000-gallon Tank 8D-4.

The amounts of radioactivity in Tanks 8D-2 and 8D-4 at the completion of reprocessing, with fission and activation products decay-corrected to July 1987, were:

- Tank 8D-2 supernatant – approximately 14,000,000 curies, primarily from Cs-137, and Ba-137m;
- Tank 8D-2 sludge – approximately 15,000,000 curies, primarily from Sr-90 and Y-90; and
- Tank 8D-4 – approximately 2,000,000 curies, primarily from Sr-90, Y-90, Cs-137, and Ba-137m.

During initial plant operations, low-level wastewater was piped underground to an interceptor tank and then held in the lagoon system before being discharged into Erdman Brook. In 1971, a new Low-Level Waste Treatment Facility (the O2 Building) entered service. Since that time, wastewater has been treated prior to discharge from the lagoon system, which can be seen in Figure ES-4.

During the 1970s when the plant was shut down, Nuclear Fuel Services decontaminated many of the Process Building cells and flushed many of the systems. On February 18, 1982, the facility was formally transferred to DOE for performance of the WVDP.

During plant operations, 30 amendments were made to License CSF-1, most related to technical specifications. License amendment 31 was issued in September 1981 to transfer the project premises to DOE in accordance with the WVDP Act. Amendment 32 was issued in February 1982 to terminate the responsibility and authority of Nuclear Fuel Services. No further amendments have been made, with the license technical specifications effectively being held in abeyance until completion of the WVDP.

Summary of WVDP Activities

To solidify the HLW, DOE built the Integrated Radwaste Treatment System and the Vitrification Facility.

The Integrated Radwaste Treatment System included (1) the Supernatant Treatment System that decontaminated HLW tank solutions by ion exchange, (2) the Liquid Waste Treatment System to concentrate waste by evaporation, (3) the Cement Solidification System to solidify concentrates, and (4) the Drum Cell to store solidified waste. By 1995, the Integrated Radwaste Treatment System had produced 19,877 71-gallon drums of solidified waste, which were stored in the Drum Cell. These drums were later shipped offsite for disposal.

Tanks 8D-1 and 8D-2 were modified and used to support the solidification process. Supernatant Treatment System ion exchange columns were installed inside Tank 8D-1.

The Vitrification Facility was used to stabilize HLW sludge, loaded ion exchange resin (zeolite), and acidic THOREX waste from Tank 8D-4 in a borosilicate glass contained in stainless steel canisters. A number of modifications were made to the former reprocessing facilities to accommodate the vitrification system and the related systems. Among these changes were removing equipment from the Chemical Process Cell, decontaminating it, and installing storage racks for the HLW canisters.

Solidification of the HLW was completed in September 2002. A total of 275 canisters of vitrified HLW were produced and placed in interim storage in the former Chemical Process Cell, now known as the HLW Interim Storage Facility. DOE has deactivated portions of the Process Building and several other site facilities. In 2008, deactivation work, which includes removal of unneeded ancillary facilities, remained underway. Additional deactivation work to be completed before activities under this plan begin will result in conditions known as the interim end state.

Nature and Extent of Contamination at the Site

Due to the nature of reprocessing operations, contamination of the site is extensive. Radionuclides include the fission products Sr-90 and Cs-137, along with uranium radionuclides and actinides such as Pu-238, Pu-239, Pu-241, and Am-241. Substantial contamination levels exist in many of the cells and rooms of the Process Building and some contamination is present inside other facilities. Subsurface soil and groundwater contamination is widespread. Figure ES-5 shows keys areas of interest that are discussed below. This figure identifies major sources to be removed during Phase 1 of the decommissioning and others to be considered in Phase 2.

Figure ES-5 shows the two major areas of environmental contamination at the site: the cesium prong and the north plateau groundwater plume. The cesium prong is a large area northwest of the Process Building where surface soil became contaminated with Cs-137 when a ventilation system filter in the Process Building failed in 1968[2]. The north plateau groundwater plume originated that same year when releases of radioactive acid leaked into soil under the southwest corner of the Process Building. Since that time, mobile radionuclides such as Sr-90 have gradually migrated more than 40 feet under the building and approximately one-quarter mile northeast of the building.

[2] Note that the cesium prong area delineated on the figure provides only an approximation of the region of surface soil impacted by the ventilation system filter failure. Data to determine the extent of the resulting soil contamination on the project premises are not available. Such data would be collected early in Phase 1 of the decommissioning to establish the extent of residual surface and near surface soil contamination in the impacted area within the project premises.

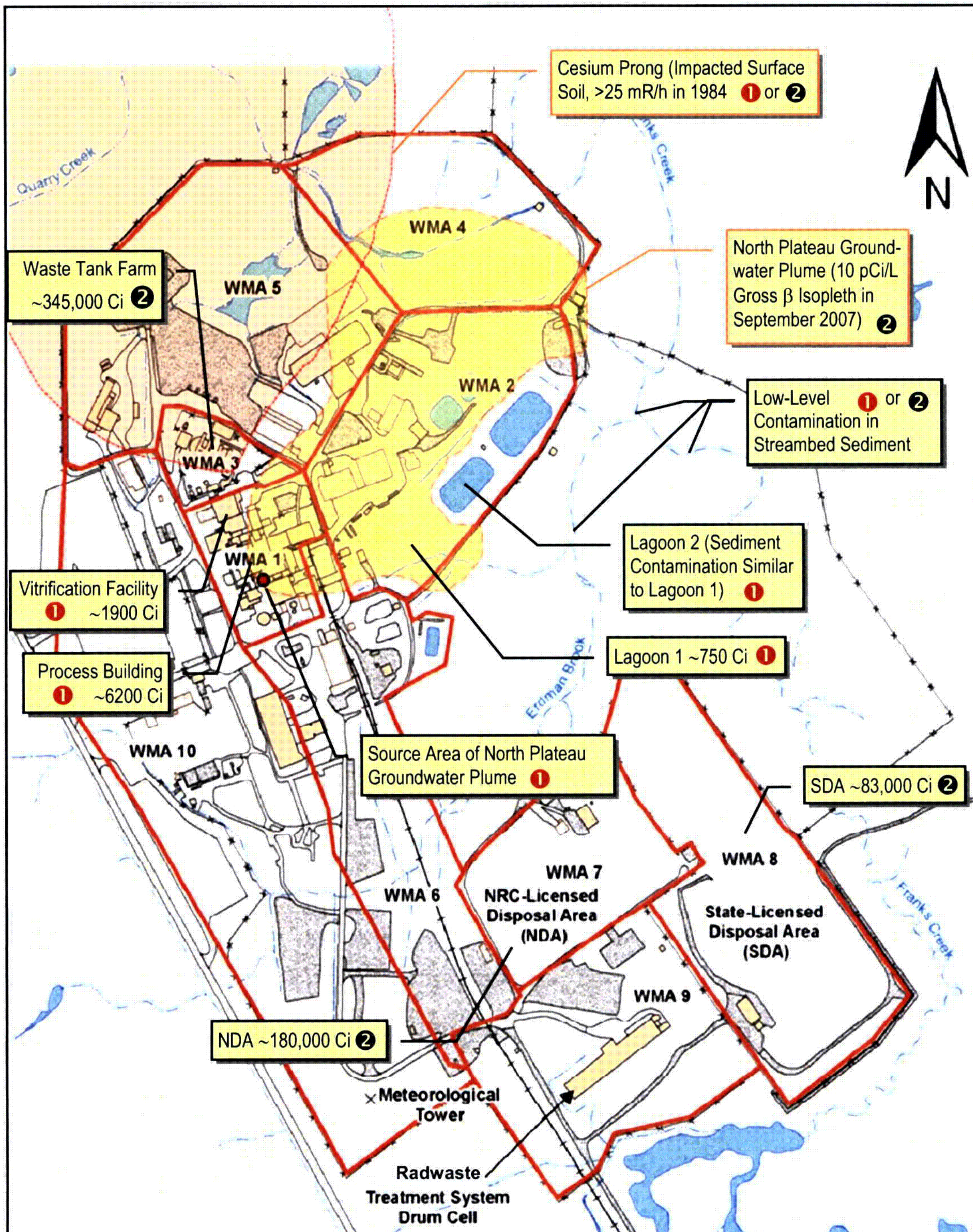

Figure ES-5. Important Sources of Contamination on the Project Premises (The ❶ symbol denotes major sources to be removed during Phase 1 of the proposed decommissioning while the ❷ symbol denotes major sources to be considered in Phase 2. The estimates for total residual radioactivity are for 2011.)

The following summary of radioactive contamination addresses the more significant contaminated facilities and areas and is organized by waste management area. DOE would perform additional characterization in connection with the Phase 1 proposed decommissioning activities. The estimates of residual radioactivity are as of 2011, when proposed Phase 1 is anticipated to start.

Waste Management Area 1, Process Building and Vitrification Facility Area.

- The total residual radioactivity in the Process Building is expected to be approximately 6200 curies, with Cs-137, Sr-90, and Pu-241 being the predominant radionuclides.[3]
- The total residual radioactivity in the Vitrification Facility is expected to be approximately 1900 curies, with Cs-137 and Sr-90 being the predominant radionuclides.
- The total residual radioactivity inside the vitrification off-gas line that runs within a concrete trench from the Vitrification Facility to the 01-14 Building is expected to be approximately 340 curies.
- Underground wastewater Tank 7D-13 is expected to contain up to 84 curies of residual radioactivity.
- Some of the underground lines in the area are expected to contain significant residual radioactivity, with one HLW transfer line expected to contain approximately 0.4 curies per linear foot.
- The subsurface soil and groundwater under the Process Building is expected to contain significant levels of residual contamination, from one or more releases of radioactivity that occurred during reprocessing that resulted in the impacted area known as the north plateau groundwater plume.

Waste Management Area 2, Low-Level Waste Treatment Facility

- Lagoon 1, which has been deactivated, is expected to contain approximately 750 curies, predominately Cs-137 and Pu-241, with most of this amount associated with sediment.
- The sediment in Lagoon 2, some of which was pumped from Lagoon 1 in 1984, is expected to contain a similar amount of residual radioactivity.
- The other three lagoons are known to contain residual radioactivity in their sediment, with concentrations much lower than concentrations in Lagoons 1 and 2.
- The water in all four active lagoons is expected to contain low levels of radioactivity, with the highest concentrations in Lagoon 2.
- The interceptors and the Neutralization Pit are expected to contain low levels of contamination, with the highest levels in the Old Interceptor.

[3] This estimate does not include radioactivity in the 275 vitrified HLW canisters temporarily stored inside the building, which are estimated to contain an average of approximately 30,000 curies each in 2011.

- Subsurface soil and groundwater in much of this waste management area has been impacted by Sr-90 associated with the north plateau groundwater plume.
- Surface soil near the interceptors contains low levels of contamination, particularly Cs-137.

Waste Management Area 3, the Waste Tank Farm Area

- The four underground waste tanks together will be empty of liquid and are expected to contain approximately 345,000 curies of residual radioactivity.
- The waste mobilization and transfer pumps, which would be removed during proposed Phase 1, are expected to contain significant amounts of residual radioactivity, with gamma radiation levels around 50 R/h.
- Some of the piping and equipment in the HLW transfer trench, which also would be removed during Phase 1, is also expected to be highly radioactive.
- The Con-Ed Building and the Equipment Shelter and condensers, which would be removed during Phase 1, are expected to contain low levels of residual radioactivity, mostly inside equipment.

Waste Management Area 4, Construction and Demolition Debris Landfill Area

- Although the buried waste in the landfill was not radioactive when it was emplaced, some of it is now expected to be contaminated with low levels of Sr-90 from the north plateau groundwater plume.
- Low levels of radioactivity are present in sediment in drainage ditches and in surface soil in this area.

Waste Management Area 5, Waste Storage Area

- The Remote-Handled Waste Facility is expected to have low levels of residual radioactivity.
- The other remaining facility – Lag Storage Addition 4 and the attached Shipping Depot – is expected to have little if any contamination above detection limits.
- Low-level contamination, especially Cs-137 associated with the cesium prong, is expected in surface soil in much of the area.
- Subsurface soil and groundwater in the eastern side of the area is known to have been impacted by the north plateau groundwater plume.

Waste Management Area 6, Central Project Premises. The soil in the two demineralizer sludge ponds is expected to contain low levels of radioactive contamination, as is the Cooling Tower basin, the remaining part of the Cooling Tower that is being removed in establishing the interim end state.

Waste Management Area 7, the NRC-Licensed Disposal Area. The buried radioactive waste in this inactive waste disposal facility is expected to contain approximately 180,000 curies.

Waste Management Area 8, the State-Licensed Disposal Area. The buried radioactive waste in this inactive waste disposal facility is expected to contain approximately 83,000 curies. The State-Licensed Disposal Area is not within the scope of this plan, as noted previously.

Waste Management Area 9, the Radwaste Treatment System Drum Cell Area. The Drum Cell is expected to have little if any radioactive contamination above detection limits.

Waste Management Area 10, the Support and Services Area. No facilities in this area are expected to have been impacted by radioactivity.

Waste Management Area 12, Balance of the Site. Only the small part of this waste management area within the project premises security fence is within the scope of this plan. The sediment in Erdman Brook and the portion of Franks Creek within the fenced area is expected to contain low levels of contamination, especially Cs-137.

The Decommissioning Objective

The objective of Phase 1 of the proposed decommissioning is to remove certain facilities and remediate portions of the project premises to criteria for unrestricted release in the License Termination Rule in 10 CFR 20.1402, thereby fulfilling part of DOE's responsibilities under the WVDP Act for decontaminating and decommissioning the tanks, facilities, materials, and hardware used in the WVDP in accordance with requirements prescribed by the NRC. The Phase 1 proposed decommissioning activities are intended to reduce short-term and long-term health and safety risks in a manner that would support any approach that could be selected for Phase 2 of the decommissioning, which would complete decontamination and decommissioning of the Center.

The objective of the Phase 1 proposed decommissioning is not license termination of any portion of the Center, which would be beyond DOE's purview since NYSERDA is the NRC licensee. However, the Phase 1 proposed decommissioning activtivies are designed to support license termination for remediated portions of the project premises if license termination for all or part of the Center were to become an objective for Phase 2 of the decommissioning.

Decommissioning Controls

The proposed decommissioning would be accomplished by a contractor employed by DOE. DOE would provide appropriate oversight. The decommissioning organization would be structured to ensure that certain functions – radiological controls, health and safety, and quality assurance – are independent of the organizational elements performing the work.

The decommissioning would be accomplished in accordance with applicable DOE and NRC requirements, and in accordance with applicable requirements of other federal agencies and the State of New York. However, given DOE's authority under the WVDP Act and, and considering that the Department is not the NRC licensee for the site, certain aspects of the proposed decommissioning would be controlled in accordance with DOE procedures, i.e., DOE regulations, directives, and technical standards. These aspects are:

- Project management and organization,
- Radiological safety controls and monitoring of workers,

- Environmental monitoring and control, and
- Radioactive waste management.

DCGLs and Cleanup Goals

To support Phase 1 proposed decommissioning activities and later decisions for Phase 2 of the decommissioning, derived concentration guideline levels (DCGLs) were developed for surface soil, subsurface soil, and streambed sediment using the RESRAD RESidual RADioactivity computer Code, Version 6.4. Table ES-1 provides the calculated DCGLs for 18 radionuclides of interest for surface soil, subsurface soil, and streambed sediment. These DCGLs assure that the dose to the average member of the critical group would be 25 millirem per year when considering the dose contribution from each radionuclide individually.[4]

Table ES-1. $DCGL_W$ Values For 25 Millirem per Year (pCi/g)[(1)]

Nuclide	Surface Soil	Subsurface Soil	Streambed Sediment
Am-241	5.4E+01	6.4E+03	1.6E+04
C-14	3.5E+01	4.3E+05	3.4E+03
Cm-243	4.7E+01	1.1E+03	3.6E+03
Cm-244	1.0E+02	2.0E+04	4.7E+04
Cs-137[(2)]	2.9E+01	4.4E+02	1.3E+03
I-129	6.5E-01	4.2E+02	3.7E+03
Np-237	1.1E-01	3.7E+01	5.4E+02
Pu-238	6.4E+01	1.2E+04	2.0E+04
Pu-239	5.8E+01	1.1E+04	1.8E+04
Pu-240	5.8E+01	1.1E+04	1.8E+04
Pu-241	1.8E+03	2.2E+05	5.2E+05
Sr-90[(2)]	9.7E+00	3.1E+03	9.5E+03
Tc-99	3.2E+01	1.1E+04	2.2E+06
U-232	6.3E+00	1.2E+02	2.7E+02
U-233	2.2E+01	1.7E+03	5.8E+04
U-234	2.3E+01	1.7E+03	6.1E+04
U-235	1.5E+01	9.5E+02	2.9E+03
U-238	2.4E+01	1.8E+03	1.3E+04

NOTES: (1) The $DCGL_W$ is the DCGL applicable to the average concentration over a survey unit.
(2) DCGLs for Sr-90 and Cs-137 apply to the year 2041 and later.

Phase 1 proposed decommissioning activities would involve removal of subsurface soil in the bottom and sides of the large excavation for removal of the Waste Management Area 1 facilities and the large excavation in Waste Management Area 2 for removal of Lagoon 1, Lagoon 2,

[4] The DCGLs for Sr-90 and Cs-137 apply to the year 2041 and later, that is, they incorporate a 30-year decay period from 2011. The 30-year decay period was selected for these key radionuclides because of their short half-life. License termination actions that may take place in Phase 2 of the decommissioning would not likely be fully implemented before 2041.

Lagoon 3, the interceptors, and the Neutralization Pit. Phase 1 proposed decommissioning activities may include remediation of surface soil and streambed sediment depending on best management practices and available funding.

The DCGLs in Table ES-1 were developed considering the separate areas of interest and the critical group for exposure to radioactivity in surface soil and subsurface soil is different from the critical group for exposure to radioactivity in streambed sediment. In consideration of this situation, and because only limited portions of the project premises would be remediated during Phase 1 of the proposed decommissioning, two assessments were performed that involved apportioning doses from different portions of the remediated project premises to ensure that DCGLs used for remediation in Phase 1 of the proposed decommissioning would not limit Phase 2 options.

Considering the results of these assessments, and the results of the ALARA analysis discussed below, DOE has established the following cleanup goals, which are lower than the DCGLs, to ensure that remediation accomplished during Phase 1 of the proposed decommissioning would support any approach that might be used during Phase 2 of the decommissioning.

Table ES-2. Cleanup Goals to be Used in Remediation in pCi/g(1)

Nuclide	Surface Soil	Subsurface Soil	Streambed Sediment
Am-241	4.9E+01	2.9E+03	1.6E+03
C-14	3.1E+01	1.9E+05	3.4E+02
Cm-243	4.2E+01	5.1E+02	3.6E+02
Cm-244	9.4E+01	8.8E+03	4.7E+03
Cs-137(2)	2.7E+01	2.0E+02	1.3E+02
I-129	5.8E-01	1.9E+02	3.7E+02
Np-237	9.6E-02	1.7E+01	5.4E+01
Pu-238	5.8E+01	5.5E+03	2.0E+03
Pu-239	5.2E+01	5.0E+03	1.8E+03
Pu-240	5.2E+01	5.0E+03	1.8E+03
Pu-241	1.6E+03	9.8E+04	5.2E+04
Sr-90(2)	8.7E+00	1.4E+03	9.5E+02
Tc-99	2.9E+01	5.0E+03	2.2E+05
U-232	5.6E+00	5.3E+01	2.7E+01
U-233	2.0E+01	7.5E+02	5.8E+03
U-234	2.1E+01	7.7E+02	6.1E+03
U-235	1.4E+01	4.3E+02	2.9E+02
U-238	2.2E+01	8.2E+02	1.3E+03

NOTES: (1) These cleanup goals, which, like the $DCGL_W$ values in Table ES-1, apply to the average concentration over a survey unit, are to be used as the criteria for the Phase 1 remediation activities.

(2) Cleanup goals for Sr-90 and Cs-137 apply to the year 2041 and later. That is, they incorporate a 30-year decay period from 2011. The 30-year decay period was selected for these key radionuclides because of their short half-life. License termination actions that may take place in Phase 2 of the decommissioning would not likely be fully implemented before 2041.

Since these cleanup goals were developed for individual radionuclides of interest, a sum-of-fractions approach based on radionuclide distributions in different areas would be used to ensure that potential doses from the remediated areas would be no more that the dose from one of the individual radionuclides at the concentration specified in Table ES-2.

Although the subsurface soil cleanup goals in Table ES-2 form the criteria for residual radioactivity in the two large excavations, remediation plans involve excavation at least one foot into the Lavery till and, in Waste Management Area 2, at least one foot below the sediment in the bottoms of Lagoons 2 and 3. This approach is expected to produce residual radioactivity levels well below the cleanup goals, based on limited existing data on residual radioactive contamination in the Lavery till. A preliminary, order-of-magnitude dose analysis using these data suggests that potential futures doses from these excavated areas would be approximately one millirem per year for Waste Management Area 1 and approximately 0.1 millirem per year for Waste Management Area 2.

After additional characterization data become available early in Phase 1 of the decommissioning, the DCGLs and the cleanup goals would be reevaluated using these data and refined as appropriate. After the Phase 1 decommissioning activities have been completed, another dose analysis using Phase 1 final status survey data would be performed to estimate the potential doses from the remediated subsurface areas.

Summary of ALARA Evaluations

DOE has performed a preliminary cost-benefit analysis using NRC methodology to determine whether removal of soil or sediment with radioactivity concentrations below the DCGLs would be consistent with the ALARA principal. These analyses compared the cost of disposal of additional soil or sediment with the reduction in radiation exposure associated with removal of additional soil or sediment below the DCGLs valued at $2000 per person-rem as set forth in NRC guidance. They indicate that removal of soil or sediment with radioactivity concentrations below the DCGLs would not be cost-effective.

DOE would perform another similar analysis when the subsurface soil remediation work is in progress (and when surface soil and streambed sediment remediation is in progress, if that work is done in Phase 1) to confirm the results of the preliminary ALARA evaluation. This second, more-detailed analysis would use updated information and consider other factors such as other societal and socioeconomic considerations and costs related to transportation of additional waste.

Initiation and Completion Dates

Subject to the decision in the Record of Decision for the Decommissioning EIS, expected in 2009, and upon NRC approval of this plan, DOE would begin Phase 1 of the proposed decommissioning in 2011 and it would last until 2018.

Post-Remediation Activities

The proposed post remediation activities fall into two categories: (1) a monitoring and maintenance program and (2) an institutional control program, both of which focus on the project premises.

The monitoring and maintenance program would continue until Phase 2 of the decommissioning starts, when it would be reevaluated. It would include an environmental monitoring program tailored to conditions that would exist at the conclusion of the Phase 1 decommissioning activities. This program would monitor onsite groundwater, storm water, and air, along with onsite and offsite surface water, sediment, and radiation. Groundwater monitoring would be accomplished using approximately 36 monitoring wells.

The monitoring and maintenance program would also ensure that important facilities and systems serve their intended purposes during the period between the completion of Phase 1 of the decommissioning and the start of Phase 2. Facilities and systems within the scope of this program include:

- The subsurface hydraulic barrier wall and French drain to be installed during Phase 1 on the north and east sides of the excavation for removal of the Waste Management Area 1 facilities,
- The subsurface hydraulic barrier wall to be installed during Phase 1 on the northwest and northeast sides of the excavation for removal of key Waste Management Area 2 facilities,
- The tank and vault drying system for the underground waste tanks that is to be installed before Phase 1 of the decommissioning,
- The dewatering well used to minimize in-leakage into the underground waste tank vaults,
- The hydraulic barrier wall and geomembrane cover for the NRC-Licensed Disposal Area, and
- The security features and monitoring systems installed for the new Canister Interim Storage Facility to be established on the south plateau.

Performance of the hydraulic barrier walls would be assessed with hydraulic monitoring piezometers.

Insofar as institutional controls are concerned, DOE would continue control of the project premises during the Phase 1 decommissioning activities and the period between completion of these activities and the start of Phase 2 of the decommissioning. Institutional controls would include security fences and signs along the perimeter of the project premises, a full-time security force, provisions for controlled access through designated gateways, and appropriate security measures for the new Canister Interim Storage Facility on the south plateau, which would be established during Phase 1 of the decommissioning.

1.0 INTRODUCTION

PURPOSE OF THIS SECTION

The purpose of this section is to provide introductory information to help readers understand this plan, which is particularly complex for several reasons.

INFORMATION IN THIS SECTION

This section explains the purpose of this plan and describes its scope. It briefly summarizes the background related to the decommissioning.

It then discusses the two environmental impact statements that pertain to the decommissioning, along with the decommissioning criteria. It briefly describes four programs pertaining to the decommissioning that would be carried out in accordance with Department of Energy directives and technical standards: (1) project management and organization, (2) the health and safety program, (3) the environmental monitoring and control program, and (4) the radioactive waste management program.

It describes the interim end state for the site that would be reached at the conclusion of deactivation work scheduled to end in 2011, which would form the starting conditions for the Phase 1 decommissioning work. It then briefly summarizes the Phase 1 decommissioning work.

Finally, this introduction briefly describes the responsibilities of the organizations involved, explains how the plan is organized, and describes the process to be used to control changes to the plan after initial approval by the Nuclear Regulatory Commission.

RELATIONSHIP TO OTHER PLAN SECTIONS

The information in this section establishes the context for the other parts of this plan.

1.1 Purpose

This plan is being issued by the U.S. Department of Energy (DOE) to fulfill part of its statutory obligations under Public Law 96-368, the West Valley Demonstration Project (WVDP) Act of 1980, which holds DOE responsible for decontamination and decommissioning of facilities used in solidification of high-level radioactive waste (HLW) and material and hardware used in connection with this project.[1]

[1] The WVDP Act states that "The Secretary [of Energy] shall decontaminate and decommission (A) the tanks and other facilities of the Center in which the high level waste solidified under the project was stored, (B) the facilities used in the solidification of the waste, and (C) any material and hardware used in connection with the project, in accordance with such requirements that the [Nuclear Regulatory] Commission may prescribe."

The proposed decommissioning is being accomplished in two phases following a "phased decision-making" approach. This plan addresses proposed Phase 1, describing:

(1) The activities that would take place during this phase of the decommissioning;

(2) The site conditions that would exist at the conclusion of Phase 1; and

(3) The methods that would be used to organize and manage the project, to protect the health and safety of workers and the public, to protect the environment, and to ensure quality in the decommissioning work.

Phase 2 of the proposed decommissioning would be accomplished using an approach determined after completion of additional studies and evaluations to be the most appropriate.

This plan also provides information to the U.S. Nuclear Regulatory Commission (NRC) on the first of the two proposed phases of the WVDP decommissioning, consistent with the related 1981 Memorandum of Understanding between DOE and NRC (DOE and NRC 1981), which calls for DOE to submit a decommissioning plan to NRC for review. On February 3, 2003, NRC specifically requested that DOE submit a decommissioning plan for the WVDP portion of the site (NRC 2003a). DOE agreed to do so in its response of February 28, 2003 (DOE 2003a).

1.2 Scope

Under the provisions of the WVDP Act, DOE exercises control over a portion of the Western New York Nuclear Service Center (the Center) for the purpose of carrying out the WVDP. The Center is owned by the New York State Energy Research and Development Authority (NYSERDA), who is the NRC licensee.

The area controlled by DOE comprises approximately 168 acres, lies in the approximate middle of the Center, and contains the facilities used by Nuclear Fuel Services, Inc. (NFS) from 1966 through 1972 to reprocess spent nuclear fuel. This area is known as the project premises.

A small stream divides the project premises into two regions known as the north plateau and the south plateau. The facilities used by NFS are located on the north plateau, with the exception of two shallow land radioactive waste disposal facilities known as the NRC-Licensed Disposal Area (NDA) and the State-Licensed Disposal Area (SDA)[2], which are located on the south plateau.

The facilities of interest in Phase 1 of the proposed decommissioning are located on the north plateau, with one exception: the WVDP Radwaste Treatment System Drum Cell on the south plateau, which was used for radioactive waste storage. Phase 1 of the proposed WVDP decommissioning would entail removal of the Radwaste Treatment System Drum Cell and all of the north plateau facilities with the exceptions of the Waste Tank Farm with its four

[2] The SDA, which is not part of the project premises, is managed by NYSERDA, licensed by the New York State Department of Health, and permitted by the New York State Department of Environmental Conservation (NYSDEC).

underground waste storage tanks, the waste tank farm supporting facilities, and the Construction and Demolition Debris Landfill.

Phase 1 activities include remediation of the "source area" portion of the impacted area known as the north plateau groundwater plume, where groundwater and subsurface soil is contaminated with radioactivity from spent fuel reprocessing. The source area lies underneath the Main Plant Process Building. The non-source area of the plume, which is downgradient of the building, would be considered during Phase 2 of the proposed decommissioning.

Phase 1 includes removal of impacted soil in excavations dug to remove the facilities in the Process Building and Vitrification area and in a portion of the Low-Level Waste Treatment Facility area. Phase 1 also includes characterization of soil and stream sediment within the project premises, especially in the Phase 1 areas.[3]

Phase 2, which this plan does not address, would complete the proposed decommissioning for the Waste Tank Farm, the Construction and Demolition Debris Landfill area, the NDA, and the non-source area of the north plateau groundwater plume, following an approach determined later through additional studies and evaluations to be the most appropriate, as noted previously. These studies and evaluations are beyond the scope of this plan, except for the soil and sediment characterization within the project premises to be accomplished early in Phase 1, which is discussed in Section 1.10.2.

The Phase 1 activities are designed to be conservative with respect to the extent of remediation in the areas of interest to avoid prejudicing the decision on the Phase 2 approach. More information on the facilities within the scope of this Phase 1 plan appears in Section 1.10.2.

While this plan provides for removal of certain radioactive facilities and remediation of surface and subsurface soil on portions of the project premises, it does not address license termination of any portion of the site. Licensing matters are not within DOE's purview since DOE is neither the licensee nor the property owner. However, the work accomplished under this plan would result in data that can potentially be used by NYSERDA in support of license termination for portions of the Center.

This plan focuses primarily on radioactivity. Hazardous and toxic materials are addressed in some instances and activities specified in this plan would be in compliance with the Resource Conservation and Recovery Act. However, closure of facilities under the provisions of the Resource Conservation and Recovery Act is being addressed separately in coordination with appropriate state and federal agencies and is not within the scope of this plan.

[3] The project premises is the portion of the site controlled by DOE as shown in Figure 1-1. The Phase 1 areas are those within the scope of this plan. The Phase 2 areas are the Waste Tank Farm area, the Construction and Demolition Debris Landfill, the non-source area of the north plateau groundwater plume, and the NDA. Although the Waste Tank Farm area is considered to be a Phase 2 area, limited work would be performed in this area during Phase 1, as discussed below. Characterization of soil and sediment in the Phase 2 source areas would be limited and would not include the NDA.

The approach described in this plan represents DOE's preferred alternative among those alternatives evaluated in the *Environmental Impact Statement on Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*, hereafter referred to as the Decommissioning EIS.[4] Under this alternative, the decommissioning would be performed in two phases, as indicated above.

The organization and content of this plan are based on NRC guidance in Volume 1 of NUREG-1757, *Consolidated Decommissioning Guidance, Decommissioning Process for Materials Licensees* (NRC 2006) and agreements made between NRC and DOE on the applicability of this guidance to the Phase 1 plan (NRC 2008). This plan would be supplemented by more detailed plans for demolition of major facilities that would be completed prior to the start of the decommissioning.

The Unique Nature of the Phase 1 Decommissioning

Among the atypical elements of this decommissioning are (1) the radiological complexity of the site; (2) the project being carried out under the WVDP Act; (3) the project being carried out by a department of the federal government when the property is owned by a New York State Agency that is the NRC licensee; and (4) the purpose of the Phase 1 decommissioning work being limited to removing certain facilities and remediating impacted soil in certain areas, rather than terminating the NRC license.

1.3 Background

Situated approximately 30 miles south of Buffalo on 3,345 acres of property owned by the State of New York, the Center is the location of the only NRC-licensed commercial spent nuclear fuel reprocessing facility to operate in the United States. NFS reprocessed irradiated nuclear fuel to recover uranium and plutonium until 1972. Figure 1-1 shows a portion of the Center and the WVDP as they appeared in 2006.

The reprocessing operations produced approximately 600,000 gallons of HLW, which were stored in two underground waste tanks. These operations were conducted under License CSF-1, which was issued by the U.S. Atomic Energy Commission in 1966. After NFS withdrew from the reprocessing business in 1976, NYSERDA became the sole licensee.

Reprocessing work resulted in extensive radioactive contamination of site facilities, especially the Main Plant Process Building where the chemical processes that separated uranium and plutonium from fission products in the spent fuel were carried out. The Low-

[4] When this plan was completed, the Decommissioning EIS existed in the form of the *Revised Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*. If changes are made to the Decommissioning EIS during the course of the National Environmental Policy Act process that affect this plan, such as changes to the preferred alternative, this plan would be revised as necessary to reflect those changes.

Level Waste Treatment Facility – which included five lagoons – also became contaminated with licensed radioactivity.

Environmental contamination also resulted from site operations. The contaminated areas of most significance are known today as the north plateau groundwater plume and the cesium prong. The approximate lateral extent of both impacted areas is shown in Figure 1-1.[5]

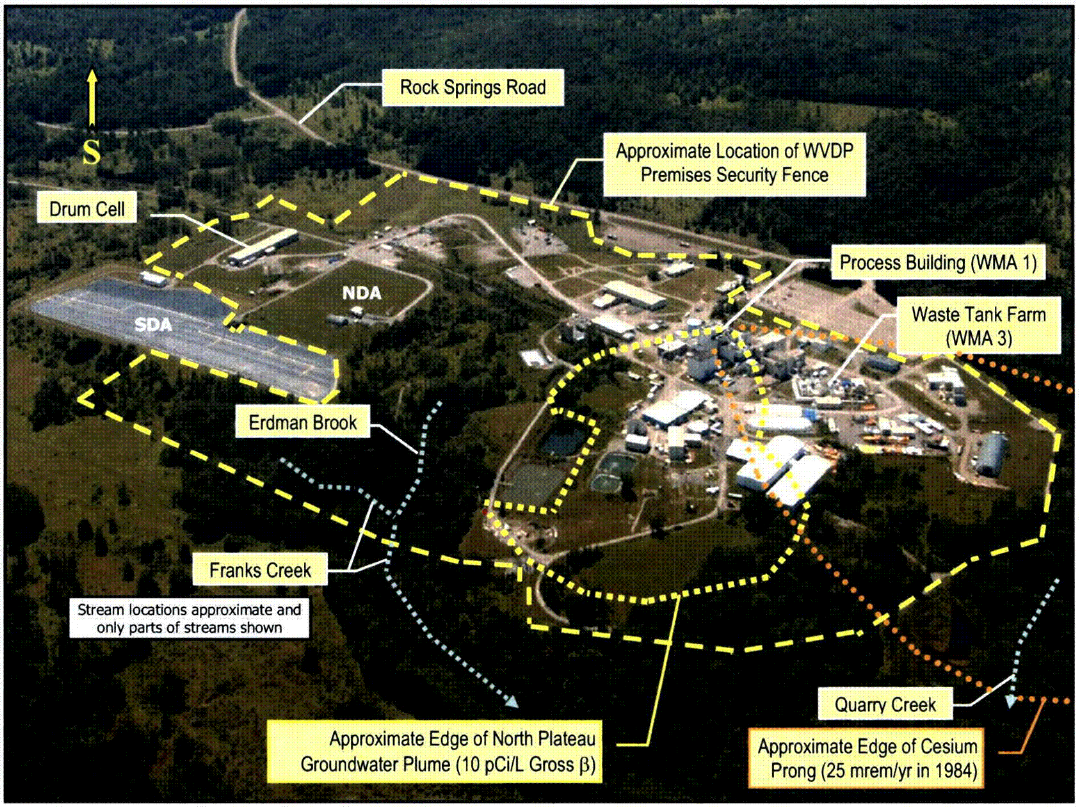

Figure 1-1. The Former Nuclear Fuel Reprocessing Plant and the WVDP in 2006

The north plateau groundwater plume impacts a subsurface area of more than 15 acres under and northeast of the Process Building. This contamination resulted from a leak of nitric acid solution containing licensed radioactive material that occurred during fuel reprocessing. Groundwater movement has carried mobile radionuclides such as strontium 90 approximately one-quarter mile northeast of the Process Building. Contamination beneath the Process Building is known to extend at least 40 feet below the ground.

[5] Note that the cesium prong area delineated on the figure provides only an approximation of the region of surface soil impacted by the ventilation system filter failure. Data to determine the extent of the resulting soil contamination on the project premises are not available. Such data would be collected early in Phase 1 of the decommissioning to establish the extent of residual surface and near surface soil contamination in the impacted area within the project premises.

The cesium prong, an impacted area that extends northwest of the Process Building, resulted from a 1968 ventilation system accident. A series of investigations that included aerial monitoring surveys has shown that cesium 137 released from the Process Building main stack contaminated surface soil in the northwest part of the Center and offsite.

Streams in the vicinity of the project premises were also impacted with radioactivity from regulated discharges of treated wastewater, surface water runoff, and contaminated groundwater that seeps to the surface at several points on the project premises.

There are also other places on the Center where environmental media have been impacted by unplanned releases of radioactivity. These include low levels of contamination in a drainage channel near a sewage outfall that resulted from a 1974 underground sewer line failure and low levels of contamination in drainage ditches resulting from a 1985 spill of radioactive condensate in the area of the underground waste tanks. Low levels of radioactive contamination have also been identified in surface and subsurface soil in other areas.

In 1980, Congress enacted the WVDP Act to establish the WVDP as a research and development project to demonstrate solidification techniques for HLW. The WVDP Act assigned the primary responsibility for the project to DOE, although it did not authorize the federal government to acquire title to the HLW.[6] Since 1981, portions of NYSERDA's NRC Part 50 license for the Center, including the technical specifications, have been effectively suspended by NRC to facilitate execution of the provisions of the WVDP Act.

In 2002, DOE completed solidification of the HLW using a vitrification process. The solidified HLW is contained within 275 stainless steel canisters that are presently stored in the Process Building. This material would have to remain on site until it can be transported to a federal geologic repository, which is one factor in DOE's decision to pursue a two-phase decommissioning approach.

DOE in recent years has been partially decontaminating portions of the Process Building and other facilities and removing unneeded ancillary facilities in preparation for the WVDP decommissioning. This effort is expected to culminate in 2011, achieving site conditions known as the interim end state, which are described in Section 1.10.1.

The amounts of residual radioactivity at the site are now substantially less than when the facility was shutdown in 1972 owing to radioactive decay and NFS and WVDP decontamination efforts. However, a significant amount of radioactivity will remain on site when the proposed Phase 1 decommissioning activities are scheduled to begin in 2011. The estimated amounts in key areas in 2011, exclusive of radioactivity in the HLW waste canisters, include:

- The Process Building, approximately 6200 curies;

[6] The WVDP Act states in pertinent part: "The Secretary [of DOE] shall carry out, in accordance with this Act, a high level radioactive waste demonstration project at the Western New York Service Center in West Valley, New York, for the purpose of demonstrating solidification techniques which can be used for preparing high level radioactive waste for disposal. . . . The State will make available to the Secretary the facilities of the Center and the high level radioactive waste at the Center which are necessary for completion of the project. The facilities and the waste shall be made available without transfer of title and for such period as may be required for completion of the project."

- The Vitrification Facility, approximately 1900 curies;
- Lagoon 1, approximately 750 curies;
- The four underground waste tanks, approximately 345,000 curies;
- The NDA, approximately, 180,000 curies; and
- The SDA, approximately, 83,000 curies.

The Process Building, the Vitrification Facility, and the Low-Level Waste Treatment Facility lagoons are addressed in Phase 1 of the proposed decommissioning, as explained below. The other facilities – commonly referred to, along with the radioactivity in the non-source area of the north plateau groundwater plume, as Phase 2 sources – would be addressed in Phase 2 of the proposed decommissioning.

1.4 Environmental Impact Statements

In 1996, DOE prepared a Draft EIS covering the remaining actions to be completed under the WVDP Act and evaluating different alternatives for closure and long-term stewardship of the facilities at the Center. Based upon comments received, ongoing discussions between DOE and NYSERDA, and various other factors, DOE decided not to move forward with the 1996 Draft EIS in its immediate form. Instead, DOE decided to revise its strategy to address the remaining activities required under the WVDP Act in two phases (and two EISs) – the first covering short-term, offsite waste disposal activities and the second covering longer-term closure and stewardship activities.

1.4.1 Waste Management EIS

The Final Waste Management EIS (DOE 2003b) on short-term, offsite waste disposal activities was issued by DOE on January 12, 2004. It addresses, as DOE's preferred alternative:

- Continued onsite management of HLW until it can be shipped to a federal geologic repository,
- Shipping low-level radioactive waste (LLW) and mixed (radioactive and hazardous) LLW offsite for disposal,
- Shipping transuranic waste to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, and
- Actively managing the underground waste tanks, including ventilating them to minimize moisture and associated corrosion.

The EIS Record of Decision was issued in the Federal Register on June 16, 2005 (70 FR 115). It partially implemented the preferred alternative, deferring the decision on transuranic waste shipment pending a determination that this waste meets all statutory and regulatory requirements for disposal at the Waste Isolation Pilot Plant.

1.4.2 Decommissioning EIS

The Decommissioning EIS addresses DOE's remaining activities under the WVDP Act, any waste management activities that could arise as a result of proposed decommissioning activities, and activities related to decommissioning or long-term stewardship of the balance of the Center. DOE and NYSERDA are jointly preparing this EIS.

The Decommissioning EIS also evaluates potential management and disposition actions for those facilities and areas, including the SDA, for which NYSERDA is responsible. The NRC is participating in the Decommissioning EIS as a cooperating agency, as are the U.S. Environmental Protection Agency (EPA) and NYSDEC. A Notice of Intent to prepare the Decommissioning EIS appeared in the Federal Register on March 13, 2003 (68 FR 49).

As noted previously, the proposed decommissioning approach described in this plan is DOE's preferred alternative in the Decommissioning EIS. If changes to that document occur during the National Environmental Policy Act process that affect this plan, such as changes to the preferred alternative, this plan will be revised as necessary to reflect the changes. The proposed activities under the Decommissioning Plan would begin only after issuance of the Decommissioning EIS Record of Decision.

1.5 Decommissioning Criteria

Under the authority of the WVDP Act, the NRC in 2002 issued its Final Policy Statement on the decommissioning criteria for the WVDP (67 FR 22) specifying the application of its License Termination Rule (10 CFR 20, Subpart E) to the decommissioning. This policy statement indicated that the final end-state may involve a long-term or even perpetual license for parts of the site where cleanup to License Termination Rule requirements would be prohibitively expensive or technically impractical. The policy statement also indicated that closure of the underground waste tanks (if the tanks were to be closed in place) must meet specified criteria for incidental waste as set forth in NRC's Final Policy Statement.

The criteria of the License Termination Rule are being applied to the decommissioning of: (1) underground waste tanks and other facilities in which HLW, solidified under the project, was stored; (2) facilities used in the solidification of the waste; and (3) any material and hardware used in connection with the WVDP.

Requirements in 10 CFR 20.1402 address license termination without restrictions. Requirements in 10 CFR 20.1403 address license termination under restricted conditions.

The unrestricted release criteria in 10 CFR 20.1402 state that a site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent to an average member of the critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

The restricted release criteria of 10 CFR 20.1403 involve addressing matters such as the following:

- That residual radioactivity levels are ALARA;
- Provisions for legally enforceable institutional controls that provide reasonable assurance that the total effective dose equivalent to the average member of the critical group will not exceed 25 mrem per year;
- Financial assurance;
- Considering the advice of individuals and institutions in the community who may be affected by the decommissioning or planned institutional controls; and
- That residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the total effective dose equivalent from residual radioactivity to the average member of the critical group is ALARA and would not exceed either (1) 100 mrem per year or (2) 500 mrem per year provided certain conditions are met.

In 2003, NRC issued an Implementation Plan for its Final Policy Statement on the Decommissioning Criteria for the WVDP (NRC 2003b).

Although Phase 1 of the WVDP proposed decommissioning would not result in license termination under either restricted or unrestricted conditions, this plan does include derived concentration guideline levels (DCGLs) and associated cleanup goals to be used for remediation of surface and subsurface soil in the excavated areas on the project premises described previously that are based on the unrestricted release criteria of 10 CFR 20.1402.[7] The cleanup goals take into account the results of a limited, site-wide integrated dose assessment. This assessment was performed to ensure that conditions in the excavations for the Process Building-Vitrification Facility and Low-Level Waste Treatment Facility lagoon areas at the conclusion of Phase 1 would not limit potential approaches that may be considered for Phase 2 of the proposed decommissioning.

1.6 Project Management and Organization

The project would be managed in accordance with DOE requirements in a manner similar to deactivation work currently underway at the WVDP. Necessary tasks would be defined and scheduled. Appropriate schedules would be used for this purpose, such as a long-range schedule, short-range schedules, and plans-of-the-week. NRC would be provided copies of these schedules for information.

Implementing plans would be prepared as necessary in support of the work. Examples of these plans include:

- A Health and Safety Plan to implement requirements outlined in Section 1.7;

[7] The DCGLs and cleanup goals for Sr-90 and Cs-137 incorporate a 30-year decay period from 2011. That is, achieving residual radioactivity levels less than the cleanup goals for these radionuclides would ensure that dose criteria of 10 CFR 20.1402 would be met in 2041 and any time thereafter, around the time when the vitrified HLW canisters are expected to be shipped to the federal geologic repository.

- Decommissioning Work Plans for demolition of major facilities, which are discussed in Section 7;
- A Quality Assurance Project Plan, which is described in Section 8;
- A Characterization Sample and Analysis Plan, which is described in Section 9, and
- A Final Status Survey Plan, which is also described in Section 9.

NRC would be provided copies of these plans for information.

Written procedures would be prepared as necessary to support the project activities. Work packages would be used for individual procedures or groups of procedures. After completion of work activities, the work packages would be formally closed out to ensure that all required work was accomplished.

Radiological work permits would be prepared as necessary and approved by the Radiological Control Manager or his or her designee in accordance with applicable DOE procedures. Persons working in areas covered by radiological work permits would be briefed before starting work in accordance with DOE procedures.

Training of project personnel would be commensurate with their experience, their responsibilities and the potential hazards to which they could be exposed. Records would be maintained showing the employee's name, training date, type of training received and other relevant information. This training would include, as applicable:

- General Employee Training, which would consist of a general orientation on site requirements and policies;
- Radiation worker training, with formal written and practical examinations to certify that the individuals are qualified as radiation workers;
- Radiological control technician training, also with formal written and practical examinations to certify individual qualification;
- Job-specific training, which would be performed as appropriate for individual jobs; and
- Pre-shift briefings, which would be conducted as appropriate at the beginning of each work shift.

DOE would employ a contractor to accomplish the proposed Phase 1 decommissioning activities. The decommissioning contractor organization would provide the necessary functions to this end, such as operations, engineering, radiological controls, health and safety, quality assurance, and training.

The decommissioning contractor senior executive would be responsible to the Director of the WVDP for carrying out the proposed decommissioning work in accordance with applicable DOE requirements and guidance as specified in the contract. The requirements would include this plan and all of its provisions, such as those associated with the health and safety program, environmental monitoring and control, and radioactive waste management as specified in the subsections that follow. Additional contractual provisions may also be invoked by DOE, such as compliance with DOE-STD-1107-97, *Knowledge, Skills, and*

Abilities for Key Radiation Protection Positions at DOE Facilities, and (2) DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for Nuclear Facilities*.

1.7 Health and Safety Program

The health and safety program for Phase 1 of the proposed decommissioning would be based on DOE procedures. This approach is consistent with DOE's authority and responsibilities to protect human health and safety under applicable laws and the provisions of the WVDP Act.

The DOE procedures that address radiological safety controls during decommissioning appear in the form of regulations, directives (orders, policies, guides, and manuals), and supplemental technical standards, and in contract conditions with its site or decommissioning contractors. DOE and its decommissioning contractor would follow these procedures for radiation safety controls and monitoring for workers during Phase 1 of the proposed decommissioning, along with other applicable requirements and guidance.

Among the applicable DOE procedures is a policy statement that expresses the Department's position to ensure that radiation exposures to its workers and the public and releases of radioactivity to the environment are maintained below regulatory limits, and that deliberate efforts are taken to further reduce exposures and releases to ALARA. This statement appears in DOE Policy 441.1.

Applicable requirements include the following:

- 10 CFR 830, *Nuclear Safety Management*
- 10 CFR 835, *Occupational Radiation Protection*
- 29 CFR 1910.134, *Respiratory Protection*
- DOE Order 420.1B, *Facility Safety*
- DOE Order 430.1B, *Real Property Asset Management*
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*
- DOE Manual 231.1-1A, *Environment, Safety, and Health Reporting Manual*

The Department's supplemental technical standards associated with these requirements would also be followed.

1.8 Environmental Monitoring and Control

DOE has maintained an extensive environmental monitoring and control program at the site since 1982 to satisfy the environmental monitoring requirements of federal and state laws and regulations and of DOE Orders and technical standards, and to comply with environmental permits that have been issued to the WVDP by NYSDEC and the EPA. Annual environmental monitoring reports (WVES and URS 2008) describe the results of this program.

The environmental monitoring and control program that would be implemented during Phase 1 of the proposed decommissioning would be based on the program currently in place at the WVDP. It would continue to comply with federal and state laws, federal and state environmental permits, DOE Orders and technical standards, and other applicable requirements and guidance under which the WVDP operates, which are consistent with the applicable NRC requirements of 10 CFR 20.

Three major elements of this program are: (1) the ALARA evaluation program, (2) the effluent monitoring program, and (3) the effluent control program. The program would be modified as necessary during decommissioning to ensure compliance with applicable requirements. As noted in Section 1.7, it is DOE policy to ensure that releases of radioactivity to the environment are maintained below regulatory limits, and that deliberate efforts are taken to further reduce releases to ALARA (DOE Policy 441.1).

The proposed decommissioning environmental program would meet the following monitoring and control requirements:

- Clean Air Act of 1970, as amended
- Clean Water Act of 1977
- Resource Conservation and Recovery Act of 1976, as amended
- Executive Order 11988, *Floodplain Management* (42 FR 26951)
- Executive Order 11990, *Protection of Wetlands* (42 FR 26961)
- Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements* (58 FR 150)
- Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition* (63 FR 179)
- Executive Order 13148, *Greening the Government through Leadership in Environmental Management* (65 FR 81)
- 10 CFR 830.122, *Quality Assurance Criteria*
- 40 CFR 61, *National Emission Standards for Hazardous Air Pollutants*
- 40 CFR 141, *National Primary Drinking Water Regulations*
- 40 CFR 143, *National Secondary Drinking Water Regulations*
- DOE Manual 231.1-1A, *Environment, Safety, and Health Reporting Manual*
- DOE Order 414.1C, *Quality Assurance*
- DOE Order 435.1, *Radioactive Waste Management*
- DOE Order 440.1B, *Worker Protection Management for DOE Federal Employees*
- DOE Order 450.1, *Environmental Protection Program*
- DOE Order 451.1B, *National Environmental Policy Act Compliance Program*
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*

DOE and the decommissioning contractor would also comply with applicable DOE technical standards, active site environmental permits, and active administrative orders of consent associated with the Resource Conservation and Recovery Act.

Note that information specified in NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NRC 2003c), that is normally provided in decommissioning plans, can be found in Section 3 of this plan, in the Decommissioning EIS, or both.

1.9 Radioactive Waste Management

The radioactive waste management program for Phase 1 of the proposed decommissioning would also be based on DOE procedures, consistent with the provisions of the WVDP Act. The WVDP Act states that DOE shall, in accordance with applicable license requirements, dispose of LLW and transuranic waste produced by the solidification of the HLW under the project.[8]

The DOE procedures that address waste management appear in the form of requirements contained in the Code of Federal Regulations, in DOE Orders, and in guidance contained in supplemental technical standards. DOE and its decommissioning contractor would follow these procedures for management of radioactive waste during Phase 1 of the proposed decommissioning, along with other applicable requirements and guidance.

The principal requirements for management of DOE radioactive waste appear in DOE Order 435.1, *Radioactive Waste Management*. This order applies to HLW, transuranic waste, and LLW, and to the radioactive component of mixed waste. Additional detailed requirements appear in DOE Manual 435.1-1, *Radioactive Waste Management Manual*. Detailed guidance for implementation of these requirements is given in DOE Guide 435.1, *Implementation Guide for Use with DOE M 435.1*.

Other applicable requirements include the following:

- 10 CFR 830.120, *Quality Assurance Requirements*
- 10 CFR 835, *Occupational Radiation Protection*
- DOE Order 414.1C, *Quality Assurance*
- DOE Order 460.1B, *Packaging and Transportation Safety*

The proposed Phase 1 decommissioning waste management activities would also be consistent with applicable federal laws such as the Resource Conservation and Recovery Act of 1976, as amended, and the Toxic Substances Control Act of 1976, as amended, and with applicable permits and consent orders. These activities would also be consistent with other applicable DOE guidance, such as that contained in DOE Guide 460.1-1, *Implementation Guide for Use with DOE Order 460.1A.*

[8] The WVDP Act also states that DOE "shall, as soon as feasible, transport in accordance with applicable provisions of law, the waste solidified at the Center [the vitrified HLW canisters] to an appropriate Federal repository for permanent disposal." This activity would take place in Phase 2 of the decommissioning.

All radioactive waste produced during the decommissioning would be disposed of offsite at appropriate government-owned or commercial facilities. In some cases, waste produced would be temporarily stored onsite for later shipment. Note that at the time this plan was completed, there was no approved disposal path for transuranic waste that would be generated during Phase 1 of the proposed decommissioning. Transuranic waste generated would therefore be temporarily stored onsite until such time that it can be shipped to an approved disposal facility.

1.10 Planned End States Before and After Phase 1

Site deactivation activities will produce conditions known as the interim end state that will be the conditions in effect at the start of the proposed Phase 1 decommissioning work.

1.10.1 The Interim End State

The map of the project premises shown in Figure 1-2 depicts the facilities that will still be in place at the start of proposed Phase 1 decommissioning activities. It shows the waste management areas (WMAs) into which the project premises has been divided for remediation purposes. It also shows the two large excavations for removal of facilities in WMA 1 and WMA 2 during the proposed Phase 1 decommissioning work, as explained in Section 1.10.2 below.

The deactivation activities required to achieve the interim end state will include removal of other ancillary facilities not shown in Figure 1-2. Certain facilities will be partially decontaminated to facilitate demolition during Phase 1 without the use of radiological containment. Section 3 of this plan describes the facilities in detail.

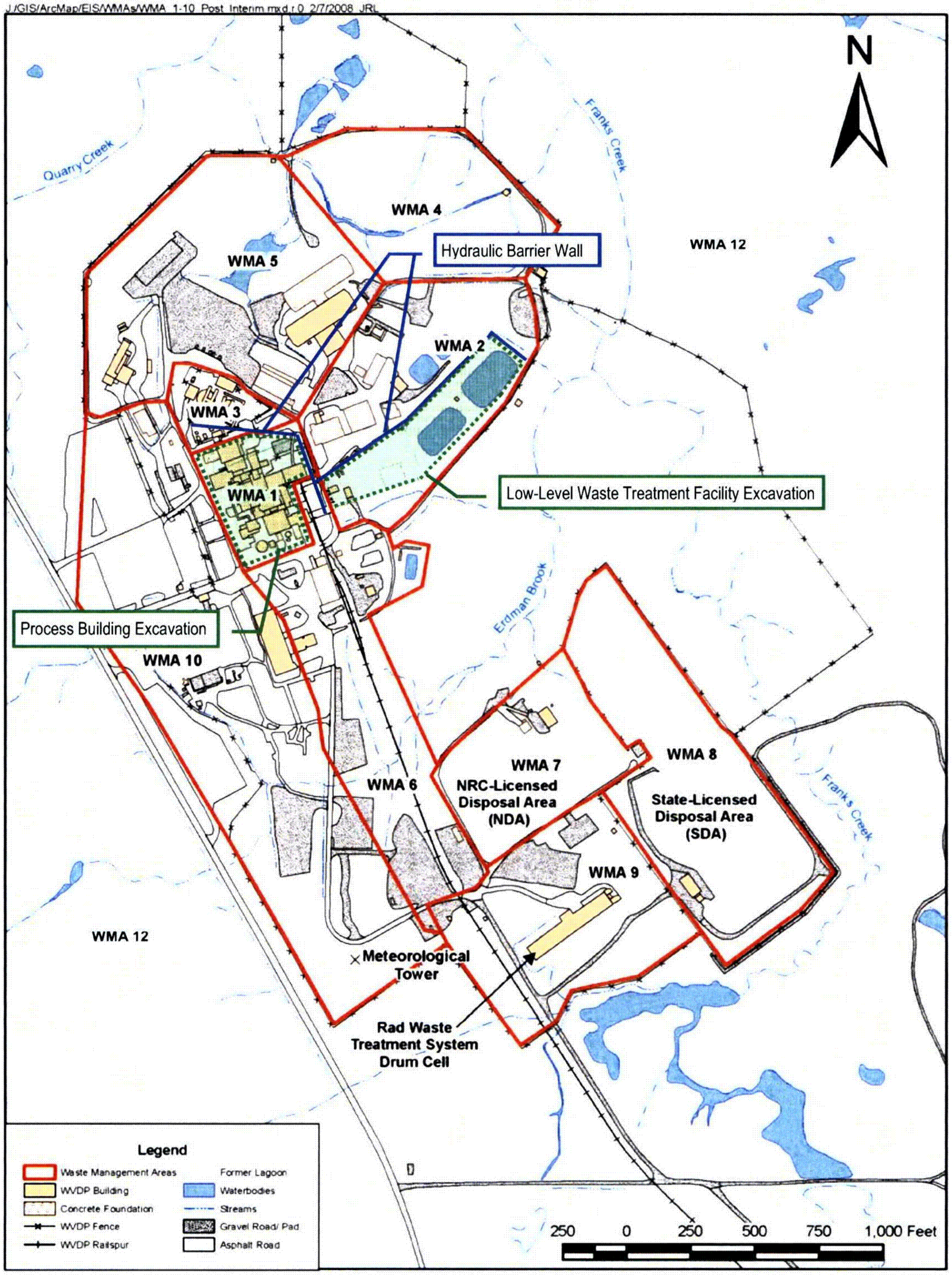

Figure 1-2. The Project Premises Showing WMAs and the Phase 1 Excavations

WMA 1

The partially decontaminated facilities in WMA 1 are the Process Building, the Vitrification Facility, and the 01-14 Building. The other facilities that will remain within WMA 1 when the interim end state is reached are the Utility Room, the Utility Room Expansion, the Plant Office Building, the Load-in/Load-out Facility, the Electrical Substation, the Fire Pumphouse, and the Water Storage Tank. Figure 1-3 shows these facilities, along with the Laundry Room, which will be removed in achieving the interim end state.[9]

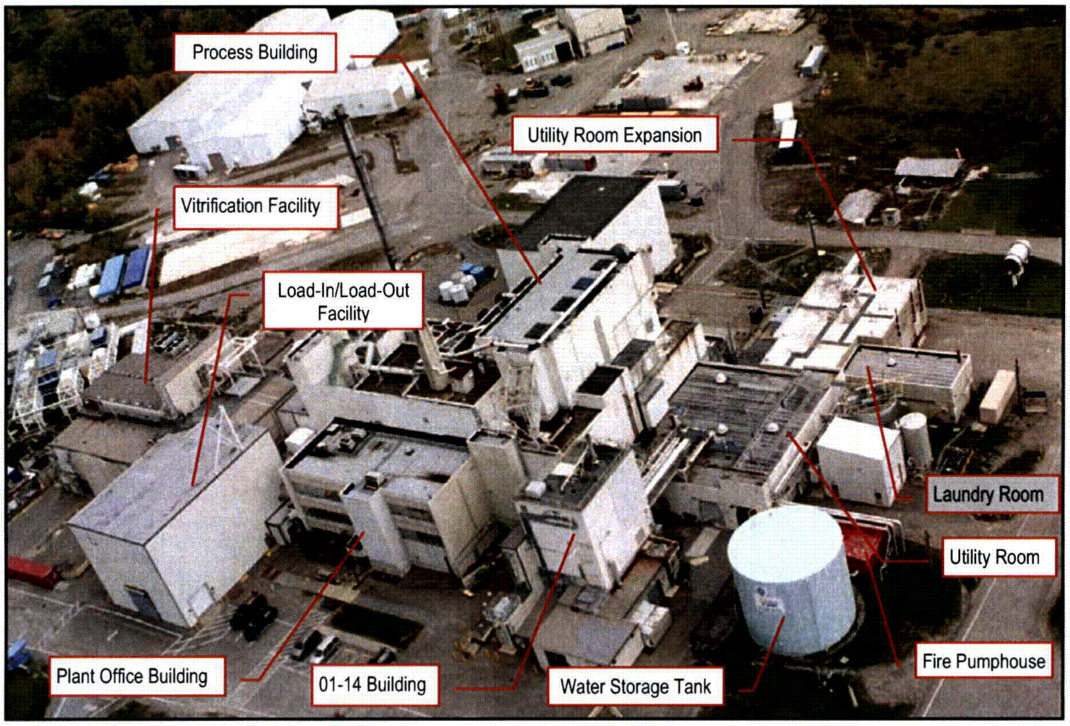

Figure 1-3. WMA 1 Area in 2007

WMA 2

The facilities that will remain in WMA 2, the Low-Level Waste Treatment Facility area, when the interim end state is reached include the five lagoons, with Lagoon 1 having been backfilled in 1984; the LLW2 Facility; the two New Interceptors; the Old Interceptor; the Neutralization Pit; the inactive Solvent Dike, the pilot permeable treatment wall; and the Maintenance Shop Leach Field. Concrete floor slabs and foundations for removed facilities such as the Maintenance Shop will also remain in place. Figure 1-4 shows this area.

One additional facility will be installed in WMA 2 as part of the work to achieve the interim end state: a full-scale permeable treatment wall to control the leading edge of the north plateau groundwater plume.

[9] The Electrical Substation, which is located behind the Process Building, cannot be seen in the photograph.

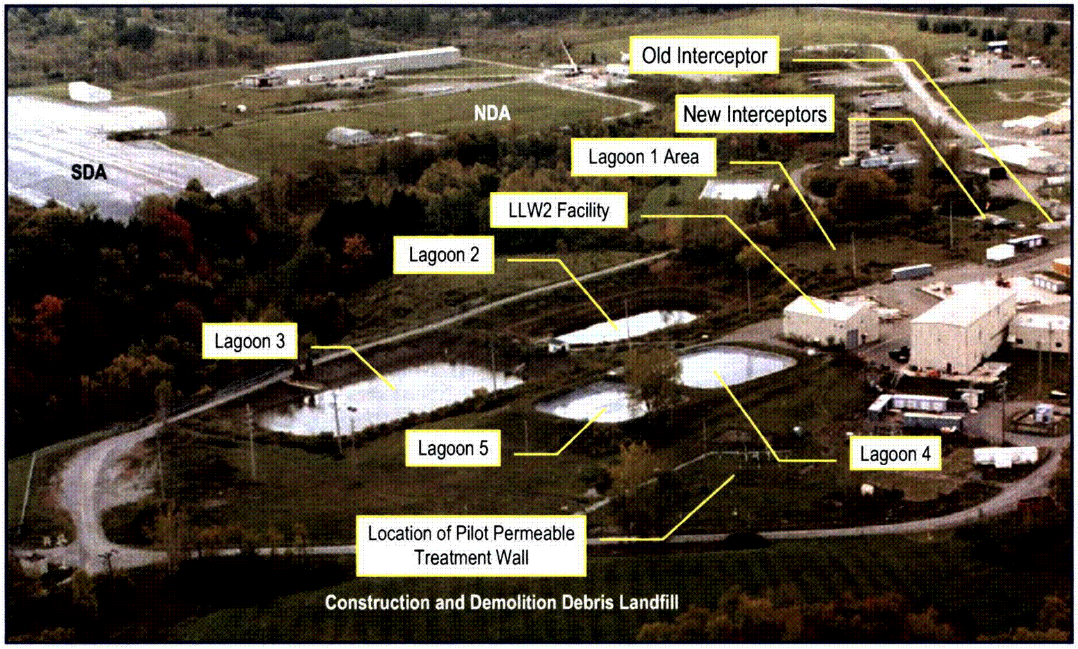

Figure 1-4. WMA 2 in 2007

WMA 3

In WMA 3, the four underground waste tanks will remain in place, along with the Permanent Ventilation System Building, the Supernatant Treatment System Support Building, the Equipment Shelter and condensers, the Con-Ed Building, and the HLW transfer trench. The tank drying system used to dry up liquid in the waste tanks will be still operational. The tank mobilization and transfer pumps and their support structures will remain in place.

Other WMAs

The closed Construction and Demolition Debris Landfill will remain in WMA 4. A permeable reactive barrier will be installed in a surface drainage ditch in WMA 4 as part of work to achieve the interim end state as a north plateau groundwater plume control measure.

Two buildings will remain in WMA 5, Lag Storage 4 and its associated shipping depot and the Remote-Handled Waste Facility. Two structures will remain in WMA 6 along with the Equalization Basin, the Equalization Tank, and the two demineralizer sludge ponds. The Old Sewage Treatment Plant will have been completely removed.

The NDA will remain in place in WMA 7, with the Interim Waste Storage Area removed and a new geomembrane cover and upgradient hydraulic barrier wall installed to control infiltration. The Radwaste Treatment System Drum Cell will remain in place in WMA 9. The New Warehouse, the Meteorological Tower, and the Security Gatehouse will remain in place in WMA 10, along with the security fence that surrounds the project premises.

1.10.2 Facilities and Areas Within Phase 1 Scope

Table 1-1 lists the facilities that are within the scope of Phase 1 of the proposed decommissioning. These facilities are described in Section 3 of this plan. Figures 1-5 and 1-6 show their locations on the project premises. Remediation of surface soil and sediment on the project premises would be accomplished as indicated in the table.

The new Canister Interim Waste Storage Facility for the vitrified HLW canisters would be constructed on the south plateau near the rail spur early in Phase 1 and the canisters moved to this location. The HLW canisters would be stored at this facility inside shielded canisters[10].

The soil and sediment characterization program would be undertaken early in Phase 1 to better define the nature and extent of radioactive contamination in surface soil and stream sediment on the project premises. However, removal of contaminated soil and sediment in excess of the cleanup goals would be limited to the areas of the major excavations in WMA 1 and WMA 2 unless this plan is revised to provide for additional soil removal after evaluation of the characterization data.

Before the large excavations for removal of the Process Building and the Low-Level Waste Treatment Facility shown in Figure 1-2 are filled in, Phase 1 final status surveys[11] of the excavated areas would be performed and arrangements made for regulator confirmatory surveys. The same process would be used for excavations associated with removal of concrete floor slabs, foundations, and gravel pads, which would be up to two feet deep.

Mitigative measures would be taken as described in Section 7 to eliminate or reduce potential impacts to human health and the environment during the proposed decommissioning work and to prevent recontamination of remediated areas.

[10]Section 7 of this plan describes the general conceptual design of the new Interim Waste Storage Facility, which may be changed somewhat as the design is finalized.

[11] These surveys would be performed following guidance in the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (NRC 2000) and the provisions of NUREG-1575, Volume 2 (NRC 2006).

Table 1-1. Facilities and Areas Within Phase 1 Decommissioning Scope[1]

WMA	Facility or Area to be Removed or Remediated	Remarks
1	Process Building	The HLW canisters would be moved to a new Interim Waste Storage Facility located on the south plateau. All listed facilities would be removed along with the source area of the north plateau groundwater plume. A single large excavation would be dug for this purpose. A vertical hydraulic barrier wall would be installed on the north and east sides of the excavation as shown in Figure 1-2. The soil in the excavated area would be removed to cleanup goals for unrestricted release. The vertical hydraulic barrier wall installed on the north and west side of the excavation would remain in place. The south hydraulic barrier wall would be removed after the excavation is backfilled.
	Utility Room	
	Utility Room Expansion	
	Plant Office Building	
	Vitrification Facility	
	01-14 Building	
	Load-in/Load-out Facility	
	Fire Pumphouse	
	Water Storage Tank	
	Electrical Substation	
	Off-Gas Trench	
	Underground piping and wastewater tanks (3)	
	Other remaining concrete slabs	
	Source area of North Plateau Groundwater Plume	
2	Low-Level Waste Treatment Facility Building	A single excavation would be made to remove Lagoons 1, 2, and 3, the Interceptors, the Neutralization Pit, and the Solvent Dike. Underlying soil and sediment in this excavation would be removed to cleanup goals that support unrestricted release. The vertical hydraulic barrier wall shown in Figure 1-2 would remain in place.
	Lagoons 1 – 5	
	New Interceptors (2)	
	Old Interceptor	
	Neutralization Pit	
	Solvent Dike	
	Maintenance Shop Leach Field	
	Remaining concrete floor slabs and foundations	
3	Mobilization and Transfer Pumps	The support structures for the mobilization and transfer pumps would be removed as well as the pumps themselves.
	Piping and equipment in HLW Transfer Trench	
	Con-Ed Building	
	Equipment Shelter and Condensers	
5	Lag Storage Area 4 and Shipping Depot	
	Remote-Handled Waste Facility	
	Remaining concrete floor slabs, hardstands, and gravel pads	
6	Sewage Treatment Plant	The rail spur would remain operational.
	South Waste Tank Farm Test Tower	
	Remaining concrete floor slabs and foundations	
	Asphalt, concrete, and gravel pads[2]	
	Equalization Basin	
	Equalization Tank	
	Demineralizer Sludge Ponds (2)	
	Cooling Tower basin	
7	NDA hardstand	
9	Radwaste Treatment System Drum Cell	
	Trench soil container area, other pads	
10	New Warehouse	
	Former Waste Management Storage Area	
	Remaining concrete floor slabs and foundations	
	Surface soil and sediment within the project premises	To be remediated only in the Process Building-Vitrification Facility and Low-Level Waste Treatment Facility excavation areas. Soil and sediment is other areas may be remediated in Phase 1 by revision to this plan.

NOTES: (1) See Section 3 of this plan for facility descriptions. (2) Including the LLW Rail Packaging and Staging Area.

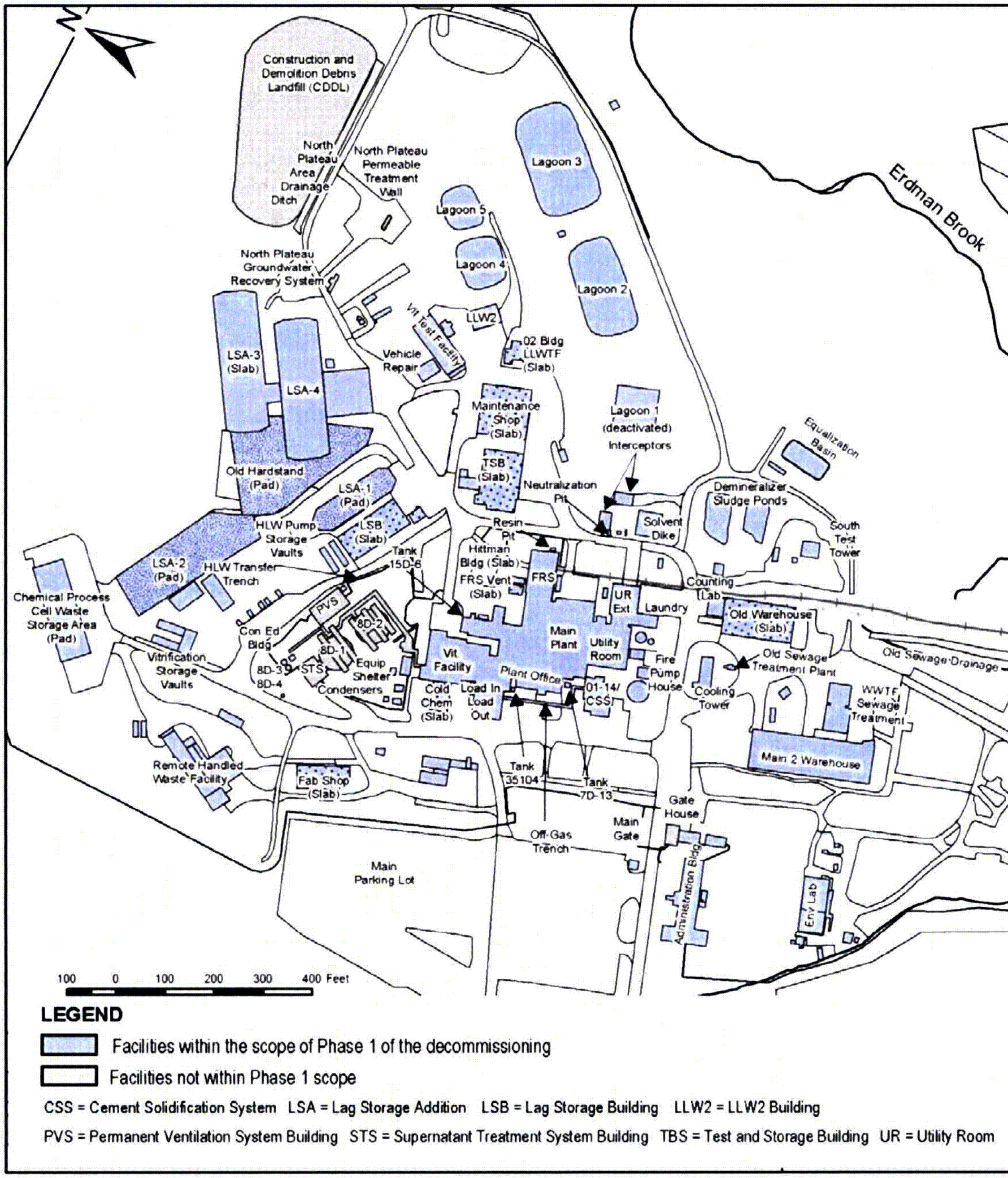

Figure 1-5. Facilities Within the Scope of Phase 1 of the Decommissioning, North Plateau

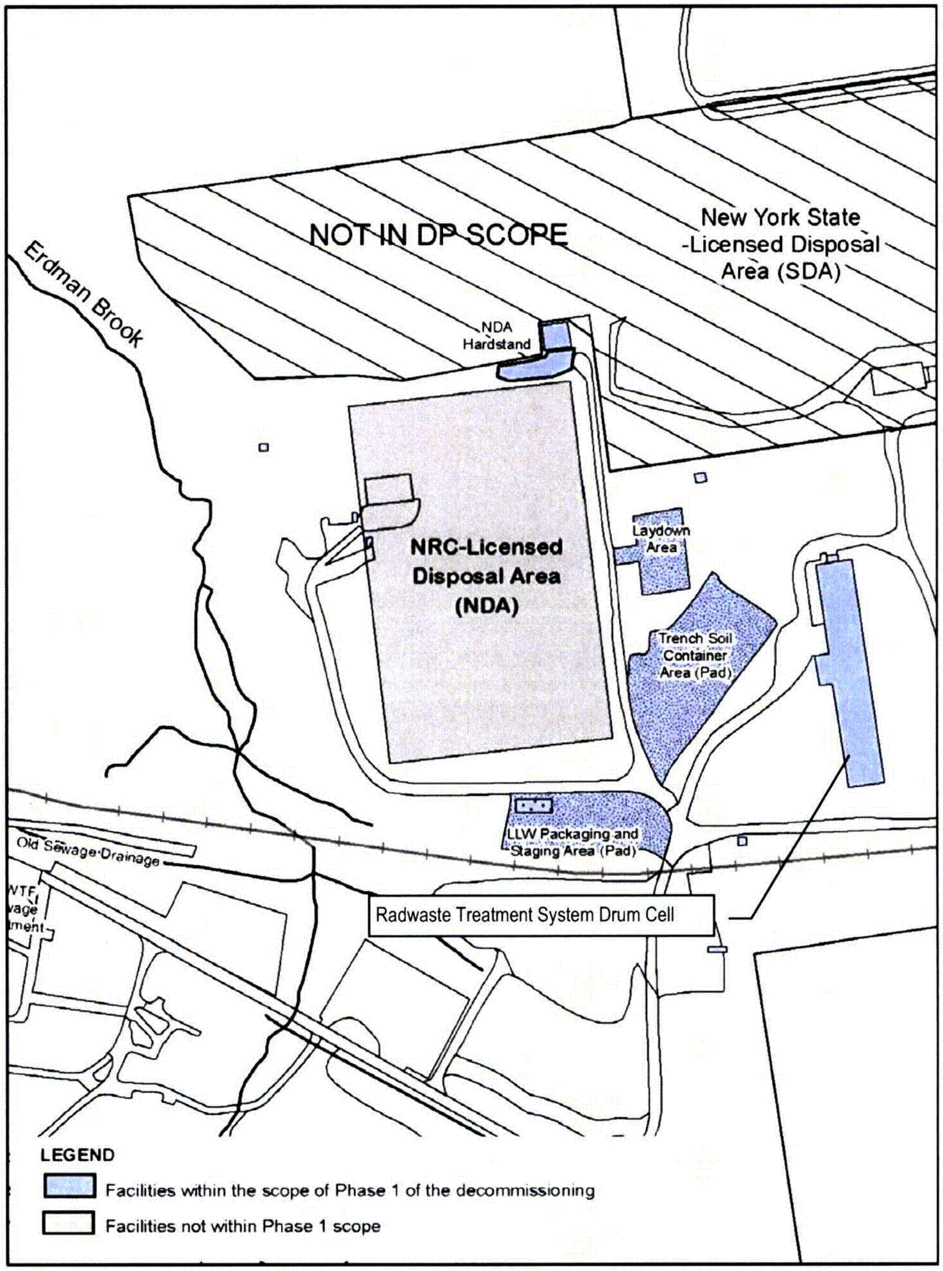

Figure 1-6. Facilities Within the Scope of Phase 1 of the Decommissioning, South Plateau

Figure 1-7 shows the expected appearance of the project premises in the interim end state, when proposed Phase 1 decommissioning activities would begin.

Figure 1-7. The WVDP in the Interim End State

Figure 1-8 shows the planned general appearance of the project premises after completion of the proposed Phase 1 decommissioning activities. The interim storage area for the HLW canisters would be located on the south plateau near the rail spur.

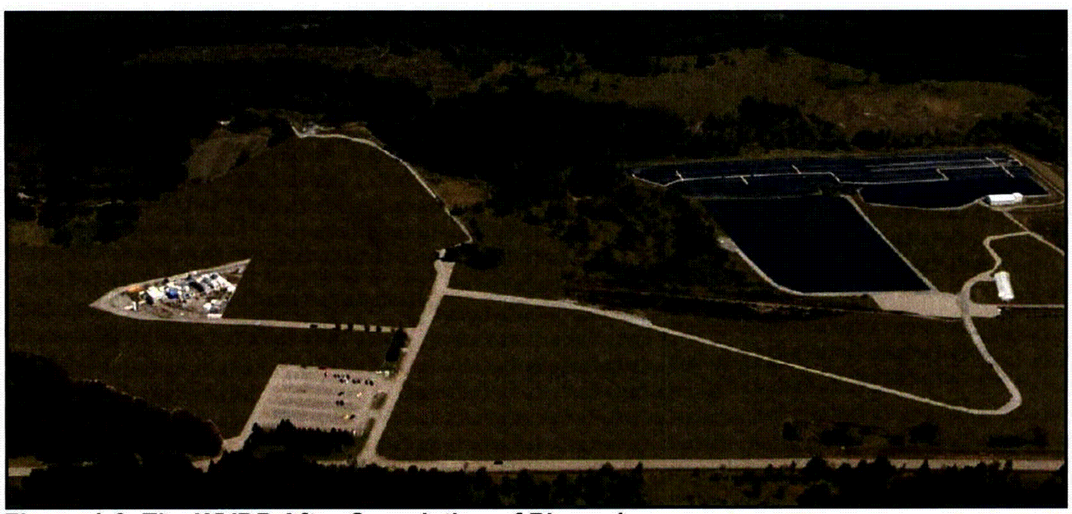

Figure 1-8. The WVDP After Completion of Phase 1

1.11 Organizational Responsibilities

Because the proposed WVDP decommissioning is being carried out under the authority of the WVDP Act, organizational responsibilities are different from decommissioning of a typical NRC-licensed site. The organizational responsibilities prescribed by the WVDP Act for decontamination and decommissioning of the WVDP are summarized below.

1.11.1 DOE

The Act directed the DOE to carry out the following activities: (1) Solidify the HLW, (2) develop containers suitable for permanent disposal of the solidified HLW waste, (3) transport the waste to a federal repository for permanent disposal, (4) dispose of LLW and transuranic waste produced in the solidification of the HLW, and (5) decontaminate and decommission the tanks, facilities, materials, and hardware used in the project in accordance with requirements prescribed by the NRC.

The Act also directed DOE to enter into a cooperative agreement with the State for the State to make available to DOE the facilities and HLW necessary to carry out the project, without transfer of title, with DOE providing technical assistance in securing required license amendments. The Act directed DOE to enter into an agreement with the NRC for review and consultation on the project by NRC and to afford NRC access to the site to monitor activities under the project for the purposes of health and safety. Both of these agreements were formalized in 1981 (DOE and NYSERDA 1981, DOE and NRC 1981).

The Act further directed DOE to consult with the EPA in carrying out the project. Under the WVDP Act, DOE is responsible for the activities outlined above and for determining the manner in which facilities, materials, and hardware for which DOE is responsible are managed or decommissioned, in accordance with applicable federal and state requirements. To this end, DOE would determine what, if any, material or structures for which DOE is responsible would remain on site and what, if any, institutional controls, engineered barriers, or stewardship provisions would be needed.

The Act also set up a cost sharing arrangement for the WVDP, with DOE paying 90 percent of the total project costs and the State paying 10 percent of these costs.

DOE is responsible as noted previously for certain matters associated with the decommissioning: (1) project management and the decommissioning organization, (2) safety and health, (3) waste management, and (4) environmental protection.

1.11.2 NRC

The WVDP Act gave NRC the authority to prescribe requirements for decontamination and decommissioning and to review and consult with DOE, not to include formal procedures or actions pursuant to the Atomic Energy Act or any other law. It also gave NRC monitoring responsibilities for the purpose of assuring public health and safety. Pursuant to these responsibilities, NRC will issue public reports during decommissioning to document its position with respect to DOE compliance with NRC decommissioning criteria. The WVDP Act does not give NRC licensing authority over DOE.

NRC is also a cooperating agency in development of the Decommissioning EIS, as mentioned previously.

1.11.3 NYSERDA

As explained in the NRC Implementation Plan (NRC 2003b), NYSERDA would determine the manner in which facilities and property for which NYSERDA is responsible are managed and decommissioned, in accordance with applicable federal and state requirements. To this end, NYSERDA would determine what, if any, material or structures for which it is responsible would remain on the site and what, if any, institutional controls, engineered barriers, or stewardship provisions would be needed.

The NRC Implementation Plan also indicates that if NYSERDA decides to terminate the license after DOE completes proposed decommissioning activities for the project facilities, NYSERDA would be required to submit a decommissioning plan. As noted previously, NYSERDA is jointly preparing the Decommissioning EIS with DOE.

1.12 Organization of this Plan

The organization and content of this plan are generally consistent with Volume 1 of NUREG-1757 (NRC 2006). Differences are described in Appendix A, which consists of an annotated version of the decommissioning plan evaluation checklist found in Appendix D to NUREG-1757, Volume 1 (DOE 2006). NRC has concurred with certain topics not being applicable to this decommissioning as shown in the Appendix A checklist (NRC 2008).

The contents of the plan are described in the Table of Contents. To aid readability, certain details appear in appendices.

1.13 Control of Changes

DOE plans to treat this plan as a "living document," revising it when circumstances warrant. DOE may issue revisions to make significant changes that could affect the project end conditions. Such revisions would be provided to NRC for review and comment prior to issue. After NRC comments are incorporated or otherwise formally resolved, DOE would issue the revised plan.

DOE may make changes to the plan that could not affect the project end conditions without providing them to NRC for review and comment. DOE would informally consult with NRC on such changes prior to issue to ensure that NRC concurs that the changes could not affect project end conditions. NRC would be provided copies of such changes when they are issued. Examples of such changes could include:

- A change to reflect actual conditions of a particular facility at the end of deactivation work planned for the 2008 – 2011 period,
- A change in decontamination methods, or
- A change to include information on additional ALARA analyses performed after proposed decommissioning activities began that did not result in a change to the decommissioning approach.

1.14 References

Federal Statutes

Clean Air Act of 1970, as amended.

Clean Water Act (Federal Water Pollution Control Act) of 1977.

Toxic Substances Control Act of 1976, as amended.

Resource Conservation and Recovery Act of 1976, as amended.

West Valley Demonstration Project Act, Public Law 96-368 (S. 2443), of October 1, 1980 (and related legislative history).

Code of Federal Regulations and Federal Register Notices

10 CFR 20, *Standards for Protection Against Radiation*

10 CFR 20, Subpart E., *Radiological Criteria For License Termination (LTR).*

10 CFR 830, *Nuclear Safety Management.*

10 CFR 835, *Occupational Radiation Protection*

29 CFR 1910.134, *Respiratory Protection.*

40 CFR 61, *National Emission Standards for Hazardous Air Pollutants.*

40 CFR 141, *National Primary Drinking Water Regulations.*

40 CFR 143, *National Secondary Drinking Water Regulations.*

42 FR 26951, Executive Order 11988, *Floodplain Management*. Federal Register, May 24, 1977.

42 FR 26961, Executive Order 11990, *Protection of Wetlands*. Federal Register, May 24, 1977.

58 FR 150, Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements*. Federal Register, August 6, 1993.

63 FR 179, Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*. Federal Register, September 16, 1998.

65 FR 81, Executive Order 13148, *Greening the Government through Leadership in Environmental Management*. Federal Register, April 26, 2000.

67 FR 22, *Decommissioning Criteria for the West Valley Demonstration Project (M-32) at the West Valley Site; Final Policy Statement*. Federal Register, February 1, 2002.

68 FR 49, *Notice of Intent to Prepare an Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*. Federal Register, March 13, 2003.

70 FR 115, *West Valley Demonstration Project Waste Management Environmental Impact Statement, Record of Decision.* Federal Register, June 16, 2005.

DOE Orders, Policies, Manuals, Standards, and Guides

DOE Order 414.1C, Change 1, *Quality Assurance.* U.S. Department of Energy, Washington, D.C., June 17, 2005.

DOE Order 420.1B, *Facility Safety.* U.S. Department of Energy, Washington, D.C., December 22, 2005.

DOE Order 430.1B, *Real Property Asset Management.* U.S. Department of Energy, Washington, D.C., February 8, 2008.

DOE Order 435.1, Change 1, *Radioactive Waste Management.* U.S. Department of Energy, Washington, D.C., August 28, 2001.

DOE Order 440.1B, *Worker Protection Management for DOE Federal and Contractor Employees.* U.S. Department of Energy, Washington, D.C., May 17, 2007.

DOE Order 450.1, *Environmental Protection Program.* U.S. Department of Energy, Washington, D.C., January 15, 2003.

DOE Order 451.1B, Change 1, *National Environmental Policy Act Compliance Program.* U.S. Department of Energy, Washington, D.C., September 28, 2001.

DOE Order 460.1B, *Packaging and Transportation Safety.* U.S. Department of Energy, Washington, DC, April 4, 2003.

DOE Order 5400.5, Change 2, *Radiation Protection of the Public and the Environment.* U.S. Department of Energy, Washington, D.C., January 7, 1993.

DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for Nuclear Facilities.* U.S. Department of Energy, Washington, D.C., November 15, 1994.

DOE Policy 441.1, *Department of Energy Radiological Health and Safety Policy.* U.S. Department of Energy, Washington, D.C., April 26, 1996.

DOE Manual 231.1-1A, Change 1, *Environment, Safety, and Health Reporting Manual.* U.S. Department of Energy, Washington, D.C., June 3, 2004.

DOE Manual 435.1-1, Change 1, *Radioactive Waste Management Manual.* U.S. Department of Energy, Washington, D.C., June 19, 2001.

DOE Guide 435.1-1, *Implementation Guide for Use with DOE M 435.1.* U.S. Department of Energy, Washington, D.C., July 9, 1999.

DOE Guide 460.1-1, *Implementation Guide for Use with DOE Order 460.1A.* U.S. Department of Energy, Washington, D.C., June 5, 1997.

DOE-STD-1107-97, *Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities,* Change 1. U.S. Department of Energy, Washington, D.C., November 2007.

Other References

DOE 2003a, DOE Letter from Alice C. Williams (Director, WVDP) to Larry W. Camper of NRC (Chief Decommissioning Branch), dated February 28, 2003.

DOE 2003b, *West Valley Demonstration Project Waste Management Final Environmental Impact Statement,* DOE/0337F. U.S. Department of Energy – West Valley Area Office, West Valley, New York, December 2003.

DOE and NRC 1981, *West Valley Demonstration Project Memorandum of Understanding Between the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission.* September 23, 1981.

DOE and NYSERDA 1981, *Cooperative Agreement between the United States Department of Energy and New York State Energy Research and Development Authority on the Western New York Nuclear Service Center at West Valley, New York.* Signed November 3, 1980, amended September 18, 1981.

NRC 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Revision 1. NRC, Washington, DC, August, 2000. (Also EPA 4-2-R-97-016, Revision 1, U.S. Environmental Protection Agency and DOE-EH-0624, Revision 1, DOE)

NRC 2003a, NRC Letter from Larry W. Camper (Chief Decommissioning Branch) to Alice C. Williams of DOE (Director, WVDP), dated February 2, 2003.

NRC 2003b, *U.S. Nuclear Regulatory Commission Implementation Plan for the Final Policy Statement on Decommissioning Criteria for the West Valley Demonstration Project at the West Valley Site.* U.S. Nuclear Regulatory Commission, Division of Waste Management, Office of Nuclear Materials Safety and Safeguards, Washington, D.C., May 2003.

NRC 2003c, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs, Final Report*, NUREG-1748. U.S. Nuclear Regulatory Commission, Washington, D.C., August 2003.

NRC 2006, NUREG-1757, *Consolidated Decommissioning Guidance, Decommissioning Process for Materials Licensees*, Volume 1, Revision 2. U.S. Nuclear Regulatory Commission, Washington, D.C., September 2006.

NRC 2008, *Report of May 19, 2008 Meeting With U.S. Department of Energy to Discuss the West Valley Demonstration Project Phase 1 Decommissioning Plan.* U.S. Nuclear Regulatory Commission, Washington, D.C., June 2, 2008.

WVES and URS 2008, *West Valley Demonstration Project Annual Site Environmental Report, Calendar Year 2007*. West Valley Environmental Services and URS Group, Inc., West Valley, New York, December 2008.

2.0 FACILITY OPERATING HISTORY

PURPOSE OF THIS SECTION

The purpose of this section is to describe the facility operating history, thereby providing a foundation for understanding the rest of the plan. Section 2 is also intended to provide information to allow NRC staff to understand (1) the license history, (2) previous decommissioning activities, (3) radioactive spills that have occurred, and (4) onsite burials of radioactive materials.

INFORMATION IN THIS SECTION

This section provides the following information:

- A summary of the license history, including the radionuclides present and how they have been used, addressing both Nuclear Fuel Services (NFS) operations under the license through 1982 and WVDP activities since that time that were not performed under the license;
- A summary of the previous decommissioning and remediation activities and the remediation activities to take place during the period leading up to the interim end state, which will be the point at which Phase 1 proposed decommissioning activities begin;
- A summary of spills of radioactivity that have had the potential to have impacted the environment, both under NFS and during the WVDP; and
- Information on prior onsite burials of radioactive material, except for those in the State-Licensed Disposal Area (SDA) and Waste Management Area 11 (outside the project premises), which are beyond the scope of this plan.

RELATIONSHIP TO OTHER PLAN SECTIONS

To put into perspective the information in this section, one must consider the information in Section 1 on the project background and those facilities and areas within the scope of the DP. Consideration of the information in Section 3 on the facility description and the information in Section 4 on the radiological status of the facility would also help place information in Section 2 into context.

The information in this section serves as the foundation for later sections, such as facility description in Section 3, the radiological status in Section 4, and the decommissioning activities in Section 7.

2.1 License History

Provisional Operating License Number CSF-1 (AEC 1966) was issued on April 19, 1966 by the U.S. Atomic Energy Commission to NFS and the New York State Atomic and Space Development Authority under Section 104b of the Atomic Energy Act of 1954, as amended, to operate a spent fuel reprocessing and radioactive waste disposal facility at the Center. The Atomic Energy Commission was the regulator of this license until 1975 when the NRC was established by passage of the Energy Reorganization Act of 1974.

License CSF-1 provided limits for (1) nuclear fuel (source, special nuclear material and byproduct materials in irradiated or unirradiated solid fuel elements and solutions); (2) unirradiated source material; and (3) material for storage and use for standards, test, measurements, and calibration. The radionuclides and possession limits for these categories are identified in Tables 2-1, 2-2, and 2-3. (See note at the end of Tables 2-1 and 2-2.)

Table 2-1. Limits for Nuclear Fuel in Solid Fuel Elements and Solutions[(1)]

Category	Pre-irradiation Fuel Compound	Pre-irradiation % U-235 Enrichment in U
1	UO_2	5%
2	UO_2	>5% but ≤10%
3	$ThO_2 + UO_2$ Not exceeding 8.5% U	No limitation
4	U-Mo alloy	26.5%
5	U-Zircaloy alloy U-Zr alloy (U content 10 w/o [wt.%] of alloy)	No limitation
6	U metal or UO_2	5%
7	U-Al alloy	No limitation
8	U-Mo alloy	4.5%
9	U metal	2.5%
10	Plutonium nitrate - In depleted uranyl nitrate solution	250 grams fissile plutonium (Pu-239 and Pu-241) per liter.
The possession limits of the above special nuclear material were 21,000 kg of U-235, 3,200 kg of U-233, and 4,000 kg of plutonium.		

NOTE: (1) The chemical forms of the radionuclides authorized for use changed from solid fuel (elemental metal) to aqueous solutions during reprocessing, with radionuclides used for calibration standards, testing, etc. used primarily in laboratories.

Table 2-2. Limits for Unirradiated Source Material[1]

Material	Possession Limit	Form
Uranium of natural isotopic composition	50,000 pounds	Hanford N-Reactor Fuel
Uranium depleted in the isotope U-235	100,000 pounds	UO_2, metal prototype fuel elements and U_3O_8 granules of depleted uranium
Thorium	50,000 pounds	Thorium nitrate or thorium oxide

NOTE: (1) The chemical forms of the radionuclides authorized for use changed from solid fuel (elemental metal) to aqueous solutions during reprocessing, with radionuclides used for calibration standards, testing, etc. used primarily in laboratories.

Table 2-3. Limits Used for Standards, Test, Measurements, and Calibration[1]

Material	Possession Limit	Form
Uranium-235	105 grams	Any
Uranium-233	75 grams	Any
Plutonium[2]	62 grams	Any
Plutonium[2]	14 grams	sealed source
Plutonium-242	6 grams	Any
Plutonium-238	1 gram	Any
Neptunium-237	3.5E-03 curie	Any
Americium-241	1.0E-03 curie	Any
Thallium-204	5.0E-06 curie	Any
Cesium-137	5.0E-03 curie	Any
Cesium-137	33 curies	sealed source
Cesium-134	5.0E-03 curie	Any
Cerium-144	1.0E-02 curie	Any
Iodine-131	6.0E-06 curie	Any
Iodine-129	5.0E-06 curie	Any
Ruthenium-106	1.0E-02 curie	Any
Zirconium-95	5.0E-02 curie	Any
Strontium-90	1.0E-02 curie	Any
Strontium-85	1.0E-02 curie	Any
Krypton-85	3 curies	Any

Table 2-3. Limits Used for Standards, Test, Measurements, and Calibration(1)

Material	Possession Limit	Form
Zinc-65	1.0E-02 curie	Any
Cobalt-60	5.0E-02 curie	Any
Cobalt-58	1.0E-02 curie	Any
Manganese-54	5.0E-03 curie	Any
Antimony(2)	5.0E-03 curie	Any
Any byproduct material with atomic numbers from 3 to 85	3.0E-06 curie each	Any

NOTES: (1) From Section 3.3 of Appendix A of Provisional License CSF-1, Change 18 (AEC 1966)
(2) Section 3.3 of Appendix A of Provisional License CSF-1, Change 18 (AEC 1966) omitted the mass number of this radionuclide.

From 1966 to 1972, NFS reprocessed under the license more than 600 metric tons of spent fuel in the Process Building (Table 2-4) and generated approximately 600,000 gallons of liquid high-level waste. The facility shut down in 1972 for modifications to increase reliability and to expand capacity. In 1976, without restarting the operation, NFS withdrew from the reprocessing business and returned control of the facilities to the site owner, NYSERDA, the successor to the New York State Atomic and Space Development Authority.

License CSF-1 has been amended by 32 License Amendments. Amendments 1 through 30 allowed operation of the facility with changes to the technical specifications. The changes to the technical specifications were based on changes to facility operations and physical plant modifications. No license amendments were made from 1976 to the start of the WVDP Act implementation in 1981.

License Amendment No. 31 (NRC 1981) transferred the project premises to DOE in accordance with the WVDP Act. The WVDP Act authorized the DOE, in cooperation with NYSERDA, the owner of the site and the holder of NRC license CSF-1, to carry out a high-level radioactive waste management demonstration project for the purpose of demonstrating solidification techniques that could be used for preparing high-level liquid radioactive waste for disposal (DOE and NYSERDA 1981).

On February 11, 1982, the NRC issued License Amendment 32, as requested by NFS, to terminate the authority and responsibility of NFS under the license effective upon DOE assumption of exclusive possession of the project premises. Control of the project premises was formally transferred to DOE effective February 26, 1982 (WVNSCO 1983a). Section 2.1.1 describes NFS activities under the license in more detail. As noted in Section 1, portions of NYSERDA's NRC Part 50 license for the Center, including the technical specifications, have been effectively suspended by NRC since 1981 to facilitate execution of the provisions of the WVDP Act.

2.1.1 Nuclear Fuel Services Operations From 1966 to 1982

Fuel receipt began in 1965, and reprocessing began in April 1966 and ended in 1972.

Receiving Fuel for Reprocessing

Table 2-4 shows the sources of spent nuclear fuel reprocessed at the facility. Additional shipments comprised of 750 spent nuclear fuel assemblies were received between February 1973 and December 1975 in anticipation of facility restart, which never occurred. Of these 750 assemblies, 625 were promptly returned to their original owners and the remaining 125 assemblies remained in storage in the Fuel Receiving and Storage Facility. The final shipment to remove the fuel assemblies from the WVDP was made in 2001.

The spent fuel assemblies were received in casks by rail or truck and placed into the Fuel Receiving and Storage area. The casks were unloaded in the Cask Unloading Pool and the fuel placed in storage canisters, which were then placed in the Fuel Storage Pool awaiting reprocessing. Reprocessing started with moving the canisters by underwater conveyer to the Process Mechanical Cell in the Process Building.

Process Building Arrangements

The Process Building contained the physical and chemical reprocessing operations, which were conducted in specially designed cells, rooms, and aisles. Descriptions of these areas are contained in Section 3. The cells were shielded rooms with concrete walls up to five feet thick where remote spent fuel reprocessing occurred. The rooms in which activities such as chemical preparation and laboratory analysis occurred that did not involve high levels of radioactivity were typically not shielded. The aisles were located adjacent to the shielded cells and provided for remote control of the physical and chemical reprocessing in the cells.

Sectioning and Dissolving the Fuel

The first step in reprocessing operations involved bringing fuel assemblies to the Process Mechanical Cell, where they were remotely disassembled with saws. The fuel rods were chopped into pieces with a shear prior to dissolution. The small pieces of fuel were then loaded into baskets, temporarily stored in the General Purpose Cell, and then transported to one of two dissolvers located in the Chemical Process Cell. The dissolution process consisted of placing the fuel pieces in a dissolver with concentrated nitric acid, which dissolved the irradiated fuel into an aqueous stream containing uranium nitrate, plutonium nitrate, and fission products. Unirradiated fuel went through a similar but abbreviated process.

Table 2-4. Nuclear Fuel Received and Reprocessed[1]

Lot	Source	Reactor	Process Date	Received MTU[2]	Recovered Pu (kg)
2	AEC	N-Reactor	4-22-66	19.7	1.7
1	AEC	N-Reactor	5-20-66	28.8	2.3
3	AEC	N-Reactor	7-15-66	46.7	50.9
4	Commonwealth Edison	Dresden-1	11-12-66	50.0	191.1
5	Yankee Atomic Electric	Yankee Rowe	6-7-67	49.8	285.1
6	AEC	N-Reactor	9-2-67	26.6	52.6
7	AEC	N-Reactor	12-2-67	26.1	47.4
8	AEC	N-Reactor	1-6-68	42.4	75.4
9	AEC	N-Reactor	5-5-68	38.8	79.1
10	AEC	N-Reactor	6-29-68	55.3	115.7
11[3]	Consolidated Edison	Indian Point-1	11-15-68	1.1	-
12	AEC	N-Reactor	2-13-69	48.9	102.5
13	Yankee Atomic Electric	Yankee Rowe	5-14-69	19.6	176.0
14[4]	AEC	N-Reactor	8-16-69	30.3	-
15	Commonwealth Edison	Dresden-1	10-1-69	21.5	104.6
16	Consolidated Edison	Indian Point-1	11-23-69	15.6	107.6
17	Yankee Atomic Electric	Yankee Rowe	6-2-70	9.3	95.6
18	Northern States Power	Pathfinder	8-14-70	9.6	7.1
19	Consumers Power	Big Rock Point	11-26-70	16.4	72.8
20	Consolidated Edison	Indian Point-1	1-11-71	7.6	68.1
21	AEC	N-Reactor	2-25-71	15.8	25.4
22	Puerto Rico Water Resources Authority	Bonus Superheater Bonus Boiler	4-15-71 4-18-71	1.7 2.4	0.9 4.0
23	Pacific Gas and Electric	Humboldt Bay	5-20-71	20.8	87.2
24	Yankee Atomic Electric	Yankee Rowe	7-16-71	9.5	95.7
25	Carolinas-Virginia Nuclear Power Associates	Carolinas-Virginia Tube Reactor	10-4-71	3.5	11.6
26	Consumers Power	Big Rock Point	11-30-71	5.8	27.9
27	NFS, Erwin, Tennessee[5]	SEFOR	12-12-71	0.1	95.5
			Total	**625.7**	**1983.7**

NOTES: (1) From DOE 1996.
(2) Metric tons uranium
(3) The lot 11 fuels from Indian Point-1 consisted of highly enriched uranium and thorium but no plutonium.
(4) The lot 14 fuel was unirradiated and therefore contained no plutonium.
(5) This material was a liquid residue generated during fabrication of fuel for the Southwest Experimental Fast Oxide Reactor (SEFOR).

Separating Uranium, Plutonium, and Fission Products

A five-stage solvent extraction process used a tributyl phosphate/n-dodecane solution to separate the fission products from the uranium and plutonium, and then separate the uranium from the plutonium. Following initial separation, the uranium-bearing solution underwent two further solvent extraction purification cycles while the plutonium bearing solutions underwent one additional purification cycle.

After leaving the extraction columns, the uranium-bearing solutions underwent an additional purification step that consisted of silica gel bed sorption. An ion-exchange process further purified the plutonium bearing solutions. The product solutions were concentrated, packaged, stored, and shipped off site. The NFS West Valley product was a nitrate solution (uranyl nitrate or plutonium nitrate) that was shipped to another out-of-state facility for purification and conversion to oxide. A representation of the fuel reprocessing operation is shown in Figure 2-1. The process used was the PUREX[1] process.

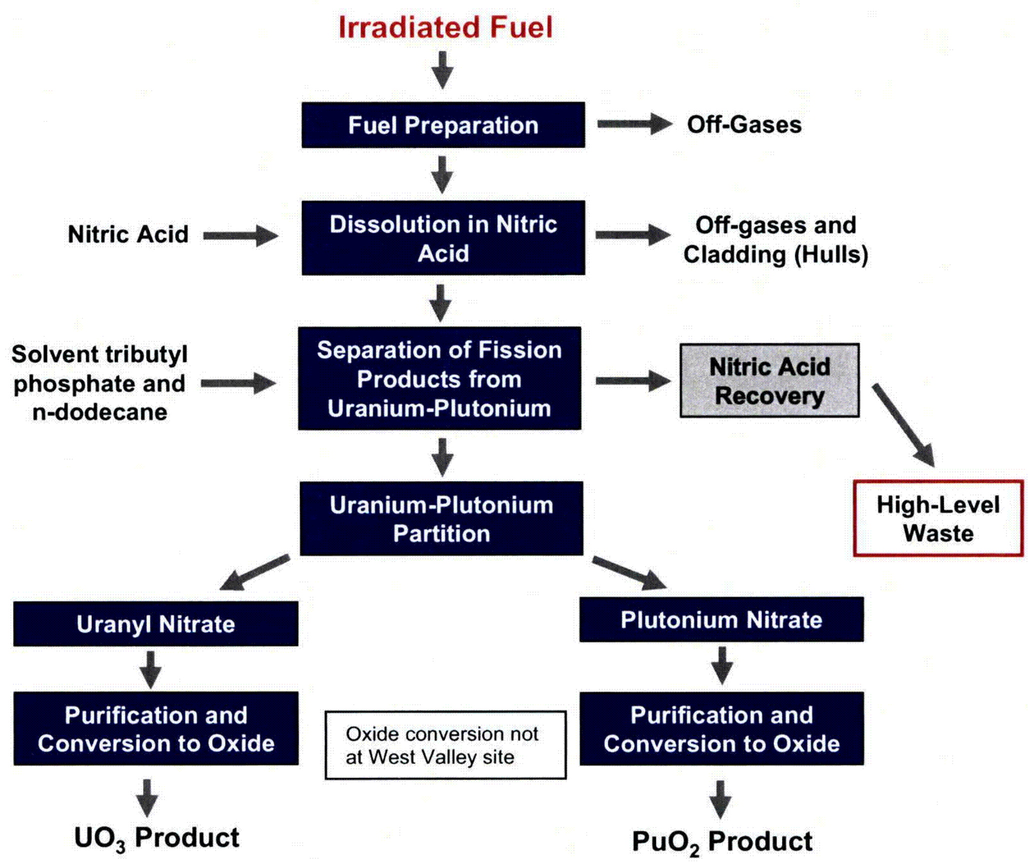

Figure 2-1. Spent Fuel Reprocessing Diagram (PUREX Process)

[1] Plutonium uranium refining by extraction.

Two systems, the HLW Evaporator and the LLW Evaporator were used to reduce the volume of aqueous waste generated during fuel reprocessing operations. The HLW Evaporator reduced the volume of aqueous waste generated during the partition cycle of the solvent extraction process. Both evaporators were used to reduce the volume of aqueous waste generated in the other four solvent extraction cycles.

Use of HLW Tanks 8D-1, 8D-2, 8D-3, and 8D-4

Approximately 580,000 gallons of liquid HLW was produced from the normal operation of the plant in reprocessing uranium fuel using the PUREX process (Duckworth 1972a). This waste was neutralized by the addition of sodium hydroxide before transfer to Tank 8D-2, a 750,000-gallon HLW storage tank. (Tank 8D-1, a spare 750,000-gallon tank identical to 8D-2 was designed for storing excess liquid from Tank 8D-2, but was never used by NFS to store HLW.)

Neutralizing the acidic high-level waste prior to transfer caused most of the fission product elements (the major exception was cesium) to precipitate out and form sludge at the bottom of Tank 8D-2. Therefore, the waste was not homogeneous but was comprised of supernatant liquid and solids (sludge).

Approximately 12,000 gallons of acidic high-level radioactive liquid waste were produced in reprocessing thorium-enriched uranium fuel using the THOREX[2] process. This waste was not neutralized because the thorium would have precipitated out of solution. This acidic waste was stored in Tank 8D-4, a 15,000-gallon capacity stainless steel tank. (Spare Tank 8D-3 is identical to Tank 8D-4 but was never used by NFS to store HLW.)

The radionuclide content of the HLW stored in Tanks 8D-2 and 8D-4 at the completion of reprocessing is given in Table 2-5. The chemical compositions of the supernatant and sludge in Tank 8D-2 at the completion of reprocessing are provided in Tables 2-6 and 2-7, respectively. The chemical composition of Tank 8D-4 at the completion of reprocessing is provided in Table 2-8. The radioactivity content is indexed to the start of HLW processing activities in 1988.

The spent tributyl phosphate/n-dodecane solvent solution used in each of the five solvent extraction cycles was cleaned in the extraction cells after each use. Following solvent wash, the clean solvent was transferred to the solvent storage tank. The spent wash solutions were then sent to tanks in the Liquid Waste Cell.

The Solvent Waste Catch Tank received the spent sodium carbonate and dilute nitric acid wash solutions that were used in the solvent cleanup system. The sodium carbonate and nitric acid washes used in the solvent cleanup were also collected in the Waste Catch Tank and then transferred to the Solvent Waste Hold Tank where they were sampled and subsequently sent through normal plant waste processing (Tank 8D-2 or LLW treatment) depending on their radioactivity concentration.

[2] Thorium reduction extraction.

Other liquid waste from Process Building operations (i.e., acid fractionator condensate, floor drains in various cells, chemical makeup areas, analytical laboratory, wash solutions from decontamination operations, etc.) were either treated in the Low-Level Waste Treatment Facility or routed to the underground waste tanks depending on their radioactivity level.

Use of the Low-Level Waste Treatment Facility

During initial NFS operations prior to construction of the Low-Level Waste Treatment Facility in 1971, low-level wastewater was routed through the Neutralization Pit, the Interceptor, and Lagoons 1, 2, and 3 in series before being discharged to Erdman Brook.

Following construction of the Low-Level Waste Treatment Facility and Lagoons 4 and 5, wastewater containing low levels of radionuclides (<0.005 µCi/mL) was treated in that facility by clarification, filtration, and ion exchange. This wastewater was collected from the Process Building, the Laundry, and the Fuel Receiving and Storage Facility and transported by underground drain lines sequentially to the Neutralization Pit, interceptors, and Lagoon 1, Lagoon 2, and to the Low-Level Waste Treatment Facility for treatment. Treated wastewater was piped to Lagoons 4 or 5, then to Lagoon 3 before batch discharge to Erdman Brook. (NFS 1973). See Figure 2-3 for the location of the Low-Level Waste Treatment Facility.

Radionuclides removed from the water were confined in a sludge that was packaged in drums and disposed of as radioactive waste. Much of the sludge was buried in the NRC-Licensed Disposal Area (NDA), mostly after closure of the SDA in 1975. While NFS used the State-Licensed Disposal Area (SDA) for LLW disposal, the WVDP did not use the SDA for radioactive waste disposal (DOE 1978, Wild 2000).

Table 2-5. Estimated Radionuclide Content (in Curies) of Tanks 8D-2 and 8D-4 at the Completion of Reprocessing[(1)]

Radionuclide	Half-Life (Year)[(2)]	Tank 8D-2 Supernatant	Tank 8D-2 Sludge	Tank 8D-4	Total
H-3	1.23E+01	9.5E+1	~0	<2.0E+00	<9.7E+01
C-14	5.73E+03	1.4E+02	~0	(3)	1.4E+02
Fe-55	2.7E+00	(3)	1.0E+03	(3)	1.0E+03
Ni-59	7.5E+04	(3)	8.2E+01	(3)	8.2E+01
Co-60	5.27E+00	~0	4.7E+00	1.2E+03	1.2E+03
Ni-63	1.00E+02	8.9E+02	6.4E+03	(3)	7.3E+03
Se-79	6.5E+04	3.7E+01	~0		3.7E+01
Sr-90	2.86E+01	2.9E+03	6.9E+06	5.0E+05	7.4E+06
Y-90[3]	7.31E-03	2.9E+03	6.9E+06	5.0E+05	7.4E+06
Zr-93	1.53E+06	(3)	2.3E+02	(3)	2.3E+02
Nb-93m	1.46E+01	(3)	2.3E+02	(3)	2.3E+02

Table 2-5. Estimated Radionuclide Content (in Curies) of Tanks 8D-2 and 8D-4 at the Completion of Reprocessing[1]

Radionuclide	Half-Life (Year)[2]	Tank 8D-2 Supernatant	Tank 8D-2 Sludge	Tank 8D-4	Total
Tc-99	2.13E+05	1.6E+03	[3]	8.0E+01	1.7E+03
Ru-106	1.01E+00	[3]	1.3E+02	<3.1E-01	1.3E+02
Rh-106	9.48E-07	[3]	1.3E+02	<3.1E-01	1.3E+02
Pd-107	6.5E+06	[3]	1.2E+00	[3]	1.2E+00
Sb-125	2.77E+00	4.8E+01	4.5E+03	[3]	4.5E+03
Te-125m	1.59E-01	1.1E+01	1.0E+03	[3]	1.0E+03
Sn-126	1.00E+05	[3]	4.0E+01	[3]	4.0E+01
Sb-126m	3.61E-05	[3]	4.0E+01	[3]	4.0E+01
Sb-126	3.39E-02	[3]	5.6E+01	[3]	5.6E+01
I-129	1.57E+07	2.1E-01	[3]	<1.5E-01	<3.6E-01
Cs-134	2.06E+00	1.4E+04	[3]	2.9E+02	1.4E+04
Cs-135	2.3E+06	1.6E+02	[3]	[2]	1.6E+02
Cs-137	3.02E+01	7.3E+06	[3]	5.1E+05	7.8E+06
Ba-137m[3]	4.85E-06	6.8E+06	[3]	4.8E+05	7.3E+06
Ce-144	7.78E-01	2.9E-05	1.4E+01	<2.0E-02	1.4E+01
Pr-144	3.29E-05	2.9E-05	1.4E+01	<2.0E-02	1.4E+01
Pm-147	2.62E+00	1.7E+02	3.1E+05	4.5E+03	3.1E+05
Sm-151	9.0E+01	1.1E+00	2.1E+05	1.5E+01	2.1E+05
Eu-152	1.36E+01	4.2E-02	4.2E+02	5.8E+00	4.3E+02
Eu-154	8.8E+00	1.4E+01	1.3E+05	2.6E+03	1.3E+05
Eu-155	4.96E+00	2.3E+00	2.3E+04	3.1E+02	2.3E+04
Th-232	1.41E+10	[3]	[3]	1.6E+00	1.6E+00
U-233	1.59E+05	4.9E-01	6.9E+00	2.6E+00	1.0E+01
U-234	2.45E+05	2.9E-01	4.0E+00	3.0E-01	4.6E+00
U-235	7.04E+08	6.4E-03	8.9E-02	4.9E-03	1.0E-01
U-236	2.34E+07	1.9E-02	2.7E-01	1.0E-02	3.0E-01
U-238	4.47E+09	5.7E-02	7.9E-01	6.1E-04	8.5E-01
Np-237	2.14E+06	[3]	1.1E+01	[3]	1.1E+01
Np-239	6.45E-03	[3]	2.4E+03	[3]	2.4E+03
Pu-238	8.78E+01	1.3E+02	6.5E+03	5.3E+02	7.2E+03
Pu-239	2.41E+04	2.5E+01	1.7E+03	1.7E+01	1.7E+03

Table 2-5. Estimated Radionuclide Content (in Curies) of Tanks 8D-2 and 8D-4 at the Completion of Reprocessing[1]

Radionuclide	Half-Life (Year)[2]	Tank 8D-2 Supernatant	Tank 8D-2 Sludge	Tank 8D-4	Total
Pu-240	6.57E+03	1.9E+01	1.3E+03	9.0E+00	1.3E+03
Pu-241	1.44E+01	1.5E+03	8.5E+04	9.3E+02	8.7E+04
Pu-242	3.76E+5	2.5E-02	1.7E+00	1.3E-02	1.7E+00
Am-241	4.32E+02	(3)	7.2E+04	2.7E+02	7.2E+04
Am-242	1.83E-03	(3)	2.1E+01	(3)	2.1E+01
Am-242m	1.52E+02	(3)	2.1E+01	(3)	2.1E+01
Am-243	7.38E+03	(3)	2.4E+03	8.8E+00	2.4E+03
Cm-242	4.47E-01	(3)	2.2E+00	<1.1E-03	2.2E+00
Cm-243	2.85E+01	(3)	1.7E+02	5.0E-02	1.7E+02
Cm-244	1.81E+01	(3)	2.2E+04	1.6E+01	2.2E+04
Cm-245	8.50E+03	(3)	1.0E+01	1.2E-03	1.0E+01
Cm-246	4.75E+03	(3)	4.3E+00	(3)	4.3E+00

NOTES: (1) From Eisenstatt 1986, fission and activation products decay-corrected to July 1987.
(2) Half-life values from Grove Engineering 2003.
(3) Not present or undetectable.
(4) The progeny of Sr-90 and Cs-137 are included here counter to normal practice because they were reported in Table 6 of Eisenstatt 1986.

Table 2-6. Chemical Composition of Tank 8D-2 Supernatant at the Completion of Reprocessing[1]

Compound	% (weight of compound/total weight of supernatant) Wet Basis	% (weight of compound/total weight of compounds) Dry Basis	Total Weight of compounds in Supernatant (Kg)
$NaNO_3$	21.10	53.38	602,659
$NaNO_2$	10.90	27.57	311,326
Na_2SO_4	2.67	6.76	76,261
$NaHCO_3$	1.49	3.77	42,557
KNO_3	1.27	3.21	36,274
Na_2CO_3	0.884	2.24	25,249
NaOH	0.614	1.55	17,537
K_2CrO_4	0.179	0.45	5,113
NaCl	0.164	0.42	4,684
Na_3PO_4	0.133	0.34	3,799

Table 2-6. Chemical Composition of Tank 8D-2 Supernatant at the Completion of Reprocessing[1]

Compound	% (weight of compound/total weight of supernatant) Wet Basis	% (weight of compound/total weight of compounds) Dry Basis	Total Weight of compounds in Supernatant (Kg)
Na_2MoO_4	0.0242	0.06	691
Na_3BO_3	0.0209	0.05	597
$CsNO_3$	0.0187	0.05	534
NaF	0.0176	0.04	503
$Sn(NO_3)_4$	0.00859	0.02	245
$Na_2U_2O_7$	0.00808	0.02	231
$Si(NO_3)_4$	0.00806	0.02	230
$NaTcO_4$	0.00620	0.02	177
$RbNO_3$	0.00416	0.01	119
Na_2TeO_4	0.00287	0.007	82
AlF_3	0.00271	0.007	77
$Fe(NO_3)_3$	0.00152	0.004	43
Na_2SeO_4	0.00054	0.001	15
$LiNO_3$	0.00048	0.001	14
H_2CO_3	0.00032	0.0008	9
$Cu(NO_3)_3$	0.00022	0.0005	6
$Sr(NO_3)_2$	0.00013	0.0004	4
$Mg(NO_3)_2$	0.0008	0.0002	2
Compound Totals	**39.53 %**	**100.00 %**	**1,129,038**
Total H_2O (100% - 39.53%)	**60.47 %**	**NA**	**1,727,164**

NOTE: (1) From Eisenstatt 1986.

Table 2-7. Chemical Composition of Tank 8D-2 Sludge at the Completion of Reprocessing[1]

Compound	Total Mass in Sludge (kg)	Compound	Total Mass in Sludge (kg)
$Fe(OH)_3$	66,040	$Cu(OH)_2$	376
$FePO_4$	6,351	$Zr(OH)_2$	159
$Al(OH)_3$	5,852	$Sm(OH)_3$	143
MnO_2	4,581	$Zn(OH)_2$	128
$CaCO_3$	3,208	$Cr(OH)_3$	65
$UO(OH)_2$	3,087	$Hg(OH)_2$	23
$Ni(OH)_2$	1,088	$Eu(OH)_3$	7.5
SiO_2	1,263	$Gd(OH)_3$	1.7
$MgCO_3$	826	$Pm(OH)_3$	1.5
AlF_3	536		
Fission Products		**Fission Products**	
$Zr(OH)_4$	805	$Y(OH)_3$	103
$Nd(OH)_3$	621	$Rh(OH)_4$	79
$Ru(OH)_4$	458	$Pd(OH)_2$	34
$Ce(OH)_3$	354	$Sn(OH)_4$	2.5
$BaSO_4$	303	$Cd(OH)_2$	1.7
$SrSO_4$	217	AgOH	0.7
$La(OH)_3$	185	$Sb(OH)_3$	0.7
$Pr(OH)_3$	170	$In(OH)_3$	0.3
Transuranics		**Transuranics**	
PuO_2	37	AmO_2	28
NpO_2	35	CmO_2	0.4
Total Chemical Composition = 97,172 kg			

NOTE: (1) From Eisenstatt 1986, with fission products reported separately, unlike other tables, consistent with Eisenstatt 1986.

Table 2-8. Chemical Composition of Tank 8D-4 Waste at the Completion of Reprocessing[1]

Compound	% (Mass of Compound/Mass of Solution)	Total Solution Mass in Tank (kg)	Compound	% (Mass of Compound/Mass of solution)	Total Solution Mass in Tank (kg)
$Th(NO_3)_4$	26.69	12,997	$Ce(NO_3)_3$	0.0387	19
$Fe(NO_3)_3$	19.41	9,452	$Zr(NO_3)_4$	0.0288	14
$Al(NO_3)_3$	9.57	4,660	$Sm(NO_3)_3$	0.0286	14
HNO_3	4.88	2,376	$La(NO_3)_3$	0.0269	13
$Cr(NO_3)_3$	4.40	2,143	$Pr(NO_3)_3$	0.0267	13
$Ni(NO_3)_2$	1.81	881	$Zn(NO_3)_2$	0.0226	11
H_3BO_3	1.10	536	$Rh(NO_3)_4$	0.0222	11
$NaNO_3$	0.759	370	Na_2TcO_4	0.0206	10
Na_2SO_4	0.414	202	$UO_2(NO_3)_3$	0.0156	8
KNO_3	0.294	143	$Y(NO_3)_3$	0.0134	7
Na_2SiO_3	0.290	141	Na_2SeO_4	0.00767	4
K_2MnO_4	0.281	137	$RbNO_3$	0.00619	3
$Nd(NO_3)_3$	0.146	71	$Co(NO_3)_2$	0.00505	2
$Mg(NO_3)_3$	0.131	64	$Pd(NO_3)_4$	0.00469	2
NaCl	0.115	56	NaF	0.00244	1
Na_2MoO_4	0.114	56	$Cu(NO_3)_2$	0.00177	0.9
$Ca(NO_3)_2$	0.0700	34	$Pu(NO_3)_4$	0.00152	0.7
$Ba(NO_3)_2$	0.0697	34	$Eu(NO_3)_3$	0.00142	0.7
$Ru(NO_3)_4$	0.0643	31	$Gd(NO_3)_3$	0.00037	0.2
$CsNO_3$	0.0502	24	[1]$X(NO3)_4$	0.00035	0.2
Na_2TeO_4	0.0410	20	$Pm(NO_3)_2$	0.00034	0.2
$Sr(NO_3)_2$	0.0407	20			
Total Weight % in Solution = 71.02 % (total mass of compounds/total mass of solution) or 34,583 kg in Tank. Total weight % of H_2O (100% - 71.02%) = 28.98 % or 14,114 kg in Tank					
Solids					
Compound	**Total Solids Mass (kg)**		**Compound**	**Total Solids Mass (kg)**	
$Th(NO_3)_4$	18,958		Insolubles	39	

NOTE: (1) From Eisenstatt 1986. LEGEND: X = Am-241, Am-243, Cm-242, Cm-243, Cm-244, Cm-24

2.1.2 West Valley Demonstration Project From 1982 to 2008

To meet its objective of solidifying HLW at the site, the WVDP developed the Integrated Radwaste Treatment System and built the Vitrification Facility.

Integrated Radwaste Treatment System

The Integrated Radwaste Treatment System was designed for supernatant and sludge wash solution processing, solidification, and storage. The Integrated Radwaste Treatment System was comprised of four components:

- The Supernatant Treatment System, which decontaminated solutions from the HLW tanks through an ion-exchange process;
- The Liquid Waste Treatment System, which employed an evaporator to concentrate solutions received from the Supernatant Treatment System and byproduct solutions received from vitrification operations;
- The Cement Solidification System that was used to solidify Liquid Waste Treatment System concentrates; and
- The Drum Cell, which provided storage for solidified wastes received from the Cement Solidification System.

The Integrated Radwaste Treatment System pretreatment process is illustrated in Figure 2-2. The initial objective of this system was successfully attained in 1995, resulting in nearly 20,000 drums of solidified waste stored in the Drum Cell. In 2007 those drums were shipped to an offsite LLW disposal facility, leaving the Drum Cell empty of stored radioactive waste in 2008.

Vitrification Facility

This facility was designed for the stabilization and packaging of HLW sludge and contaminated ion-exchange resin (zeolite) generated as a byproduct of Supernatant Treatment System operations. It stabilized the following waste streams in a borosilicate glass matrix: (1) the HLW sludge in Tank 8D-2 that had been generated during PUREX reprocessing by NFS, (2), spent Supernatant Treatment System zeolite, and (3) acidic THOREX waste from Tank 8D-4 generated by the reprocessing of thorium fuel.

The former reprocessing facilities were modified to accommodate the vitrification system and ancillary waste treatment and storage systems. Modifications included removing the reprocessing equipment and decontaminating a number of process cells so that workers could enter the cells for extended periods without respiratory protection. After cleaning the former reprocessing cells, equipment was installed to process gaseous and liquid waste streams. Risers were remotely installed in the HLW tanks, and equipment and pumps were installed for processing HLW supernatant and washing HLW sludge.

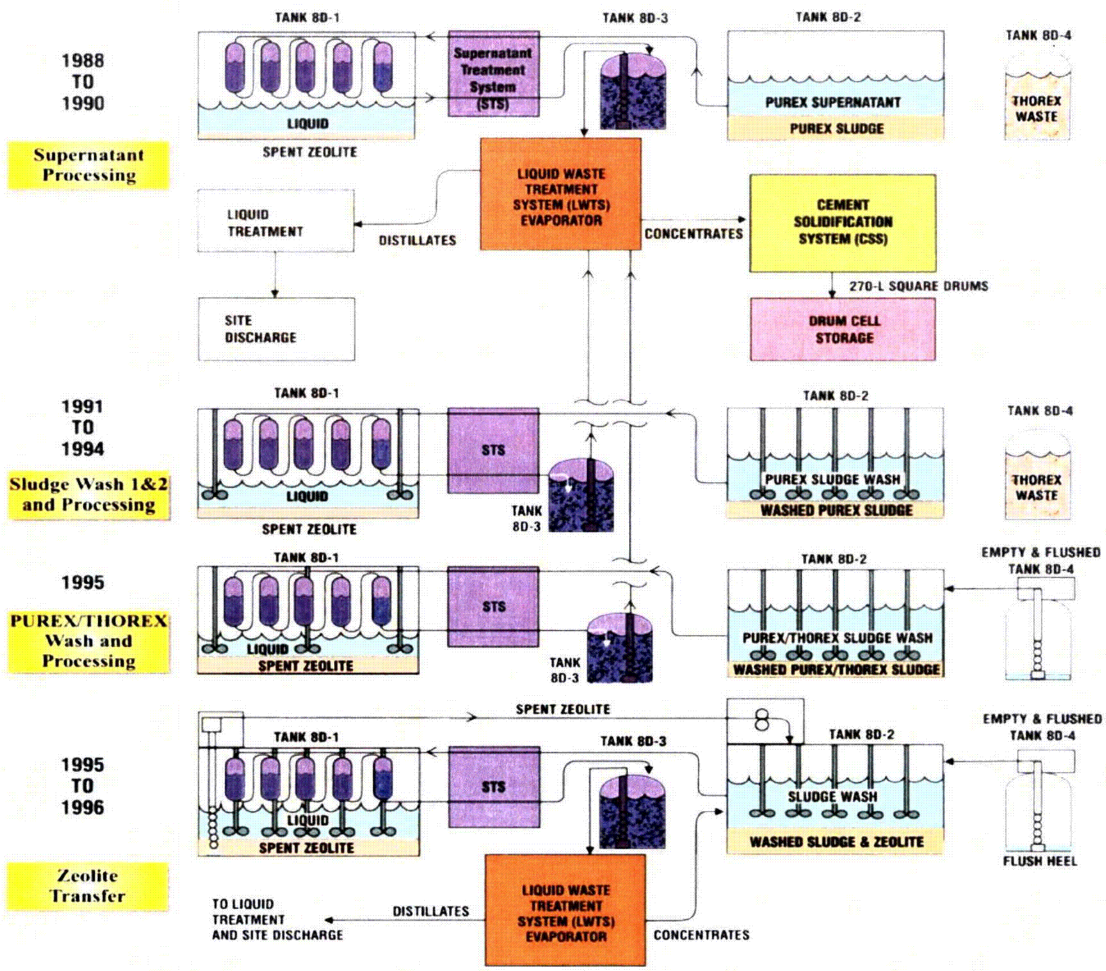

Figure 2-2. Simplified HLW Pretreatment Process Diagram

Underground Waste Tanks 8D-1, 8D-2, 8D-3, and 8D-4

Pre-Vitrification HLW tank usage by the WVDP is outlined in Section 2.1.2 under Integrated Radwaste Treatment System. Tank 8D-1 was used to house the Supernatant Treatment System treatment columns used to remove radioactivity from the Tank 8D-2 supernatant, sludge wash, and PUREX/THOREX wash processing campaigns. The treated liquid was transferred to Tank 8D-3 and then volume-reduced in the Liquid Waste Treatment System, and solidified in the Cement Solidification System for offsite disposal as LLW. The zeolite resin used to treat the supernatant, sludge wash, and PUREX/THOREX wash remained in Tank 8D-1, and was added to the feed mixture to be vitrified. The thorium-bearing HLW from tank 8D-4 was mixed with the contents of tank 8D-2 and washed to remove soluble salts before being readied for vitrification.

Solidification Activities

During the vitrification process, the mobilized sludge and cesium-loaded zeolite resin (which was transferred from Tank 8D-1 to Tank 8D-2) were transferred to the Concentrator Feed Makeup Tank in the Vitrification Cell, where excess water was removed and glass formers added. The resulting mixture was then transferred to the Melter Feed Hold Tank. From this tank, the feed was delivered to the Slurry-Fed Ceramic Melter, where it was heated to form a molten, waste-loaded, borosilicate glass.

The molten glass was then poured into a stainless steel canister located in and positioned by a rotating turntable. Once a canister was filled, it remained on the turntable for initial cooling, then it was removed from the turntable for further cooling, canister lid welding, and external decontamination. The borosilicate glass matrix filled each canister to more than 80 percent of its volume as required by the Waste Acceptance Product Specifications established by DOE (DOE 1993).

After decontamination, the canister was loaded onto a transfer cart that moved on rails through the transfer tunnel and into the High Level Waste Interim Storage Facility (the former Chemical Process Cell) in the Process Building, where the canisters were loaded into racks for storage. The canisters will remain there until they are transported to an alternate storage location.

A total of 275 canisters of HLW were produced. Two additional canisters were filled with materials which remained in the melter. The solidification of the liquid HLW waste was completed in September 2002 and the Vitrification Facility was radiologically characterized in November 2002 (Lachapelle 2003)[3].

Table 2-9 provides the major chemical components of the glass waste form, and Table 2-10 describes the radionuclide content of a typical vitrified HLW canister processed during the HLW vitrification campaign (WVNSCO 2007a).

Sodium-Bearing Waste

As a component of tank management over time, sodium salts were added to the HLW tanks to limit corrosion of the carbon steel tanks. More recently, clean utility water used to cool the in-tank mobilization pumps added excess fluids to the HLW tanks before and during vitrification. Since sodium is a limiting ingredient in a qualified glass recipe, the high-sodium water was segregated from the HLW feed mixture. A process was developed to volume-reduce the waste water containing high levels of sodium and solidify the 11,500 gallons of concentrate into a form suitable for LLW land disposal. The solidification was completed within the 01-14 building in 2004, and the sodium-bearing waste was shipped for disposal in 2007. (Rowell 2001, WVNSCO and URS 2005, Bower 2008)

The amount of residual radioactivity in the HLW tanks is discussed in Section 4.1.

[3] This characterization took place before decontamination of the Vitrification Cell, which entailed removing the slurry-fed ceramic melter, tanks, and other equipment.

Liquid LLW Streams

Under the WVDP, the Low-Level Waste Treatment Facility included the Neutralization Pit, the interceptors, Lagoons 2-5, and the LLW2 Building, which replaced the NFS O2 Building. The wastewater is collected in one of the interceptors. After radiological analysis, the wastewater is transferred to Lagoon 2 and is then treated in the LLW2 Building. Following treatment, the wastewater is transferred to Lagoons 4 and 5. If the treated wastewater in Lagoons 4 and 5 meets specifications, it is transferred to Lagoon 3 for eventual release through a State Pollutant Discharge Elimination System-permitted outfall to Erdman Brook. Out-of-specification wastewater is returned to Lagoon 2 and is re-treated.

In summary, under the WVDP the Vitrification Facility, the Integrated Radwaste Treatment System, the Sludge Mobilization System, and a new low level waste treatment facility (LLW2 Building) were developed and operated. The waste (supernatant and sludge) in the HLW tanks was vitrified and solidified in stainless steel canisters that are stored in the High-Level Waste Interim Storage Facility in the Process Building.

Table 2-9. Chemical Composition of Glass Waste Form[(1)]

Component	Nominal Weight %	Range Weight %		Component	Nominal Weight %	Range Weight %	
AgO	0.0001			Nd_2O_3	0.1209	0.08	0.19
Al_2O_3	2.8295	1.19	7.15	NiO	0.3358	0.22	0.52
AmO_2	0.0073			NpO_2	0.0224	0.01	0.03
BaO	0.0540	0.04	0.08	P_2O_5	2.5084	0.21	3.16
B_2O_3	9.9516	9.33	10.66	PdO	0.0062		
CaO	0.5993	0.39	0.93	Pm_2O_3	0.0003		
CdO	0.0003			Pr_6O_{11}	0.0321	0.02	0.05
CeO_2	0.0670	0.04	0.10	PuO_2	0.0076		
CmO_2	0.0001			Rb_2O	0.0005		
CoO	0.0002			RhO_2	0.0136	0.01	0.02
Cr_2O_3	0.3112	0.21	0.48	RuO_2	0.0759	0.05	0.12
Cs_2O	0.0826	0.05	0.13	SO_3	0.2164	0.14	0.33
CuO	0.0001			Sb_2O_3	0.0001		
Eu_2O_3	0.0014			SeO_2	0.0005		
Fe_2O_3	12.1573	8.32	18.50	SiO_2	44.8770	42.08	48.10
Gd_2O_3	0.0003			Sm_2O_3	0.0267	0.02	0.04
In_2O_3	0.0001			SnO_2	0.0006		
K_2O	3.5733	3.36	3.84	SrO	0.0269	0.02	0.04

Table 2-9. Chemical Composition of Glass Waste Form[(1)]

Component	Nominal Weight %	Range Weight %		Component	Nominal Weight %	Range Weight %	
La_2O_3	0.0337	0.02	0.05	Tc_2O_7	0.0021		
Li_2O	3.0315	2.84	3.25	ThO_2	3.5844	1.83	6.56
MgO	1.3032	1.22	1.39	TeO_2	0.0028		
MnO_2	1.3107	0.84	1.96	TiO_2	0.9800	0.92	1.05
MoO_2	0.0088		0.01	UO_2	0.5605	0.37	0.87
NaCl	0.0183	0.01	0.03	Y_2O_3	0.0177	0.01	0.03
NaF	0.0013			ZnO	0.0010		
Na_2O	10.9335	10.25	11.71	ZrO_2	0.2943	0.19	0.45
Insolubles	0.0080						

NOTE: (1) From Eisenstatt 1986.

Table 2-10. Typical HLW Canister Radionuclide Content[(1)]

Radionuclide	Estimated Activity (Ci/canister)	Radionuclide	Estimated Activity (Ci/canister)
Ni-63	3.5E+01	Pu-240	4.0E+00
Sr-90	1.36E+04	Pu-241	1.75E+02
Sm-151	1.89E+02	Am-241	1.53E+02
Cs-137	2.34E+04	Cm-243	1.0E+01
Pu-238	1.9E+01	Cm-244	3.5E+01
Pu-239	5.0E+00		

NOTE: (1) From WVNSCO 2007a

2.2 Site Decontamination Activities (1966 – 2011)

This section summarizes remediation activities[4] performed by NFS, those that have been performed by the WVDP, and those that will be performed by the WVDP to establish the interim end state before the beginning of activities under this plan. Although the WVDP remediation activities have generally been performed in connection with cleanup, modifications, or deactivation work, they are relevant to the starting point for the decommissioning.

[4] For purposes of this section, the terms *remediation* and *decontamination* are roughly equivalent. Each is defined as the removal of undesired residual radioactivity from facilities, soil, or equipment prior to release (NRC 2006). The term *remediation* may also be used in the context of preparing facilities to conform to specific requirements using fixatives or other treatments.

2.2.1 NFS Remediation Activities (1966 – 1981)

During the 1960s, NFS remediation efforts were limited to those actions needed to maintain production, such as spill cleanup and equipment replacement. In the 1970s, NFS initiated decontamination activities initially in preparation for extensive in-cell reliability and expansion work to increase production. Decontamination procedures were prepared for decontamination of the partition cycle, uranium cycle, plutonium cycle, solvent recovery systems, acid recovery system and acid storage tanks, and the dissolver off-gas system (Riethmiller 1981).

Gross decontamination was accomplished by flushing process tanks and piping and removing loose contamination from the cells and process equipment. In some cases, fixatives were applied to contamination that could not be readily removed.

Changes in mixed fission product activity levels were determined from measurements obtained by lowering dosimeters, strung at various levels, into Extraction Cells 1, 2, and 3 through holes drilled in the Extraction Chemical Room floor. Activity removed by decontamination activities from 1972 through 1977, including amounts of uranium and plutonium, is summarized in Table 2-11. No extensive decontamination activities are documented from 1977 until commencement of DOE operations in 1982.

Table 2-11. Activity Removed by NFS for the Period 1972 Through 1977(1)

Year	Mixed Fission Products (curies)	Uranium (grams)	Plutonium (grams)
1972	182,758.1	47,700	1550
1973	886.2	3,722	24
1974	659.6	5,099	229
1975	15	572	12
1976	22.3	282	18
1977	6.8	718	1
Total	184,348	58,093	1,834

NOTES: (1) From Riethmiller 1981.

Radioactive material generated during the NFS remediation work was disposed of as radioactive waste in the NDA and SDA.

2.2.2 WVDP Remediation Activities (1982 – 2011)

After 1982, remediation activities included decontamination, waste removal, equipment removal, and the application of fixatives. Procedures were developed by West Valley Nuclear Services Company (WVNSCO) as part of the remediation project for each facility. Radioactive material and waste generated or removed as part of remediation activities were packaged for offsite shipment or temporary storage, with some waste disposed of in the NDA prior to 1987.

Figures 2-3 and 2-4 show those WVDP facilities that have had a history of radiological contamination. Figure 2-5 shows locations of planned remediation activities for site facilities before Phase 1 of the proposed decommissioning. Table 2-12 that follows these figures provides a legend for the acronyms and abbreviations in the figures. This table also identifies the functions of the facilities.

List of Facilities Remediated or to be Remediated

Table 2-13 that follows these figures lists those facilities (in alphabetical order) that have been or will be remediated (or partially remediated) before the start of the Phase 1 of the proposed decommissioning. The type and form of contamination are specified, as well as information on the radiological conditions before and after remediation based on available data. The activities that caused the facility to become contaminated are also summarized. Facilities that have been removed as of 2008 are identified as "Removed." More-detailed descriptions of these facilities appear in Section 3, along with layout drawings showing their locations. Section 3 also contains photographs of many of these facilities.

Note that Table 2-13 does not list non-radiological facilities that have been or will be removed as part of the work to establish the interim end state, such as the Cold Chemical facility, the Vehicle Repair shop, and the Vitrification Test Facility (as shown on Figure 2-5). The table also does not address facilities outside of the project premises since the scope of the Phase 1 proposed decommissioning activities is limited to the project premises.

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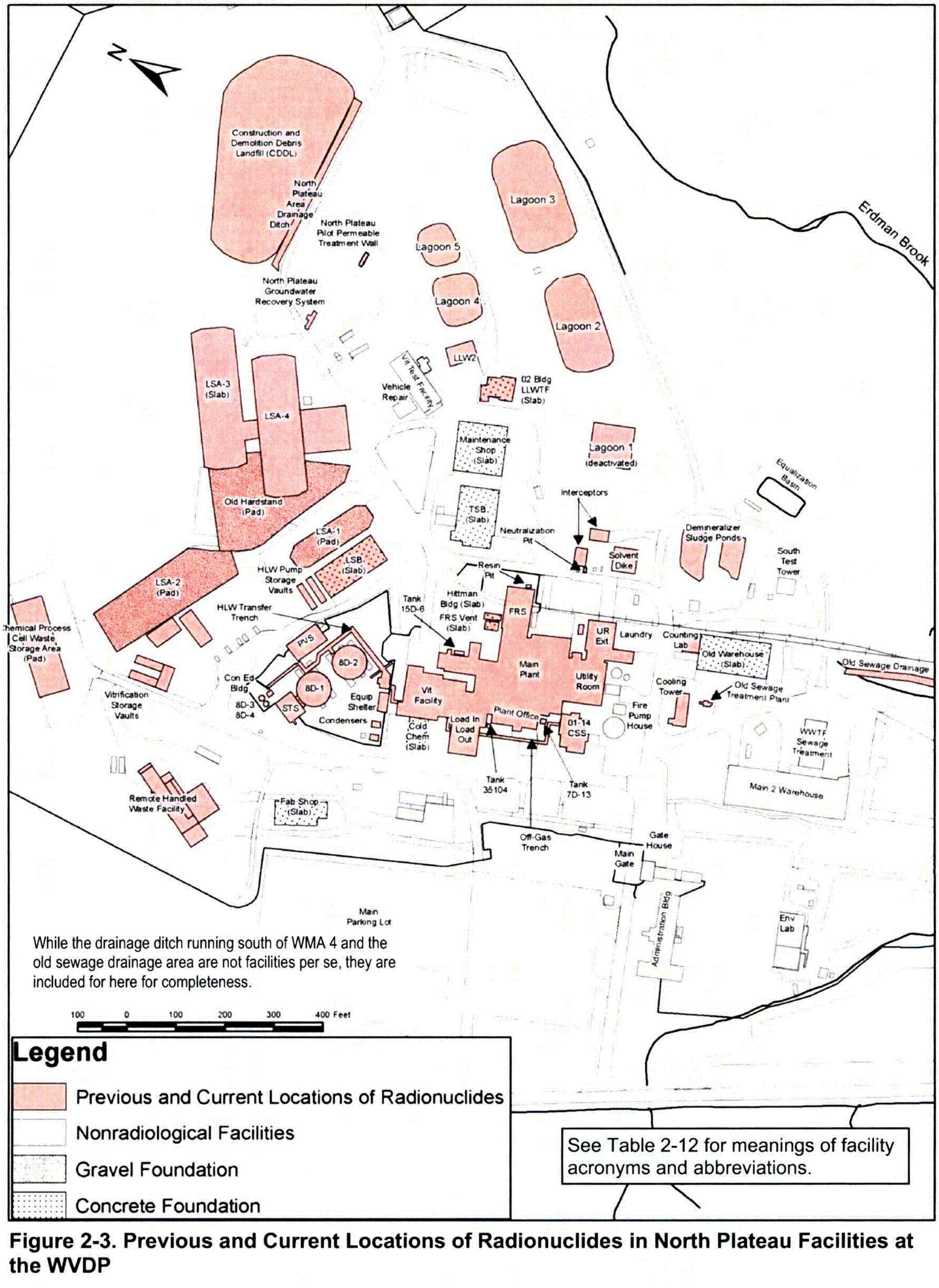

Figure 2-3. Previous and Current Locations of Radionuclides in North Plateau Facilities at the WVDP

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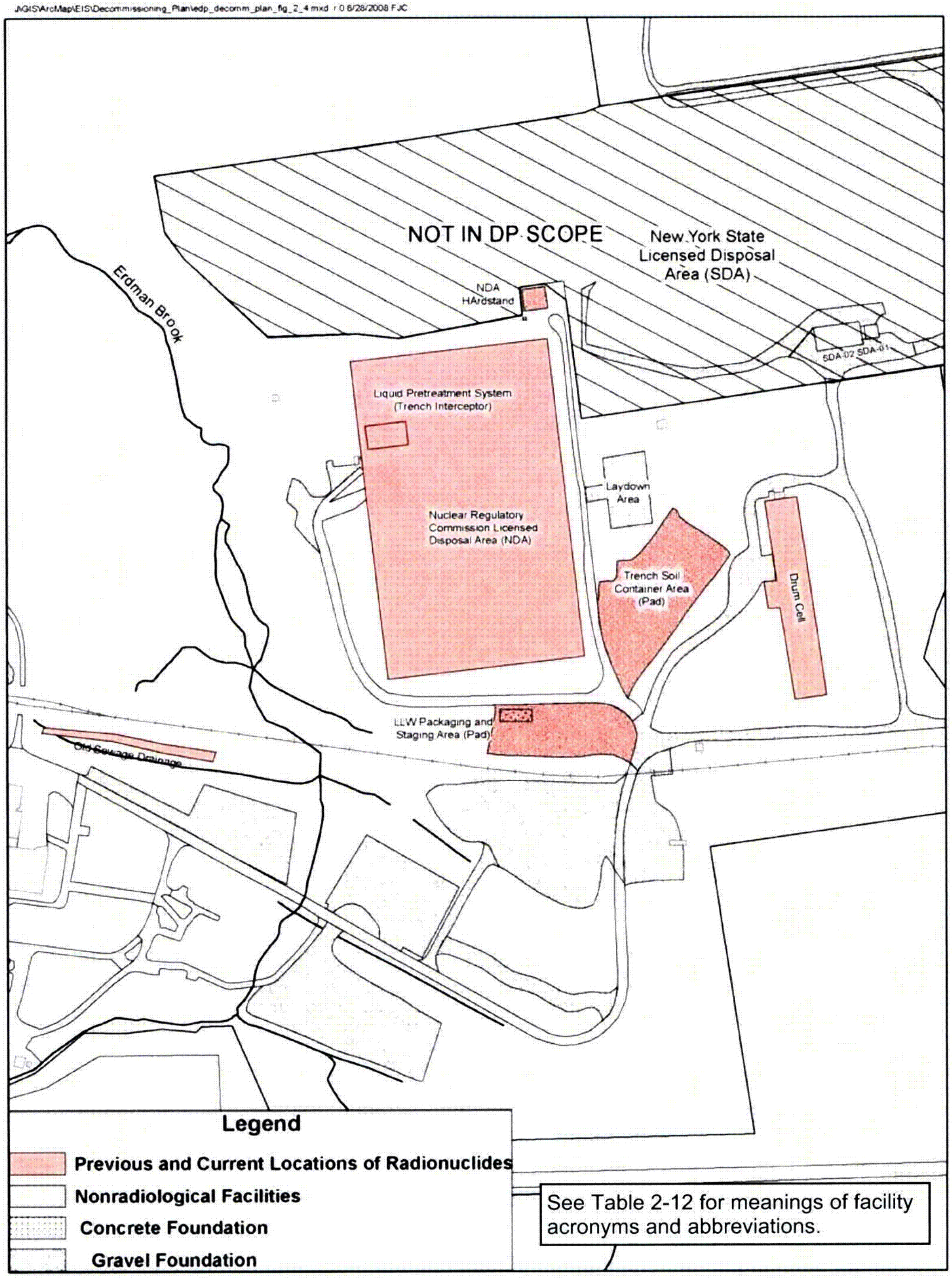

Figure 2-4. Previous and Current Locations of Radionuclides in South Plateau Facilities at the WVDP

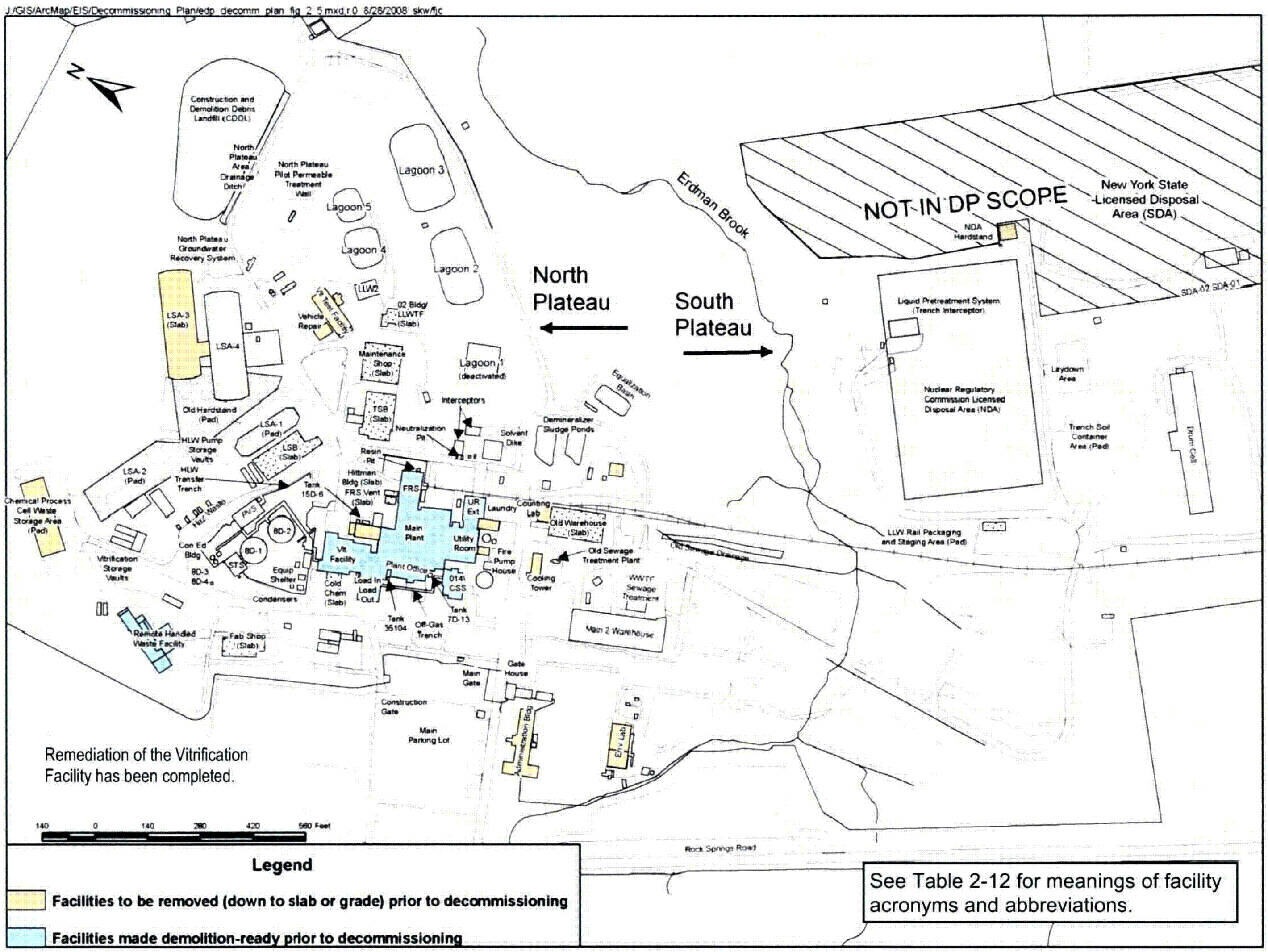

Figure 2-5. Locations of Planned Remediation Activities for Site Facilities Prior to Phase 1 of the Proposed Decommissioning

Table 2-12. Facilities Shown in Figures 2-3 through 2-5

Designation	Facility	Function
8D-1, -2, -3, -4	Underground waste tanks	Designed to store HLW; 8D-1, 8D-2, and 8D-4 have contained HLW.
01-14	The Cement Solidification System building	Facility housed the Cement Solidification System and the vitrification off-gas treatment equipment.
CDDL	Construction & Demolition Debris Landfill	Non-radioactive waste burial area.
Cold Chem	Cold Chemical facility	Housed containerized non-radioactive chemicals.
Con Ed Bldg	Consolidated Edison Building	Houses HLW tank instrumentation and equipment.
CPC-WSA	Chemical Process Cell Waste Storage Area	Storage for equipment and waste from the CPC (now HLW Interim Storage Facility).
CSS	Alternate designation for the 01-14 building	Facility housed the Cement Solidification System and the vitrification off-gas treatment equipment.
Env Lab	Environmental Laboratory	Houses environmental testing equipment and instrumentation.
Equip. Shelter	Equipment Shelter	Houses HLW tank instrumentation and equipment.
Fab Shop	Fabrication Shop	Non-radioactive metal fabrication shop – demolished, slab remaining.
FRS	Fuel Receiving and Storage Facility	Formerly used to store spent nuclear fuel.
FRS Vent	Fuel Receiving and Storage Ventilation Building	Housed cooling system equipment for the FRS pool water – demolished, slab remaining.
LLW2	Low Level Waste 2	Houses low level radioactive liquid treatment system currently in use.
LLWTF	Low Level Waste Treatment Facility	Housed low level radioactive liquid treatment system – demolished, slab remaining.
LSA 1	Lag Storage Area 1 (also, LSA2, LSA3 and LSA4)	Containerized radioactive waste storage. LSA1 and LSA2 have been removed, gravel pads remain.
LSB	Lag Storage Building	Containerized radioactive waste storage building – demolished, slab remaining.
NDA	NRC-Licensed Disposal Area	Radioactive waste burial area.
O2 Bldg	An alternate designator for the LLWTF	Housed low level radioactive liquid treatment system – demolished, slab remaining.
PVS	Permanent Ventilation System [Building]	Provides ventilation for the Supernatant Treatment System and the underground waste tanks.
STS	Supernatant Treatment System [Building]	Facility used primarily for treatment of HLW supernatant.
TSB	Test and Storage Building	Non-radioactive fabrication and testing shop – demolished, slab remaining.
UR Expan	Utility Room expansion facility	Houses utility systems equipment.
Vit. Facility	Vitrification Facility	Housed systems for solidifying HLW.
WWTF	Waste Water Treatment Facility	Sewage Treatment Plant.

Table 2-13. Facilities Remediated or to be Remediated by the WVDP Before Decommissioning[1]

Facility	Location and Function	Principal Radionuclides			Expected Status at the Start of Phase 1 of the Decommissioning
		Type	Form	Initial Activity and Cause of Contamination	
01-14 Building	WMA-1 Radioactive waste processing system facility	Radionuclide mix typical of feed and waste contamination[2]	Surface contamination, fixed contamination	Contamination from previous solidification system operations, and filtration/treatment of vitrification off-gas.[3]	Deactivated and prepared for demolition. Partially decontaminated, radiation area in some cells, significant contamination in filters (if still in place).
Chemical Process Cell Waste Storage Area	WMA-5 Containerized LLW storage	Radionuclide mix typical of feed and waste contamination[2]	Surface contamination	~275 Ci Cs-137 in packaged equipment as of 1996.[4] 15 mR/h from stored waste, removable contamination below detection limits.[6] Incidental contamination possible from radioactive waste container storage activities.	Removed to grade. No contamination above 10 CFR 835 control limits.[5]
Contact Size Reduction Facility	WMA-1 Radioactive waste size reduction system facility	Radionuclide mix typical of feed and waste contamination[2]	Surface contamination	5 mR/h, removable contamination below detection limits.[6] Incidental contamination possible from radioactive waste size reduction activities.	Removed to concrete slab. No contamination above 10 CFR 835 control limits.[5]
Cooling Tower	WMA-6 Utility water cooling system	Radionuclide mix typical of feed and waste contamination[2]	Fixed surface contamination	< 0.1 mR/h, removable contamination below detection limits.[6] Coil leaks from contaminated cooling water.	Removed to concrete basin. Contamination above 10 CFR 835 control limits, posting required.[5]
FRS Ventilation Building	WMA-1 Cooling system for fuel pool water	Fission products and transuranics from spent fuel	Surface contamination	1.3 mR/h, removable contamination below detection limits.[7] Spent nuclear fuel pool water contamination.	Removed October 2006, slab remains. No contamination above 10 CFR 835 control limits.[5]
Lag Storage Addition 1 (LSA 1)	WMA-5 Radioactive waste container staging area	Radionuclide mix typical of feed and waste contamination[2]	Low-level fixed contamination in some areas	< 0.1 mR/h, removable contamination below detection limits.[7] Incidental contamination from containerized LLW staging and sorting activities.	Removed 2006, slab remains. No contamination above 10 CFR 835 control limits.[5]
Lag Storage Addition 2 (LSA 2 hardstand)	WMA-5 Radioactive waste container staging area	Radionuclide mix typical of feed and waste contamination[2]	Low-level fixed contamination in some areas	15 mR/h from stored waste, removable contamination below detection limits.[6] Incidental contamination from containerized LLW staging and sorting activities.	Slab remains. No contamination above 10 CFR 835 control limits.[5]

Table 2-13. Facilities Remediated or to be Remediated by the WVDP Before Decommissioning[(1)]

Facility	Location and Function	Principal Radionuclides			Expected Status at the Start of Phase 1 of the Decommissioning
		Type	Form	Initial Activity and Cause of Contamination	
Lag Storage Addition 3 (LSA 3)	WMA-5 Radioactive waste container staging area	Radionuclide mix typical of feed and waste contamination[(2)]	Low-level fixed contamination in some areas	50-100 mR/h from stored waste, removable contamination below detection limits.[(6)] Incidental contamination from containerized LLW staging & sorting activities.	Slab remains. No contamination above 10 CFR 835 control limits.[(5)]
Lag Storage Building	WMA-5 Radioactive waste container staging area	Radionuclide mix typical of feed and waste contamination[(2)]	Low-level fixed contamination in some areas	< 0.1 mR/h, removable contamination below detection limits.[(7)] Incidental contamination from containerized LLW staging & sorting activities.	Removed October 2006, slab remains. No contamination above 10 CFR 835 control limits.[(5)]
Laundry Room	WMA-1 Contaminated clothing cleaning facility	Radionuclide mix typical of feed and waste contamination[(2)]	Surface contamination, fixed contamination	0.4 mR/h, 2,000 dpm/100 cm^2 beta.[(8)] Incidental contamination from sorting and handling of contaminated laundry.	To be removed to concrete slab. Contamination above 10 CFR 835 control limits, posting required.[(5)]
LLWTF (O2 Building)	WMA-2 Radioactive material processing system facility	Radionuclide mix typical of feed and waste contamination[(2)]	Surface contamination, fixed contamination	0.12 mR/h, 3,700 dpm/100 cm^2 beta.[(7)] Contamination from previous radioactive water treatment system operations.	Removed October 2006, slab remains. Contamination above 10 CFR 835 control limits, posting required. [(5)]
Maintenance Shop	WMA-2 Tool crib and non-radiological equipment maintenance.	Radionuclide mix typical of feed and waste contamination[(2)]	Incidental surface contamination	< 0.1 mR/h, removable contamination below detection limits.[(8)] Incidental contamination from mud nests (bird and wasp) and tools.	Removed June 2007, slab remains. No contamination above 10 CFR 835 control limits.[(5)]
Master Slave Manipulator Repair Shop	WMA-1 Radioactive equipment repair	Radionuclide mix typical of feed and waste contamination[(2)]	Surface contamination	2.4 mR/h.[(6)] Disassembly and repair of radiologically contaminated equipment.	To be removed to concrete slab. No contamination above 10 CFR 835 control limits[(5)]
NDA Hardstand/ Staging Area	WMA-7 Radioactive waste container staging area	Fission products and transuranics from spent fuel	Surface contamination, soil contamination	6 mR/h, 6,300 dpm/100 cm^2 beta.[(7)] Storage of waste containers prior to disposal.	Above-grade structure removed September 2006, gravel pad remains. Contamination above 10 CFR 835 control limits, posting required. [(5)]

Table 2-13. Facilities Remediated or to be Remediated by the WVDP Before Decommissioning[1]

Facility	Location and Function	Principal Radionuclides			Expected Status at the Start of Phase 1 of the Decommissioning
		Type	Form	Initial Activity and Cause of Contamination	
Old/New hardstand	WMA-5 Radioactive transport vehicle staging area	Radionuclide mix typical of feed and waste contamination[2]	Surface contamination, soil contamination	~10 Ci beta, ~2 Ci alpha prior to transfer to Lagoon 1 for stabilization.[9] Storage of radioactive material transport containers prior to disposition.	Removed contaminated asphalt and peripheral biomass in 1984, gravel pad remains. Contamination above 10 CFR 835 control limits, posting required.[5]
Old Sewage Treatment Facility	WMA 6 Sanitary waste treatment until 1985	Radionuclide mix typical of feed and waste contamination[2]	Possible surface contamination	Low level radioactivity may be present from sewage lines running from the Process Building.	Possible low level contamination in concrete basins and other remaining equipment.
Old (Main 1) Warehouse	WMA-6 Receipt and storage of non-radiological materiel	Radionuclide mix typical of feed and waste contamination[2]	Incidental surface contamination	< 0.1 mR/h with removable contamination below detection limits.[8] Incidental contamination from wasp, bird, and rodent nests.	Removed May 2006, slab remains. No contamination above 10 CFR 835 control limits.[5]
Process Building	WMA-1 Spent nuclear fuel reprocessing facility	Radionuclide mix typical of feed and waste contamination[2] in most areas (see Table 4-3)	Surface contamination, some contamination in depth	Residual contamination ~6,200 Ci (see Tables 4-5, 4-6, and 4-7) from operations associated with reprocessing of spent nuclear fuel. (This does not include radioactivity in the 275 vitrified HLW canisters temporarily stored in the HLW Interim Storage Facility as shown in Table 2-10.)	Partially decontaminated, high radiation area in some cells, vitrified HLW canisters stored in the HLW Interim Storage Facility.
Radwaste Process (Hittman) Building	WMA-1 Radiological material processing	Radionuclide mix typical of feed and waste contamination[2]	Surface contamination	8 mR/h, 3,700 dpm/100 cm^2 beta[7] Stabilizing radiologically contaminated materials	Removed October 2006, slab remains. Contamination above 10 CFR 835 control limits, posting required.[5]
Remote-Handled Waste facility	WMA-5 Size-reduction and packaging of highly radioactive waste	Radionuclide mix typical of feed and waste contamination[2]	Surface contamination	~4,800 Ci aged mixed fission products (max annual waste estimate).[10] Contamination of facility cell systems from size-reduction of highly radioactive waste	Deactivated and prepared for demolition. Partially decontaminated, low levels of contamination, may be significant contamination in Work Cell.

Table 2-13. Facilities Remediated or to be Remediated by the WVDP Before Decommissioning[(1)]

Facility	Location and Function	Principal Radionuclides			Expected Status at the Start of Phase 1 of the Decommissioning
		Type	Form	Initial Activity and Cause of Contamination	
Test and Storage Building (TSB)	WMA-2 Testing & process development, equipment fabrication, office space	Radionuclide mix typical of feed and waste contamination[(2)]	Incidental surface contamination	< 0.1 mR/h, removable contamination below detection limits.[(8)] Incidental contamination from wasp and bird nests	Removed May 2006, slab remains. No contamination above 10 CFR 835 control limits[(5)]
Vitrification Facility	WMA-1 High-temperature process system for HLW vitrification	See Table 4-4.	Surface contamination	~1900 Ci, see Table 4-8. Contamination from HLW vitrification process	Deactivated and prepared for demolition. Partially decontaminated, high radiation levels in Vitrification Cell.

NOTES: (1) The list of facilities is from DOE 2006 and includes only contaminated facilities. Section 3 describes these facilities.

(2) Feed and waste contamination is described in Section 4.1 and Table 4-3 shows typical relative fractions of the dominant radionuclides in this type of contamination.

(3) No meaningful initial activity estimate is available. The vitrification off-gas system contains significant residual activity as indicated in Section 4.1.5, but most is located outside the building in the off-gas line. Approximately 3000 curies of decontaminated supernatant and sludge wash solutions were solidified in steel drums in the Cement Solidification System (Marschke 2006).

(4) WVNSCO 2007a.

(5) Removable and fixed slab/soil contamination per 10 CFR 835 control levels Listed radioactivity values for surface contamination within a controlled area are shown in Table 2-13. Radioactivity levels inside a radiological area within a controlled area may be higher, depending upon the controls imposed, per Table 2-14.

(6) WVES 2008.

(7) WVNSCO 2006.

(8) WVNSCO 2007b.

(9) Derived from WVNSCO 1995.

(10) URS 2001.

Information in Table 2-13

Radiological survey data for 2006 through mid-2008 were used to identify recent radiological conditions for most facilities. Section 4 addresses the radiological status of various areas of the Process Building and other facilities within plan scope in more detail.

Discussion of WVDP Remediation Efforts

Historical remediation activities are summarized in Section 2.2. As of 2008, remediation of WVDP facilities remained a work in progress. Areas in which initial deactivation work was completed in late 2004 include three cells in the Process building: the General Purpose Cell, the Process Mechanical Cell, and Extraction Cell 2. Additional decontamination is planned for the floors and walls of the General Purpose Cell and the Process Mechanical Cell.

Deactivation of the Vitrification Cell in the Vitrification Facility was completed in 2005. In late 2008, the cell was being used for sorting and packaging of radioactive waste so conditions in this area are subject to change and additional decontamination may be performed before Phase 1 of the proposed decommissioning.

The Interim Waste Storage Facility and the Lag Storage Building, as well as the Lag Storage Area 1 weather shelter were decontaminated and demolition completed in 2006. The Interim Waste Storage Facility concrete slab was removed. Support facilities and structures demolished and removed by the end of 2006 included the north Waste Tank Farm Test Tower, the O2/LLWTF Building, the Maintenance Storage Area, the Sample Storage and Packaging Facility, the Fabrication Shop, the Radwaste Process (Hittman) Building, and the Cold Chemical Facility. In 2007 the Test and Storage Building, the Maintenance Shop, and the Main 1 Warehouse were demolished and removed. (WVNSCO and URS 2005, WVNSCO and URS 2006, WVNSCO and URS 2007, WVES and URS 2008)

The facilities being removed are being taken down to their concrete floor slabs and foundations. Facilities inside the fenced controlled area may already be below the surface contamination levels for materials in a controlled non-radiological area per 10 CFR 835, as shown in Table 2-14. Those facility locations will have few, if any, access restraints imposed. Other remaining floor slabs and foundations within the controlled fenced area may be posted to restrict personnel access, per 10 CFR 835 requirements for radiological control area restrictions as shown in Table 2-15.

Table 2-14. DOE 10 CFR 835 Surface Contamination Guidelines (in dpm/100 cm^2)(1)

Radionuclide Contaminant(2),(4),(6)	**Removable**(2),(4)	**Total (Fixed + Removable)**(2),(3)
U-natural, U-235, U-238, and associated decay products	1,000(7)	5,000(7)
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above(5)	1,000	5,000
Tritium and STCs(6)	10,000	See note (6).

NOTES:
(1) The values in this table, with the exception noted in note (6) below, apply to radioactive contamination deposited on, but not incorporated into the interior or matrix of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides apply independently.

(2) 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.

(3) The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the surface contamination value if: (1) from measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value.

(4) The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area shall be based on the actual area and the entire surface shall be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

(5) This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

(6) Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface contamination value provided in this appendix is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply. In certain cases, a "Total" value of 10,000 dpm/100 cm^2 may be applicable either to metals of the types from which insoluble special tritium compounds (STCs) are formed, that have been exposed to tritium, or to bulk materials to which insoluble special tritium compound particles are fixed to a surface.

(7) These limits apply only to the alpha emitters within the respective decay series.

Table 2-15. Radiological Areas and Radioactive Material Areas(1)

Area Name	Posting	Reference Value
Radiation Area	"Caution, Radiation Area"	Radiation area means any area, accessible to individuals, in which radiation levels could result in an individual receiving an equivalent dose to the whole body in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the source or from any surface that the radiation penetrates
Contamination Area	"Caution, Contamination Area"	Contamination area means any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed the removable surface contamination values specified in Table 2-14, but do not exceed 100 times those values.
Radioactive Material Area	"Caution, Radioactive Material(s)"	Radioactive material area means any area within a controlled area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in appendix E of 10 CFR 835.(2)

NOTES: (1) From 10 CFR 835, with only those areas likely to be applicable to a foundation slab or other open area listed.

(2) Appendix E of 10 CFR 835 lists individual radionuclide radioactivity levels below which radiological controls are not required.

During the deactivation activities, equipment is being removed using conventional segmenting and handling techniques. The structures are being removed using conventional dismantlement and demolition methods. Waste generated is being shipped off site. Radiological surveys, which are discussed further in Section 9, would document the radiological conditions at the conclusion of deactivation. The radionuclide most significant from the standpoint of radiation protection during this work is Cs-137.

As a major facility undergoing preparation for demolition during decommissioning, most Process Building areas are being deactivated during work to achieve the interim end state, with piping and equipment removed and piping cut off flush with facility surfaces. The Vitrification Facility has undergone a similar deactivation and the Remote-Handled Waste Facility will be deactivated in the same manner. However, some radioactive equipment and significant amounts of residual radioactivity will remain in the Process Building and Vitrification facility at the beginning of Phase 1 proposed decommissioning work as detailed in Section 4.1.

2.3 Spills and Uncontrolled Release of Radioactivity

This section describes spills and uncontrolled releases of radioactivity that have impacted the environment or had the potential to do so. Most of the numerous spills of radioactivity that occurred during NFS operations were contained within the Process Building and these are not detailed here. However, the radioisotope inventory reports generated by the Facility Characterization Project (Michalczak 2004) have documented conditions resulting from significant spills contained within the facilities.

There were two major spills considered to be significant to the site that occurred during licensed reprocessing operations, producing areas of contamination known today as the north plateau groundwater plume and cesium prong. Table 2-16 provides information about the radioactivity associated with the north plateau groundwater plume. More details on radioactivity associated with these two areas appear in Section 4.2.

2.3.1 North Plateau Groundwater Plume

The north plateau groundwater plume is a 540-foot wide by 1,300-foot long (in 2007) zone of groundwater contamination that extends northeastward from the Process Building in WMA 1 to the Construction and Demolition Debris Landfill in WMA 4, where it splits into western and eastern lobes. Lagoon 1 is also a possible contributor of gross beta activity in part of the plume, at least in this lagoon's immediate vicinity (Figure 2-6) (WVES and URS 2008).

Strontium-90 and its decay product, Y-90, are the principal radionuclides in this plume, with both radionuclides contributing equal amounts of beta activity. In 1994 it was determined that Sr-90 concentrations were as high as 1.2 µCi/L in groundwater on the east side of the Process Building. Results of the latest core area investigation in 1998 determined that the highest Sr-90 concentration was 0.705 µCi/L beneath the Uranium Loadout Room near the southeast end of the Process Building (Hemann and Steiner 1999). More information about the plume appears in Section 4.2.

The presumed primary source of the plume was an acid recovery line that leaked in the southwest corner of the Process Building during the late 1960's. The leak released an estimated 200 gallons of radioactive nitric acid from the Off-Gas Operating Aisle down to the underlying Off-Gas Cell and the adjacent southwest stairwell (Carpenter and Hemann 1995).

The leakage apparently flowed through an expansion joint in the concrete floor of the Off-Gas Cell and migrated into the sand and gravel underlying the Process Building (Westcott 1998). This leak also contributed to sewage treatment system contamination (Duckworth 1972b).

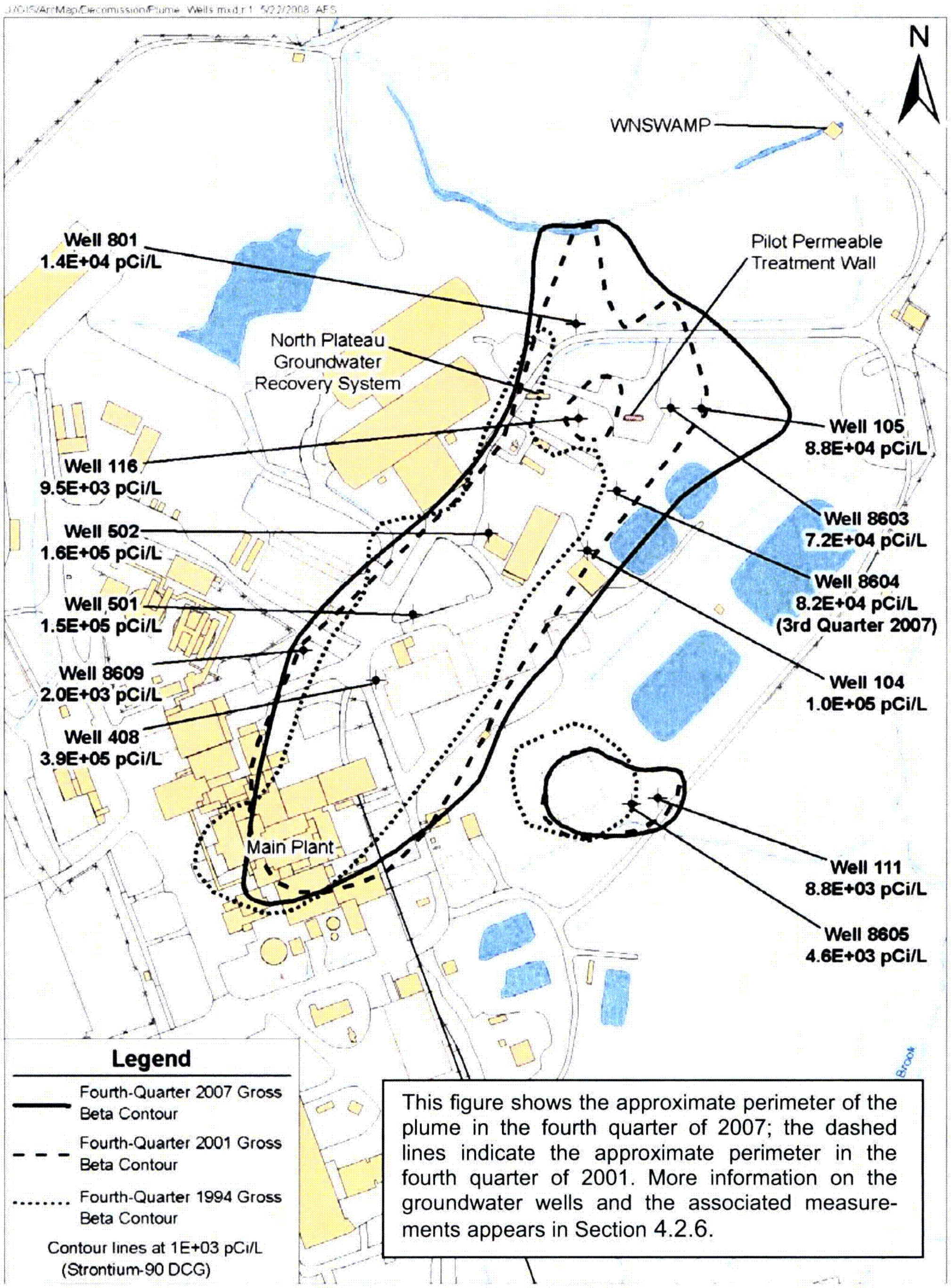

Figure 2-6. Sr-90 Groundwater Plume on the North Plateau

Mobile radionuclides such as H-3, Sr-90, and Tc-99 have migrated with groundwater along the northeast groundwater flow path in the north plateau. The Lagoon 1 design (to allow liquid to seep from the impoundment while retaining sediment and non-aqueous contaminants inside the basin) allowed tritiated water, originally containing about 6,000 curies of tritium in leachate pumped from the SDA for treatment, to infiltrate areas of the north plateau groundwater in the mid-1970s (Smokowski 1977). These conditions were an unintended consequence of the lagoon design, and resulted in an extensive investigation by NFS, extending through the transfer of operational control to DOE in the early 1980s (Marchetti 1982).

The potential dose effects of the tritium are, however, small in comparison to the potential effects from the Sr-90 plume of present interest. Currently, the highest Sr-90 concentrations in groundwater exist at the closest Geoprobe™ sampling point downgradient from the original release point beneath the Off-Gas Cell in the Process Building. Less mobile radionuclides such as Cesium-137 are expected to have remained beneath the immediate source area due to the high cesium sorption capacity of the minerals in the sand and gravel.

An order-of-magnitude estimate of the radionuclides and amounts released by the acid leak, and the estimated remaining amount in 2011, are presented in Table 2-16. These estimates totaled approximately 200 curies in 1972 and will total approximately 77 curies in 2011.

Table 2-16. Released Radionuclide Activity Estimates for the North Plateau Plume[1]

Radionuclide	Plume Activity in 1972 (Ci)	Plume Activity in 2011 (Ci)
H-3	2.4E-03	2.6E-04
C-l4	1.3E-03	1.3E-03
Co-60	3.8E-05	2.3E-07
Sr-90	9.3E+01	3.6E+01
Tc-99	1.5E-02	1.5E-02
Cd-113m	4.1E-02	5.7E-03
Sb-l25	1.8E+00	1.1E-04
Sn-126	3.8E-04	3.8E-04
1-129	2.0E-06	2.0E-06
Cs-137	9.8E+01	4.0E+01
Eu-154	4.1E+00	1.9E-01
Ra-226	0.0E+00	1.2E-10
Ac-227	1.4E-08	6.2E-09
Ra-228	2.7E-13	5.7E-14
Th-229	6.1E-11	2.5E-07
Pa-231	2.7E-09	3.4E-09
Th-232	5.5E-14	5.5E-14

Table 2-16. Released Radionuclide Activity Estimates for the North Plateau Plume[1]

Radionuclide	Plume Activity in 1972 (Ci)	Plume Activity in 2011 (Ci)
U-232	4.8E-05	3.3E-05
U-233	6.9E-05	6.9E-05
U-234	4.0E-05	4.6E-05
U-235	8.9E-07	8.9E-07
Np-237	2.4E-04	2.5E-04
U-238	7.9E-06	7.9E-06
Pu-238	6.9E-02	5.1E-02
Pu-239	1.6E-02	1.6E-02
Pu-240	1.2E-02	1.3E-02
Pu-241	1.7E+00	2.5E-01
Am-241	6.6E-01	6.6E-01
Cm-243	4.2E-04	1.6E-04
Cm-244	3.3E-01	7.4E-02

NOTE: (1) From Westcott 1998.

In 1995, a pump and treat system was installed to slow the migration and lower the water table in the western lobe of the plume. A pilot-scale permeable treatment wall was installed in 1999 to provide some plume migration control for the eastern lobe of the plume. These facilities are described in Section 3.

In addition to the known acid spill affecting the north plateau, during NFS operations several incidents such as inadvertent transfers of higher-than-intended activity occurred in the interceptor basin system upstream of the lagoon system (Lewis 1967, Taylor 1967, Wischow 1967). Documented accounts of leakage and spills in the area (Lewis 1967, Carpenter and Hemann 1995) corroborate the generally elevated observed subsurface soil contamination in the area west of Lagoon 1 to the vicinity of the Process Building. Such localized subsurface soil contamination can be attributed to these unintended operational releases.

2.3.2 Old Sewage Plant Drainage

The old sewage treatment plant outfall drainage extends approximately 650 feet to the south of a culvert near the Old Warehouse location, flowing into the first culvert under the railroad tracks on the south plateau. In the 1960s and 1970s, the old sewage treatment plant experienced several contamination events, some of which were expressed as radioactivity increases in the treated effluent (DOE 1978). Figures 2-3 and 2-4 show where the drainage is located.

Actions were taken to find and repair the suspected sewage line leak, but when excavation of the line neared the south side of the Process Building, radiation levels from soil contamination hampered the project (Duckworth 1972b). Direct radiation levels of several mR/h were measured on containers of sludge removed from the sewage treatment plant for disposal in the 1980s.

A 1982 gamma radiation survey of the drainage channel showed levels three feet above the surface ranging from 110 to 500 μR/h on a section of the channel extending approximately 200 feet south of the sewer outfall (Marchetti 1982). The contaminated portion of the area was about 15 feet wide and 600 feet long, the northern 200 feet of which exhibited significant contamination in sediments represented by an 800 pCi/g Cs-137 result on the sample collected at that location, and up to 1 mR/hr near the surface of the drainage ditch. The sediment layer is estimated to be at least a foot thick.

In order to prevent further contaminant transport downstream, a new drainage channel was excavated to the west of the contaminated drain, and the spoil was placed over the old channel. At least three feet of soil covers the old drainage channel sediment. Some drainage near the old outfall exhibits residual surface contamination. (See Section 4.)

2.3.3 The Cesium Prong

The cesium prong is an airborne deposition plume resulting from a series of Process Building ventilation system air filter failures during licensed operations starting in March 1968, and culminating in a main ventilation system filter failure that occurred on September 4, 1968 (Urbon 1968a, Urbon 1968b). These airborne releases contaminated a portion of the West Valley site as shown in Figure 2-7. The primary contaminant is Cs-137.

A study that focused on the portion of the cesium prong outside of the Center boundary showed that contamination concentrations decrease with depth. Seventy-five percent of the activity was determined to be in the upper two inches of soil, 20 percent in the layer between two inches deep and four inches deep, and five percent in the four to six inch layer (Luckett 1995). Therefore, 95 percent of the activity in the affected area outside of the Center lies in the upper four inches of soil. It is probable that similar conditions exist on the Center property closer to the source of the contamination, but data from this area are not available. Surface soil within the project premises would be characterized during Phase 1 of the proposed decommissioning as described in Section 9.

2.3.4 Summary of Spills During NFS Operations

Table 2-17 provides a summary listing of major spills that impacted the environment during the period when NFS was operating the reprocessing plant.

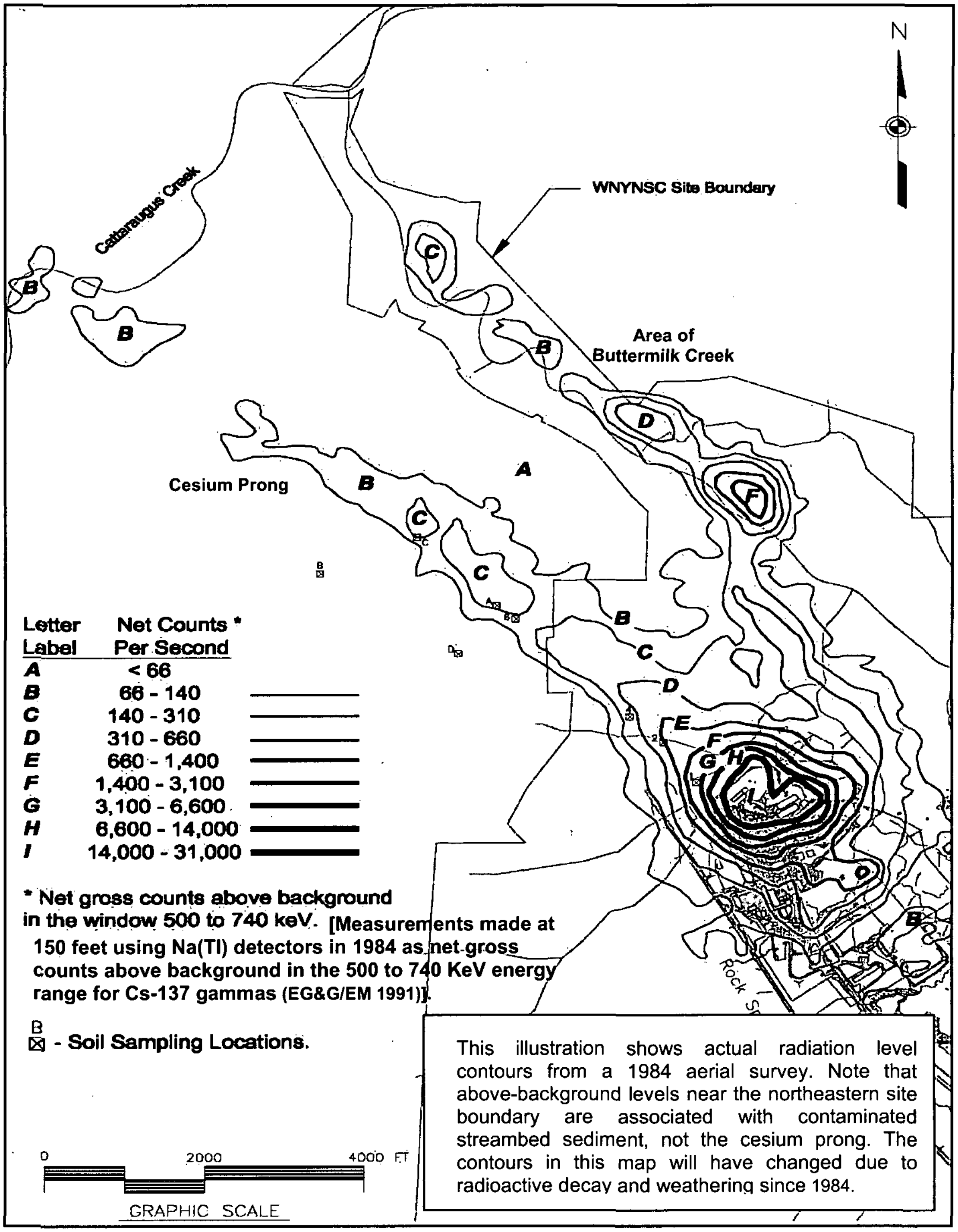

Figure 2-7. 1984 Aerial Radiation Survey Isopleths of the WVDP and Surrounding Area

Table 2-17. Principal Radionuclides in Major Spills Occurring During NFS Operations

Release Event and Origin Location	Principal Radionuclides			
	Type	Form	Activity or Concentration	Documentation Notes
1968 radioactive acid spill that produced the major contribution to the north plateau groundwater plume. **WMA 1**: from southwest corner of the Process Building.	Sr-90 (predominant mobile contaminant)	Liquid to groundwater, soil	0.705 µCi/L (maximum)[1] [Original spill volume estimated at 200 gallons, ~93 Ci Sr-90][2]	Line 7P-240-1-C failed inside the OGA in January 1968, and leakage drained from the OGA through the ARPR to the underlying soil.[3], [4]
Wastewater Line to Tank 7D-13 contribution to north plateau groundwater plume. **WMA 1**: near the south side of the Process Building.	Radionuclide mix typical of feed and waste contamination	Liquid to groundwater, soil	Unknown amount and activity At levels ~ 5E-03 µCi /mL, the interceptor release limit.	Line 7P-160-2-C leaked an unknown amount of radioactive wastewater in February 1967 during transfer from Tank 7D-13.[5]
Contaminated groundwater noted during new interceptor construction. **WMA 2**: south of Old Interceptor at site of New Interceptors.	Radionuclide mix typical of feed and waste contamination	Liquid to groundwater, soil	Unknown amount and quantity; evidently not sufficient to cause worker dose constraints.	Evidence of earlier leakage, but not a spill reported by NFS[6]
Resin Pit spills during Fuel Receiving and Storage spent nuclear fuel pool water filtration system maintenance. **WMA 1**: east of FRS.	Cs-137, Sr-90	Solid and liquid to groundwater, soil	Unknown amount and quantity. Some effect on groundwater noted.	Incidental small spills of resin and fluid during maintenance. Information from subsurface probing investigation [3]
Tank 8D-2 ventilation condensate line (operates under vacuum) was noted to be breached. **WMA 3**: one leak noted between HLW tanks and southwest side of Process Building (in **WMA 1**) at ARPR, other leaks thought to exist in WMA 3.	Cs-137, H-3	Liquid to groundwater, soil	No evidence of out-leakage, but possibility exists of localized groundwater effects.	Line 8P-46-6-A5 failed integrity test. NFS evaluation in 1977.[4]
A line from the in-cell LLW Evaporator to acid recovery failed in-cell during waste transfer to Tank 8D-2. **WMA 1**: ARPR in southwest corner of Process Building.	Fission products and transuranics from spent fuel	Liquid to groundwater, soil	Leakage resulted in 555 gallons of liquid waste sent to the interceptor (sufficient to read >~ 100 mR/hr at the interceptor), and requiring pumpout back to the Process Building for treatment.	Line 7P-170-2A failed in-cell on 2/14/67. Reported by NFS [7], [5] Leakage did not result in any known release to the environment.

Table 2-17. Principal Radionuclides in Major Spills Occurring During NFS Operations

Release Event and Origin Location	Principal Radionuclides			
	Type	Form	Activity or Concentration	Documentation Notes
Sanitary sewer line leak near Process Building allowed contaminated groundwater to affect Sewage Treatment Plant. **WMA 1**: in-leakage near southwest side of Process Building.	Cs-137, Sr-90, I-129	Liquid to groundwater, soil	Estimated 0.052 Ci Sr-90 released: sewage treatment outfall area soil contaminated to 1 mR/h.	Sewage Treatment Plant and outfall drainage were contaminated to low levels, effluent concentrations subsiding after leak was repaired. Reported by NFS [4],[8]
Overflow of Lagoons 4 and 5: treated water released to local soil and groundwater. **WMA 2**: northeast of the O2 Building.	Cs-137, Sr-90	Liquid to groundwater, soil	Unknown amount and activity: probably close to free release level of < 3E-7 µCi /mL.	Temporary loss of Lagoon 3 capacity allowed overflow of releasable treated effluent to occur at an unplanned location. Reported by NFS [9]
Leakage from waste containers or fuel casks contaminated asphalt "Old Hardstand" north of the Process Building. **WMA 5**: footprint located west of LSA 3 and LSA 4.	Fission products and transuranics from spent fuel	Liquid to groundwater, soil	Unknown amount and activity of leaks: maximum surface reading was 100 mR/hr on localized surfaces. Material was removed and placed in Lagoon 1 in 1984. Approximately 1,700 cubic yards of removed material, <10,000 dpm/g beta-gamma, <2,000 dpm alpha. [11]	Leakage from waste transport trailers parked on the hardstand contaminated the asphalt surface. Runoff contaminated the adjacent soil and drainage ditch. Noted, but not detailed during 1982 environmental characterization.[8] Significant contamination was noted in 1983.[10]
Cesium prong created by particulate deposition following 1968 dissolver off-gas HEPA filter failure. **WMA 1, 3, 4, 5, 10**: general deposits to the north-northwest of the Process Building. Detectable deposits extend several miles (outside the scope of this plan).	Cs-137	Airborne particulate to exposed surfaces, soil	Approximately 0.33 Ci particulate gross beta radioactivity released. Offsite- 44 pCi/g localized; 21pCi/g averaged over 2,500 m^2 (26,900 ft^2). Offsite data from Luckett.[13]	Several events contributed to the deposits. A DOG filter failure in March, and a main plant filter failure in September appear to have been the main sources of the observed depositions. Reported by NFS [12],[8]

LEGEND: ARPR = Acid Recovery Pump Room, DOG = dissolver off-gas, FRS = Fuel Receiving and Storage, OGA = Off-Gas Aisle,

NOTES:
(1) From Hemann and Steiner 1999.
(2) From Westcott 1998.
(3) From Carpenter and Hemann 1995.
(4) From Duckworth 1977.
(5) From Lewis 1967.
(6) From Taylor 1967.
(7) From Wischow 1967.
(8) From Marchetti 1982.
(9) From Taylor 1972.
(10) From WVNSCO 1983b.
(11) From WVNSCO 1995.
(12) From Urbon 1968a.
(13) From Luckett 1995.

2.3.5 WVDP Spills

Incidents occurring outside facility containment, and having the potential for residual environmental contamination are detailed as spills or unplanned releases. Spills that were confined inside facilities are not discussed because such spills did not lead to releases into the environment. For example, although the discovery of contaminant migration within the NDA in 1983 required action, the effects were contained within the facility (WVNSCO 1985a). Any residual contamination has been characterized along with the facility and is included in the respective facility radiological inventory.

Based on a review of event reports for the WVDP (1985 through 2008), one 1985 spill and one 1987 spill involving release of radioactive water were documented by unusual occurrence reports as identified below. These events are mentioned because they were considered to be serious enough to be reportable under DOE requirements. They are listed below in Table 2-18, along with three other unplanned releases of less significance.

Table 2-18. WVDP Spills Impacting Environmental Media (1982 – 2007)

Release Event and Origin Location	Principal Radionuclides			
	Type	Form	Activity or Concentration	Documentation Notes
1985 spill of radioactive water at the Waste Tank Farm. **WMA3**: from valve pit northwest of 8D-2, between 8D-2 and 8D-1.	Cs-137, H-3	Liquid to groundwater, soil	~400 gal at 4.6 E-02 µCi/mL gross beta, ~4E-03 µCi/mL H-3.	Spill of radioactive water March 1985 at the Waste Tank Farm from a condensate line running from Tank 8D-1 to Tank 8D-2 due to failure of flanged valve bolts. Some water (4.6E-02 µCi/mL gross beta) flowed out of valve pit. Contaminated soil was removed. Documented by Unusual Occurrence Report(1)
In 1987, condensate from a ventilation unit spilled on top of Tank 8D-2. **WMA3**: upon disassembling the unit, condensate leaked out onto the gravel surface.	Radionuclide mix typical of feed and waste contamination	Liquid to groundwater, soil	Less than 10 gallons spilled, water probably ~2E-5 µCi/mL gross beta.	A portable ventilation unit was disassembled after operations on March 2, 1987 near Tank 8D-2. Condensate from the housing spilled onto the gravel surface of Tank 8D-2 top. No soil or water contamination noted in samples collected.(2)
In 1987, the Neutralizer Pit overflowed during transfer of liquid waste to the interceptor. **WMA2**: the overflow went to the ground near the interceptors and Lagoon 1.	Radionuclide mix typical of feed and waste contamination	Liquid to groundwater, soil	Approximately 5,000 gallons of waste water was spilled, ~5E-05 uCi/mL gross beta.	The neutralizer pit overflowed on February 25, 1987 due to a malfunctioning drain valve. The overflow went to the ground near the interceptors and Lagoon 1. The flow was stopped when noted by an operator. Documented by Unusual Occurrence Report (3)

Table 2-18. WVDP Spills Impacting Environmental Media (1982 – 2007)

Release Event and Origin Location	Principal Radionuclides			
	Type	Form	Activity or Concentration	Documentation Notes
In 1987, water from a 55-gallon drum containing spent resin leaked. **WMA 5**: water spilled on the ground before or during transfer of the drum to a processing station.	Radionuclide mix typical of feed and waste contamination	Liquid to soil, potentially to groundwater	<15 gallons likely spilled, wetted soil was <100 dpm/g gross beta.	Drum was being transferred from the Lag Storage Building hardstand to a waste solidification area in the Process Building when leakage was noted.(4)
In 2001, release of airborne particulate from Process Building stack in droplet form. **WMA1 3**: fallout was localized due to droplet size.	Radionuclide mix typical of Process Building stack particulate (Cs-137 & Sr-90)	Airborne particulate to exposed surfaces and soil	4.8E-04 µCi gross beta.	Over a period of two months, September-October 2001, excess moisture appears to have become entrained in the Main Plant Ventilation system, and was emitted from the stack as droplets containing radioactive particulates. The fallout was confined to the area several hundred feet from the Process Building. Radiological surveys were conducted and accessible above-background spots were decontaminated. Total releases were less than 0.5% of the administrative release limits.(5),(6)
In 2003, breach discovered in wastewater drain line allowing contaminated laundry water to leak into adjacent soils. **WMA 1**: during wastewater line inspection a breach was discovered, but no specific event was identified which would have caused the breach. The line was repaired.	Radionuclide mix typical of feed and waste contamination	Liquid to groundwater, soil	Amount unknown, water typically ~2E-07 µCi/mL gross beta.	Discovery of hole in riser to drain line 15-ww-569 from Laundry to Interceptors in October 2003: date of breach unknown. A sample of subsurface soil near the breach showed 3,300 pCi/g Cs-137 and 87 pCi/g Am-241 as shown in Table 4-12 in Section 4; the breached line may not have caused all of this contamination.(7), (8)

NOTES:
(1) From WVNSCO 1985b.
(2) From WVNSCO 1987a.
(3) From WVNSCO 1987b.
(4) From WVNSCO 1987c.
(5) From Nagel 2001.
(6) From Nagel 2002.
(7) From Maloney 2003.
(8) From WVNSCO 2006.

2.4 Prior Onsite Burials

There are two prior burial sites within the NRC licensed property that contain radioactive material: Lagoon 1 and the NDA. A drainage area adjacent to the NDA is believed to contain contaminated soil below contouring fill. The location of these burial sites is shown in Figures 2-3 and 2-4.

2.4.1 Lagoon 1

In order to prevent further water infiltration, and to isolate contaminated fill removed in the 1980s from a hardstand north of the Process Building, radioactive wastes were stabilized and capped within Lagoon 1, one of five lagoons associated with the Low-Level Waste Treatment Facility. Lagoon 1 was an unlined basin in the system for treating liquid low-level waste. It was removed from service in 1984 because it was determined during initial WVDP environmental assessments to be a major source of tritium in nearby groundwater (Marchetti 1982).

After Lagoon 1 was taken out of service, liquid and sediment from it were transferred to Lagoon 2. Lagoon 1 was then filled with approximately 46,000 cubic feet of radioactively-contaminated debris removed during decontamination of the old/new hardstand area. Among this debris were asphalt, trees, stumps, roots, and weeds (WVNSCO 1995).

After being filled with debris, Lagoon 1 was then capped with clay, covered with topsoil, and re-vegetated. Table 2-19 provides an order-of-magnitude estimate for the residual radioactivity in Lagoon 1. Section 7 describes proposed decommissioning activities for Lagoon 1, which would include removal and offsite disposal of the buried waste.

Table 2-19. Estimated Residual Radioactivity in Lagoon 1(1)

Radionuclide	Activity (Ci)	Radionuclide	Activity (Ci)
C-14	0.053	U-234	0.012
Sr-90	19	U-235	0.0027
Tc-99	0.20	Np-237	0.0031
Cd-113m	0.065	U-238	0.025
Sb-125	0.0038	Pu-238	6.5
I-129	0.029	Pu-239	3.8
Cs-137	548	Pu-241	156
Eu-154	1.7	Am-241	11
U-233	0.22	Cm-244	0.22

NOTE: (1) From WVNSCO 1995, decay-corrected to January 2011. Most of the activity is estimated to be in the remaining sediment.

2.4.2 The NRC-Licensed Disposal Area

As explained in Section 3, the NDA is a 400-feet wide and 600-feet long shallow-land radioactive waste disposal site southeast of the Process Building. It includes three distinct areas: (1) the NFS waste disposal area, (2) the WVDP disposal trenches and caissons, and (3) the areas occupied by an interceptor trench and subsurface barrier wall (Figure 2-8).

Prior to 1972, the NDA was used exclusively for the disposal of highly radioactive solid wastes generated by the reprocessing plant. Wastes routinely buried in the area included spent fuel hulls, fuel assembly hardware, failed process vessels and large equipment, degraded process solvent absorbed on suitable solid medium, and miscellaneous packaged trash including laboratory wastes, small equipment, ventilation filters, and other process-related debris.

Also buried in the NDA are 42 ruptured spent fuel elements from the Hanford N-Reactor. According to records, the total radioactive waste volume in the NDA is approximately 361,000 cubic feet. The estimated total activity present in 2000 was approximately 299,000 curies (Wild 2000). Table 2-20 is an abridged summary of the wastes buried in the NDA. Table 2-21 is a summary of radioactivity in wastes buried in the NDA, corrected to the estimated radioactivity present in 2011.

The swale between the SDA and the NDA has been historically contaminated, presumably from spills during waste burial operations by NFS, and after SDA closure, during leachate control activities (DOE 1978). During the NDA tank removal and subsurface control period in the 1980s and 1990s, the swale area was re-contoured to prevent erosion. An unknown amount of low-level radioactive contamination remains in that area, evidenced by continuing elevated radioactive contaminant indicators in surface water immediately downstream (WVNSCO and URS 2007). The swale area averages approximately 30 feet wide running 300 feet north along the drainage from the old NDA hardstand. Based upon observations during radiation surveys in 1982, the contamination appeared to have permeated porous fill in the swale channel. Gamma readings in that area were five to seven times background, not inconsistent with observed downstream gross beta contamination (Marchetti 1982). Surface soil contamination is still occasionally noted in that area (WVNSCO 1986, WVNSCO 2007b).

Table 2-20 Summary of Wastes in the NRC-licensed Disposal Area[(1)]

NDA Location	General Waste Types (typical)	Volume (ft^3)	Estimated 2011 Activity (Ci)
NFS Deep Holes	Air filters, pumps, pipe, scrap, hulls, resin, solvent, fuel casing, shear ram, concrete, wood.	65,145	169,161
NFS Special Holes	Air filters, pumps, pipe, scrap, birdcages, resin, solvent, dissolver, jumpers, saw, shield, cask, railcar, LLWT sludge, trash.	97,298	58,914
WVDP Trenches	Air filters, metal tanks, scrap, resin, LLWT sludge, trash, concrete, wood, asphalt, glove box, snow blower.	197,656	926
WVDP Caissons	General waste, LLWT sludge.	823	0.15
	Disposal Totals	360,922	229,000

NOTE: (1) Based on the estimates in Wild 2000, decay corrected to 2011. Activity in each location estimated by proportion of overall 2000 activity.

Table 2-21. Estimated Radioactivity in the NDA[1]

Nuclide	Estimate (Ci)	Nuclide	Estimate (Ci)	Nuclide	Estimate (Ci)
Am-241	2,000	Np-237	0.17	Tc-99	10
C-14	520	Pu-238	350	U-233	11
Co-60	7,000	Pu-239	580	U-234	0.59
Cs-137	29,000	Pu-240	400	U-235	0.12
H-3	35	Pu-241	9,100	U-238	1.5
I-129	0.022	Ra-226	<0.01	-	-
Ni-63	110,000	Sr-90	22,000	-	-

NOTE: (1) From Wild 2000, radionuclide totals corrected for decay and in-growth to 2011 and rounded to two significant figures.

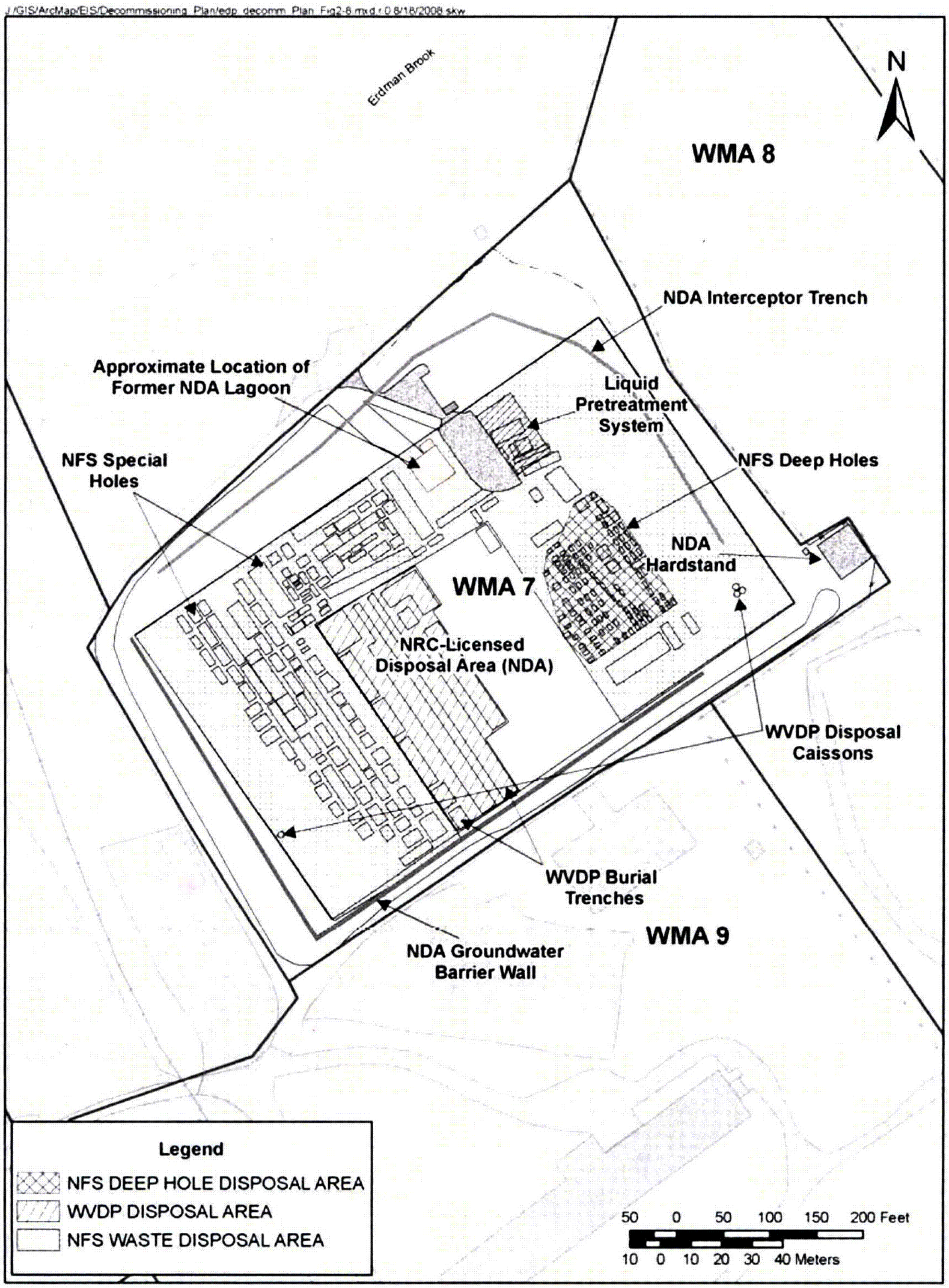

Figure 2-8. NDA Disposal Area Burials

2.4.3 Other Burial Locations

Two other areas on the Center contain buried radioactive material, although neither is within the scope of this plan[5]. One, the SDA, is not on the project premises. The other, the Construction and Demolition Debris Landfill in WMA 4, is briefly described here for completeness because it is located within the project premises.

Construction and Demolition Debris Landfill

The Construction and Demolition Debris Landfill in WMA 4 is located approximately 1,000 feet northeast of the Process Building. This landfill, the only facility within this WMA, covers approximately 1.5 acres in the southern part of the area. Nonradioactive waste material was typically placed in the landfill on existing grade in layers three to five feet thick, covered with soil, and compacted with bulldozers or trucks. The landfill is estimated to contain a total volume of 425,000 cubic feet of waste material and soil. It was initially used by Bechtel Engineering from 1963 to 1965 to dispose of nonradioactive waste generated during construction of the Process Building (WVNSCO1996).

NFS then used this landfill from 1965 to 1981 to dispose of nonradioactive construction, office, and facility generated debris, including ash from the NFS incinerator. The landfill was used from 1982 to 1984 to dispose of nonradioactive waste generated at the WVDP.

Disposal operations at the landfill were terminated in December 1984 and the DOE closed it in accordance with applicable New York State regulations. The final cover on the landfill was graded and grass planted to prevent erosion. In October 1986, the NYSDEC approved and certified the closure of the landfill (WVNSCO 1996).

Because this landfill is located in the path of the north plateau groundwater plume, radioactively contaminated groundwater in the plume is assumed to have come in contact with some of the waste buried in the landfill. Portions of the buried waste are therefore expected to be radioactive.

2.5 References

Federal Statutes

Atomic Energy Act of 1954

Energy Reorganization Act of 1974

West Valley Demonstration Project Act of 1980

Code of Federal Regulations

10 CFR 835, *Occupational Radiation Protection*.

[5] The condition of the old Sewage Plant drainage described in Section 2.3.2 could also considered to be buried radioactivity since the contaminated sediment is covered with soil.

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3.0 FACILITY DESCRIPTION

PURPOSE OF THIS SECTION

The purpose of this section is to describe the facility and its environs. This information provides a foundation for understanding the rest of the plan. Section 3 is also intended to provide information to allow NRC staff to evaluate DOE's estimation of (1) the impacts of the decommissioning activities on the site and its surrounding areas, and (2) the impacts of the environment on the site in the event of natural phenomena such as floods, tornados, and earthquakes.

INFORMATION IN THIS SECTION

This section begins with the location and description of the site, including subsurface conditions. Facilities associated with the WVDP are addressed, including those that existed in 2008 and are to be removed before activities under this plan begin. As with other sections of the plan, these facilities are organized by waste management area (WMA), with the focus on facilities located on the project premises.

The following matters are also addressed: (1) population distribution, (2) current land use and plans for future land use, (3) meteorology and climatology, (4) geology and seismology, (5) surface water hydrology, (6) groundwater hydrology, and (7) natural resources in the area.

All figures referred to in the text, which include photographs, are grouped at the end of the section.

RELATIONSHIP TO OTHER PLAN SECTIONS

To put into perspective the information in this section, one must consider the information in Section 1 on the project background and those facilities and areas within the scope of the Phase 1 decommissioning. Consideration of the information in Section 2 on site history, processes, and spills would also help place information in Section 3 into context. The information in this section serves as the foundation for later sections, such as radiological status in Section 4, the dose modeling in Section 5, and the decommissioning activities in Section 7.

3.1 Site Location and Description

3.1.1 Site Location

The WVDP is located about 30 miles south of Buffalo, in the Town of Ashford, Cattaraugus County, New York at approximately 42.45° north latitude and 78.646° west longitude. The site location with respect to major natural and man-made features in the region is shown in Figure 3-1.

The facility (i.e., the project premises) lies 2.4 miles southeast of Cattaraugus Creek at its nearest approach. Cattaraugus Creek forms the boundary between Cattaraugus and Erie counties. Buttermilk Creek, a tributary to Cattaraugus Creek, is 0.5 mile east of the project premises. Lake Erie lies approximately 30 miles west.

3.1.2 Site Description

The WVDP site consists of approximately 167 acres within the 3,345-acre Center. Figure 3-2 delineates the boundaries of the Center and the WVDP. The brief description here focuses on the Center, the WVDP, subsurface conditions on the site, and site groundwater.

The Center

The Center is located within the glaciated northern portion of the Appalachian Plateau Province of Western New York which is characterized by deep valleys which dissect rather flat-topped plateaus and range in elevation from 1,100 to 1,850 feet above mean sea level (Figure 3-3). The average elevation across the Center is 1,300 feet above mean sea level.

Slopes range from less than five percent to greater than 25 percent, with five to 15 percent slopes predominant. The Center is drained by Buttermilk Creek, which flows into Cattaraugus Creek.

Prior to 1961, much of the Center was cleared for agriculture. As a result, the Center now consists of a mixture of abandoned agricultural areas in various stages of ecological succession, forested tracts, and wetlands, along with transitional ecotones between these areas. The area of the WVDP would be classified as an industrial land use.

The WVDP Site

The WVDP lies on a plateau that ranges in elevation from 1,300 to 1,445 feet above mean sea level, 1929 datum. The plateau margins are defined by Franks Creek, Erdman Brook, and Quarry Creek which drain the WVDP and empty into Buttermilk Creek. This plateau is subdivided by Erdman Brook into the north plateau and south plateau areas. The topography on and around the WVDP site is shown on Figure 3-4.

A posted, barbed-wire fence surrounds the Center. An inner, eight feet high chain-link fence surrounds the WVDP site, with access controlled through one gate. The inner fence defining the WVDP boundary, i.e., the project premises, is shown in Figure 3-5.

Most major activities related to the WVDP, including all involving radioactivity, are performed within the WVDP site boundary. Although the State-Licensed Disposal Area

(SDA) is located within the WVDP security fence, as shown in Figure 3-5, it is not considered part of the project premises.

Subsurface Conditions and Groundwater

The subsurface conditions underlying the north plateau are different from the subsurface conditions underlying the south plateau, as shown in Figures 3-6 and 3-7. The thickness of the unsaturated zone in the weathered till on the south plateau fluctuates annually, averaging approximately 10 feet below ground surface. Groundwater flow in the weathered Lavery till on the south plateau is generally controlled by surface topography and flow is eastward (WVNSCO 1995).

More detailed information on subsurface conditions and groundwater can be found below in Sections 3.5, 3.6, and 3.7.

3.1.3 Facility Description

The following descriptions focus on the WVDP facilities as they are expected to appear at the conclusion of the interim end state in 2011. The facilities to be removed before 2011 are also briefly described.

Major Facilities

The principal facilities at the site include the former irradiated nuclear fuel reprocessing facility, known as the Main Plant Process Building; the Waste Tank Farm; and the Low-Level Waste Treatment Facility. These facilities are located on the north plateau. The two radioactive waste burial areas, the NRC-Licensed Disposal Area (NDA) and the SDA, are located on the south plateau. Figure 3-8 shows the locations of these facilities.

Waste Management Areas

For administrative purposes, the Center has been divided into 12 WMAs as listed below. The locations of WMA 1 through WMA 10 are shown in Figure 3-8. WMAs 11 and 12 are shown in Figure 3-9.

- WMA 1 Main Plant Process Building and Vitrification Facility area,
- WMA 2 Low Level Waste Treatment Facility area,
- WMA 3 Waste Tank Farm area,
- WMA 4 Construction and Demolition Debris Landfill,
- WMA 5 Waste Storage Area,
- WMA 6 Central Project Premises,
- WMA 7 NDA and associated facilities,
- WMA 8 SDA and associated facilities,
- WMA 9 Radwaste Treatment System Drum Cell Area,
- WMA 10 Support and Services Area,

- WMA 11 Bulk Storage Warehouse and Hydrofracture Test Well Area, and
- WMA 12 Balance of the Site.

Project Premises Facilities Removed Before Decommissioning Activities Begin	
WMA 1	**WMA 5** (continued)
Cold Chemical Facility	Lag Storage Addition 2
Contact Size Reduction Facility	Lag Storage Addition 3
Emergency Vehicle Shelter	Hazardous Waste Storage Lockers
Laundry Room	**WMA 6**
Master-Slave Manipulator Repair Shop	Old Warehouse
Radwaste Process (Hittman) Building	Old Sewage Treatment Facility
Recirculation Ventilation System Building	New Cooling Tower (except basin)
WMA 2	North Waste Tank Farm Training Platform
O2 Building	Road-Salt and Sand Shed
Test and Storage Building	**WMA 7**
Maintenance Shop	Interim Waste Storage Facility
Maintenance Storage Area	NDA Hardstand
Vehicle Repair Shop	**WMA 10**
Vitrification Test Facility	Administration Building
WMA 5	Expanded (Environmental) Laboratory
Chemical Process Cell Waste Storage Area	Fabrication Shop
Lag Storage Building	Vitrification Diesel Fuel Oil Building
Lag Storage Addition 1	

WMA 1: Main Plant Process Building and Vitrification Facility Area

Figure 3-10 shows the layout of WMA 1. Figure 3-11 is an aerial photograph of the Main Plant Process Building and Vitrification Facility area. A description of each facility in WMA 1 follows:

WMA 1 facilities within the scope of this plan are:

- Main Plant Process Building;
- Vitrification Facility;
- Load-In/Load-Out Facility;
- Utility Room and Utility Room Expansion;
- Fire Pumphouse and Water Storage Tank;

- Plant Office Building;
- Electrical Substation;
- 01-14 Building;
- Vitrification Off-Gas Trench;
- Source Area of the North Plateau Plume; and
- Concrete Floor Slabs for the Laundry Room, Fuel Receiving and Storage Ventilation Building, Radwaste Process Building, Cold Chemical Facility, and other removed facilities.

Main Plant Process Building. The Main Plant Process Building (Process Building) was built between 1963 and 1966, and was used by Nuclear Fuel Services (NFS) from 1966 to 1971 to recover uranium and plutonium from spent nuclear fuel. This multi-storied building is approximately 130 feet wide and 270 feet long, and rises approximately 79 feet above the ground surface at its highest point. Figures 3-12 through 3-21 show the building exterior, interior layouts, and representative areas.

The major Process Building structure rests on approximately 480 driven steel H-piles. The building is composed of a series of cells, aisles, and rooms that are constructed of reinforced concrete and concrete block. The reinforced concrete walls, floors and ceilings range from one to six feet thick. The reinforced concrete walls are typically surrounded by walls of lighter concrete and masonry construction and metal deck flooring. Six floor layout plans of different levels of the Process Building appear in Figures 3-13A through 3-13F.

Most of the facility was constructed above grade, with some of the cells extending below ground (i.e., below the ground surface reference elevation of 100 feet). The deepest cell, the General Purpose Cell, extends approximately 27 feet below-grade. The Cask Unloading Pool and the Fuel Storage Pool, located in the Fuel Receiving and Storage Area on the east side of the building, were used to receive and store spent fuel received for reprocessing, and extend approximately 49 and 34 feet below grade, respectively.

Cells such as the Process Mechanical Cell, the Chemical Process Cell, and Extraction Cells 1, 2, and 3 were constructed of reinforced high-density concrete three to five feet thick. Such thicknesses were needed to provide radiation shielding.

The operations performed in the cells were remotely controlled by individuals working in the various aisles of the Process Building, which were formed by adjacent walls of the cells. The aisles contained the manipulator controls and valves needed to support operations in the cells. Rooms not expected to contain radioactivity were typically constructed with concrete block and structural steel framing.

Wastewater generated during reprocessing was managed in one of two ways, depending on activity. High-level waste was transferred from the Process Building to the Waste Tank Farm via two underground transfer lines (7P-113 and 7P-120) to Tank 8D-2 and Tank 8D-4. Low-level wastewater was transferred to the Low Level Waste Treatment Facility via below-grade transfer lines associated with the interceptor system.

The WVDP modified portions of the Process Building to support its primary mission of solidifying HLW. Equipment in the Chemical Process Cell was removed to allow its use for storage of canisters of vitrified HLW. Extraction Cell 3 and the Product Purification Cell were emptied of equipment which was replaced with equipment used to support the Liquid Waste Treatment System. This system was used to manage supernatant and sludge wash solutions from Tank 8D-2 which contained HLW.

Vitrification Facility. Shown in Figures 3-22 and 3-23, this structural steel frame and sheet metal building houses the Vitrification Cell, operating aisles, and a control room. The Vitrification Cell is 34 feet wide, 65 feet long, and 42 feet high. Figure 3-23 shows how it looked when it went into service.

At the north end of the Vitrification Cell is the melter pit. The pit is 34 feet wide by 25 feet long with its bottom about 14 feet below grade. The Vitrification Cell is lined with 0.125-inch-thick stainless steel up to 22 feet above grade.

As explained in Section 2, HLW transferred from HLW Tank 8D-2 was mixed with glass formers and vitrified into borosilicate glass within the Vitrification Cell. Vitrification operations were performed remotely by operators in the operating aisles or in the control room. The Vitrification Cell contained the Concentrator Feed Makeup Tank, Melter Feed Hold Tank, the slurry-fed ceramic melter, turntable, off-gas treatment equipment, canister welding station, and the canister decontamination station. All equipment was removed from the Vitrification Cell during the deactivation of this facility in 2003 and 2004.

Load-In/Load-Out Facility. The Load-In/Load-Out Facility is located adjacent to the west wall of the Equipment Decontamination Room of the Process Building in WMA 1. It is a structural steel and steel sided building that is approximately 80 feet long, 55 feet wide, and 54 feet tall. The floor is poured concrete, and the roof is metal sheeting with insulation.

This facility was used to move empty canisters and equipment into and out of the Vitrification Cell. It has a truck bay and a 15-ton overhead crane that is used to move canisters and equipment. After the new Canister Storage Facility is constructed, the Load-In/Load-Out facility would be used to load-out the vitrified HLW canisters from the Process Building into transportation casks for delivery and storage at that facility.

Utility Room and Utility Room Expansion. The Utility Room and the Utility Room Expansion can be seen in Figures 3-10 and 3-11. The Utility Room is a concrete block and steel framed building located on the south end of the Process Building. It consists of two adjoining buildings that were built at different times, the original Utility Room and the Utility Room Expansion.

The original Utility Room, which was built during the construction of the Process Building, makes up the western portion of the facility and is 80 feet wide, 88 feet long, and

20 feet high. It contains equipment that supplies steam, compressed air, and various types of water to the Process Building.

The Utility Room Expansion was built in the early 1990s immediately adjacent to the original Utility Room. The Utility Room Expansion is approximately 85 feet long, 56 feet wide, and 25 feet high. It contains equipment similar to that in the Utility Room.

Fire Pump House and Water Storage Tank. The Fire Pump House was constructed in 1963 and is 20 feet wide, 24 feet long, and 10 feet high at the peak. The structure is of steel frame and sheet metal construction on a four-inch concrete slab floor, which is supported on a concrete foundation wall. Its location is shown in Figure 3-10.

The Pump House contains two pumps on concrete foundations. An adjacent small metal storage shed is used to store fire hoses and fire extinguishers. The 475,800-gallon water storage tank (Tank 32D-1) is located outside the Utility Room, as shown in Figure 3-11.

Plant Office Building. The Plant Office Building is a three-story concrete block and structural steel framed structure located adjacent to the west side of the Process Building. It is approximately 40 feet wide, 95 feet long, and 44 feet high and contains offices and men's and women's locker rooms. Figures 3-11 and 3-14 show the building.

Electrical Substation. The electrical substation is located adjacent to the southeast corner of the Process Building. A 34.5 kilovolt/480 volt transformer rests on a concrete foundation behind a steel framed structure. Its location is shown in Figure 3-10.

01-14 Building. The 01-14 Building is a four-story, 64 feet tall concrete and steel frame building located next to the southwest corner of the Process Building, as shown in Figures 3-10 and 3-11. This building was built in 1971 to house an NFS off-gas system and acid recovery system, but it was never used to support NFS operations. The 01-14 Building was modified to house the Vitrification Off-Gas System and the Cement Solidification System.

The off-gas system was used to treat off-gases generated in the melter in the Vitrification Facility. The Cement Solidification System was used to stabilize radioactive waste generated from the Liquid Waste Treatment System in a cement matrix and to package this mixture in drums that were stored in the Radwaste Treatment System Drum Cell in WMA 9.

Laundry Room. The Laundry Room is located southeast of the Utility Room as shown in Figure 3-10. It is a concrete block structure 26 feet by 56 feet by 20 feet high with metal decking and asphalt roofing. The floor is a concrete slab six inches thick, which contains a sump.

The Laundry Room contains a commercial size washer and dryer, along with sorting tables and racks for laundering contaminated protective clothing. It is separated into a radiologically "hot" side and a "clean" side. It will be removed down to its concrete floor slab at grade before the start of Phase 1 decommissioning activities.

Cold Chemical Facility Slab. The Cold Chemical Facility was a structural steel frame and sheet metal building that was approximately 34 feet wide, 57 feet long, and 36 feet tall. It was located immediately west of, and adjacent to, the Vitrification Facility, as shown in Figure 3-27. It was used to prepare non-radioactive feed materials, such as nitric acid and glass formers, which were used in the vitrification process. The Cold Chemical Facility was demolished to its concrete floor slab at grade in November 2006.

Fuel Receiving and Storage Ventilation Building Slab. This steel-framed and sheet metal sided structure was located adjacent to the Radwaste Process Building. It was 30 feet by 35 feet by 12.2 feet high and rested on a six-inch-thick concrete slab. It contained equipment that provided the majority of the heating, ventilation, and air conditioning systems for the Fuel Receiving and Storage Building. It was removed down to its concrete floor slab at grade in October 2006.

Radwaste Process Building Slab. This 15 feet wide by 46 feet long by 12 feet high steel structure, also known as the Hittman Building, was located north of the Fuel Receiving and Storage Building. It was used to manage shielded casks for high-integrity containers used to store loaded resins from the Fuel Pool Submerged Water Filtration System. This building was removed down to its concrete floor slab at grade in October 2006.

WMA 2: Low-Level Waste Treatment Facility Area

WMA 2, the Low Level Waste Treatment Facility area as it existed in 2008 is shown in Figure 3-24. Figure 3-25 shows the area before the advent of the WVDP.

This facility was used by NFS and then by the WVDP to process low-level radioactive wastewater generated on-site. The current Low Level Waste Treatment Facility includes the Neutralization Pit, interceptors, Lagoons 2-5, and the LLW2 Building. It is expected to still be in use when Phase 1 decommissioning activities begin.

WMA 2 facilities within the scope of this plan are:

- The LLW2 Building;
- Closed Lagoon 1;
- Active lagoons 2, 3, 4, and 5;
- The two New Interceptors;
- The Old Interceptor;
- The Neutralization Pit;
- The Maintenance Shop Leach Field;
- The Solvent Dike; and
- Concrete floor slabs such as those for the 02 Building, Maintenance Shop, Test and Storage Building, and Vitrification Test Facility.

A description of the WMA 2 facilities follows:

The LLW2 Building. Located southwest of Lagoon 4, this pre-engineered, single-story, metal-sided building rests on a concrete wall foundation, measuring 40 feet by 60 feet. The building houses two skid-mounted process equipment modules that are used to treat wastewater from WMA 1, WMA 3, and radiologically contaminated groundwater from the WMA 7 NDA Interceptor Trench and the north plateau groundwater plume. Figure 3-26 shows the building. The LLW2 Building was built in 1998 to replace the 02 Building, the original low-level wastewater treatment facility that was built by NFS in 1971.

The building is divided into three work areas and an office. The processing area contains the process modules (including ion exchangers, valves, piping, pumps, filters, instrumentation, and controllers), two surge tanks, and a sand filter. The packaging room contains a four feet by four feet by nine-feet-deep stainless steel lined catch basin. A portable ventilation unit located outside of the packaging area contains a high-efficiency particulate air (HEPA) filter and a short stack on the roof of the building.

Lagoon 1. Lagoon 1 was an unlined pit excavated into the sand and gravel unit that was approximately 80 feet long on each side and 5 feet deep. It was fed directly from the Old Interceptor and the New Interceptors, and had a storage capacity of more than 200,000 gallons. As explained in Section 2, it was removed from service in 1984. Most of the contaminated sediment was transferred to Lagoon 2 and Lagoon 1 was filled with contaminated debris from the NFS hardstand and then capped with clay and topsoil.

Figure 3-27 shows the area of Lagoon 1. Section 2.4.1 discusses the radioactivity in the closed lagoon.

Lagoon 2. Lagoon 2 is an unlined 17-foot deep basin excavated in the unweathered Lavery till. This lagoon has a storage capacity of 2.4 million gallons and is used to store wastewater discharged from the New Interceptors before its transfer to the LLW2 for treatment.

From 1965 to 1971, before the installation of the Low Level Waste Treatment Facility system – which initially consisted of the O2 Building and Lagoons 4 and 5 – wastewater was routed through Lagoons 1, 2, and 3 in series before discharge to Erdman Brook. Between 1971 and 1982, low-level wastewater was routed sequentially through Lagoon 1, Lagoon 2, and the O2 Building for treatment, then to Lagoons 4 or 5, and finally to Lagoon 3 before discharge to Erdman Brook. From 1982 following the closure of Lagoon 1 to the present, low-level wastewater has been routed sequentially through Lagoon 2, the O2 Building or LLW2 for treatment, Lagoons 4 or 5, and then to Lagoon 3 before discharge to Erdman Brook.

A French drain was installed on the northwest sides of Lagoons 2 and 3 and the northeast side of Lagoon 3 to prevent groundwater from flowing into Lagoons 2 and 3. The French drain was capped in 2001 and no longer discharges into Erdman Brook.

Lagoon 3. Lagoon 3 is a 24-foot deep unlined basin excavated in the unweathered Lavery till. It has a storage capacity of 3.3 million gallons. Lagoon 3 receives treated water from Lagoons 4 and 5. Lagoon 3 is periodically batch discharged to Erdman Brook through a State Pollutant Discharge Elimination System (SPDES) permitted discharge.

Lagoon 4. Lagoon 4 is a basin constructed in the sand and gravel unit on the North Plateau with a capacity of 204,000 gallons. It receives only treated water from LLW2 and discharges to Lagoon 3.

Lagoon 4 was originally excavated into the sand and gravel unit on the North Plateau and lined with reworked glacial tills. In 1974 a synthetic membrane liner was installed after NFS identified that Lagoons 4 and 5 were potential sources of tritium to groundwater in the sand and gravel unit (WVNSCO 1997). In the late 1990's, the synthetic membrane liners were removed and replaced with concrete grout and a XR-5 liner, an ethylene inter-polymer alloy membrane.

Lagoon 5. Lagoon 5 is a basin constructed in the sand and gravel unit on the North Plateau with a capacity of 166,000 gallons. It receives only treated water from the LLW2 facility and discharges to Lagoon 3.

Lagoon 5 was originally excavated into the sand and gravel unit on the north plateau and lined with reworked glacial tills. In 1974 a synthetic membrane liner was installed after NFS identified that Lagoons 4 and 5 were potential sources of tritium to groundwater in the sand and gravel unit (WVNSCO 1997). In the late 1990's, the synthetic membrane liners were removed and replaced with concrete grout and a XR-5 liner, an ethylene inter-polymer alloy membrane.

Neutralization Pit. The Neutralization Pit is a nine feet by seven feet by 5.5 feet deep concrete tank constructed with six-inch thick concrete walls and floor that are lined with stainless steel. The pit receives low-level radioactive wastewater from WVDP process areas. This liquid is subsequently transferred to the interceptors.

Old Interceptor. The Old Interceptor is a 40 feet by 25 feet by 11.5 feet deep unlined concrete liquid waste storage tank located below-grade. The floor is 24-inches thick and the walls 12 inches thick[1]. The roof is made of steel.

The Old Interceptor received low-level liquid waste generated at the Process Building from the time of initial plant operation until the new interceptors were constructed. The Old Interceptor is currently used for temporarily storing radiologically contaminated liquids that exceed the effluent standard of 0.005 µCi/mL gross beta activity. After verification of acceptable radiological contamination concentrations, the contents are transferred by steam jet to the New Interceptors.

[1] The floor of the Old Interceptor was initially 12 inches thick. An additional 12 inches of concrete was poured on the floor during NSF operations to provide radiation shielding.

New Interceptors. The New Interceptors are twin open-top concrete storage tanks, each 22 feet by 20 feet by 11.5 feet deep, located below grade. The walls and floor are 14 inches thick, and are lined with stainless steel. The roof is steel. The New Interceptors were built in 1967 to replace the Old Interceptor, which had high levels of radioactivity (WVNSCO 1997). The New Interceptors are used to collect and sample wastewater before it is transferred to Lagoon 2.

Solvent Dike. The Solvent Dike is located about 300 feet east of the Process Building. It was an 30 foot by 30 foot unlined basin excavated in the sand and gravel layer. The Solvent Dike received rainwater runoff from the Solvent Storage Terrace, which formerly housed an acid storage tank and three storage tanks containing a mixture of used n-dodecane and tributyl phosphate. The sediment has been removed and the area has been backfilled, but the Solvent Dike still contains radiologically contaminated soil.

Maintenance Shop Leach Field. The Maintenance Shop Leach Field is located just northeast of where the Maintenance Shop stood and consists of three septic tanks, a distribution box, a tile drain field, and associated piping. The leach field, which occupies an area of approximately 1500 square feet, was used until1988; all three tanks are out of service and filled with sand. Because it is located within the area of the north plateau groundwater plume, low levels of contamination may be present.

Groundwater Pump and Treat System. Installed in 1995, this system is located in the northwest corner of WMA 2 and draws water from two recovery wells at the western lobe of the north plateau groundwater plume, which is discussed in Section 2 and in Section 4.2. Groundwater is pumped to the Low Level Waste Treatment Facility for treatment by ion exchange to remove Sr-90 contaminants. The treated groundwater is pumped to Lagoon 4 or Lagoon 5, and then to Lagoon 3, and, eventually, discharged into Erdman Brook through the permitted outfall.

Pilot Scale Permeable Treatment Wall. Installed in 1999 and located northwest of Lagoon 5, this treatment wall is about 30 feet wide, seven feet thick, and 25 feet deep, extending down to the Lavery till. It is filled with clinoptilolite, a natural zeolite material, and covered with soil. Its purpose was to evaluate the effectiveness of such systems in treating groundwater contaminated with Sr-90.

O2 Building Slab. The O2 Building was a two-story, steel-framed concrete block structure 27 feet wide, 39 feet long, and 30 feet high. It contains a 16 feet deep stainless steel lined sump. Figure 3-25 shows the building when it was in service.

The O2 Building once housed filters, ion exchangers and other equipment used by NFS and the WVDP to treat radioactive wastewater before transfer to Lagoon 3. It was replaced with the LLW2 Building, It was demolished down to its concrete floor slab at grade in October 2006.

Test and Storage Building Slab. The Test and Storage Building was an 80 feet by 120 feet by 22 feet high timber frame and metal sided building located northeast of the

Process Building. It contained office spaces, a tool crib, and garage space. An 18 feet by 26 feet by 12 feet concrete block addition housed radiation and safety operations. It was demolished down to its concrete floor slab at grade in June 2007.

Vitrification Test Facility. This 40 feet wide and 120 feet long and 36 feet high metal building with a concrete floor contains a scale vitrification facility and a bulk chemical storage tank. It will be removed down to its concrete floor slab at grade before Phase 1 of the decommissioning.

Maintenance Shop Slab. The Maintenance Shop was a 60 feet by 100 feet by 28 feet high metal building with steel supports. It housed locker rooms, lavatories, instrument shops, work areas, and a finished office area. The Maintenance Shop was demolished down to its concrete floor slab at grade in June 2007.

Permeable Treatment Wall and Permeable Reactive Barrier. A full-scale passive permeable treatment wall and a permeable reactive barrier are expected to be installed before Phase 1 of the decommissioning to mitigate the off-site migration of Sr-90 contaminated groundwater in the sand and gravel unit in the north plateau.[2]

The permeable treatment wall will be located in WMA 2 immediately south of the Construction Demolition and Debris Landfill in WMA 4 approximately perpendicular to the flow path of the north plateau groundwater plume. It will be approximately 400 feet long in a northwest-southeast direction with two 50-foot long lateral sections extending off of each end of the 400-foot long section to the west and south. The permeable treatment wall will be two to four feet thick, extend down into the underlying unweathered Lavery till, and composed of granular zeolite to reduce Sr-90 concentrations in groundwater through ion-exchange.

The permeable reactive barrier will be located in the swamp ditch located immediately west of the Construction Demolition and Debris Landfill in WMA 4. Groundwater contaminated with Sr-90 intermittently discharges from a seepage face in this ditch, and commingles with surface water which eventually flows from the project premises through a monitored surface water discharge point. The permeable reactive barrier, which will be composed of zeolite and aggregate and approximately 175 feet in length, will be installed along the seepage face to reduce by ion-exchange the amount of Sr-90 in surface water draining from the project premises.

WMA 3: Waste Tank Farm Area

Shown in Figures 3-29 and 3-30, WMA 3 includes the waste storage tanks (8D-1, 8D-2, 8D-3, and 8D-4), and their associated tank vaults, the HLW transfer trench, the Permanent Ventilation System Building, the Equipment Shelter and condensers, the Con-Ed Building, and the Supernatant Treatment System Support Building.

[2] The designs for these north plateau groundwater plume control features were not finalized when this plan was completed. If different plume control features are installed, this plan will be revised as appropriate to describe them.

WMA 3 facilities and equipment within the scope of this plan are:

- Tanks 8D-1, 8D-2, 8D-3, 8D-4, and the associated vaults;
- The HLW mobilization and transfer pumps;
- The HLW transfer trench piping;
- The Equipment Shelter and Condensers; and
- The Con-Ed Building.

Descriptions of the WMA 3 facilities follow.

Waste Storage Tanks. The waste storage tanks were built to store the liquid HLW generated during the spent nuclear fuel reprocessing operations. The WVDP subsequently modified these tanks to support treatment and vitrification of the HLW. Modifications included constructing a fabricated steel truss system over tanks 8D-1 and 8D-2 to carry the weight of sludge mobilization and transfer pumps and installation of treatment equipment in Tank 8D-1.

Tank 8D-1, Tank 8D-2, and Vaults. Tanks 8D-1 and 8D-2 are identical in size and construction, with each tank housed within its own cylindrical concrete vault. Each tank is 27 feet high by 70 feet in diameter, with a storage capacity of 750,000 gallons. Figure 3-31 shows a cutaway view of a tank.

The tanks were constructed with reinforced carbon steel plate ranging in thickness from 0.4375 inch for the roofs and walls to 0.656 inch for the floors. The roof of each tank is supported internally by forty-five eight-inch diameter vertical pipe columns that rest on a horizontal gridwork of wide flange beams and cross members in the bottom two feet of each tank. Each tank rests on two six-inch-thick layers of perlite blocks that rest on a three-inch layer of pea gravel. The tank, perlite blocks, and pea gravel are contained within a carbon steel pan which rests on a three-inch layer of pea gravel that separates the pan from the floor of the vault.

Each tank and its associated pan are housed within a cylindrical reinforced concrete vault that has an outside diameter of 78.6 feet. The walls of each vault are 18 inches thick and extend nearly 36 feet above the floor of the vaults.

The floor of each vault is 27 inches thick, except under the six 30-inch diameter vertical concrete columns that support the vault roof. These columns pass upward from the floor of the vault through the tanks and are encased in steel pipes 48 inches in diameter that are welded to the top and bottom of each tank. The columns are located approximately 16 feet from the center of the tank. The floor of each vault is underlain by a four feet thick bed of gravel. The concrete vault roof is two feet thick and is supported by the six concrete columns. The top of the vaults are six to eight feet below grade.

Despite their robust construction, the tank vaults have not proven to be watertight. Groundwater seeps into both vaults and has to be regularly pumped out. A tank and vault drying system will be installed during deactivation work to achieve the interim end state to dry Tanks 8D-1, 8D-2, 8D-3, 8D-4, and their associated vaults and to maintain them in a dry condition during Phase 1 decommissioning.

The current conceptual design of the tank drying system includes a refrigeration dehumidification unit with an associated heater to supply supplemental heat to the dried airflow introduced into the bottom of the tanks. The dried and heated air will maximize evaporation of liquids within the tanks. Moisture-laden airflow will exit the tanks through ventilation piping to the Permanent Ventilation System, where it will pass though HEPA filters before discharge through the Permanent Ventilation System Building stack.

The vault drying system is expected to consist of two separate recirculation desiccant drying units, one for the Tank 8D-2 vault and the other for the Tank 8D-1 vault and the common vault housing Tanks 8D-3 and 8D-4. Dried air from the drying unit will be introduced into the tank vault through an inlet pipe equipped with discharge nozzles located at the bottom of the vault. Moisture-laden airflow will exit through the top of an outlet pipe on the opposite side of the vaults and return to the recirculation desiccant drying unit to be dried before being returned to the vault. Moisture in the desiccation unit will be removed with filtered outside ambient air passed through the reactivation sector of the desiccation drying unit. The moisture laden airflow from the reactivation sector will be discharged to the Permanent Ventilation System, where it will pass through HEPA filters before discharge through the building stack. The vault drying system will remove water from the internal surfaces of the vaults, the external surfaces of the tanks, and the tank containment pans.

The HLW transfer pumps and the mobilization pumps in Tanks 8D-1 and 8D-2 would be removed during Phase 1 of the proposed decommissioning. These pumps are illustrated in Figure 3-32.

Tanks 8D-1 and 8D-2 each contain a single HLW transfer pump. Each centrifugal multi-stage turbine type pump is more than 55 feet long and is driven by a 150 horse power motor. Tanks 8D-1 and 8D-2 also contain a total of nine mobilization pumps. These pumps are approximately the same size as the HLW transfer pumps.

Tanks 8D-1 and 8D-2 each contain an additional suction pump used in waste pretreatment and processing. The Tank 8D-1 pump is a vertical turbine pump mounted on a pipe column with an overall length of approximately 31 feet. The Tank 8D-2 pump is a submersible pump mounted on a three inch pipe column with an overall length of approximately 33 feet. All of the pumps in the underground waste tanks are expected to be highly contaminated as explained in Section 4.1.

Tank 8D-3, Tank 8D-4 and Vault. Tanks 8D-3 and 8D-4 are identical in size and construction, and both are housed within a single reinforced concrete vault. Each tank is 12 feet in diameter and 15.67 feet high, with a nominal volume of 15,000 gallons. The shell of each tank is 0.313 to 0.375 inch thick; both the tanks and their associated piping were constructed from 304L stainless steel.

The concrete vault that houses the tanks is approximately 32-feet long, 19-feet wide, and 25-feet tall. The walls, floor, and roof of the vault are 21-inches thick. The bottom of the vault is lined with stainless steel to a height of 18 inches above the floor. The floor contains a stainless-steel-lined sump. The top of the vault is six to eight feet below grade.

The HLW transfer pumps in tanks 8D-3 and 8D-4 will be removed to facilitate removal of liquids in these tanks during deactivation work to achieve the interim end state. The transfer pumps will be replaced with submersible pumps equipped with chemical resistant transfer lines. The submersible pumps and transfer lines would be removed during Phase 1 of the proposed decommissioning.

High-Level Waste Transfer Trench. The HLW transfer trench is a long concrete vault containing piping that conveyed waste between the Waste Tank Farm and the Vitrification Facility. Approximately 500 feet long, the trench extends from the Tank 8D-3/Tank 8D-4 vault along the north side of Tank 8D-1 and Tank 8D-2, before turning to the southwest and entering the north side of the Vitrification Facility. It is six to 20 feet wide and its height ranges from six to nine feet. Figure 3-33 shows the trench under construction.

The trench was constructed with reinforced concrete walls and floors, with pre-cast concrete covers. Stainless steel-lined concrete pump pits that house the upper sections of HLW transfer pumps are located on top of each of the tank vaults. The walls and floors of the pump pits are reinforced concrete, with pre-cast concrete covers forming the roof. Figure 3-34 shows a typical pump pit.

There are six piping runs in the trench, two of which are unused spares, comprising approximately 3000 linear feet of double-walled stainless steel pipe.[3] The trench also contains associated valves and jumpers. The pump pits each contain the upper part of the HLW transfer pump and flow monitoring equipment. Pump Pit 8Q-2 over Tank 8D-2 also contains grinding equipment used to size reduce zeolite.

The piping and the related equipment would be removed during Phase 1 of the proposed decommissioning.

Permanent Ventilation System Building. The Permanent Ventilation System Building is located approximately 50 feet north of Tank 8D-2, as shown in Figure 3-30. This steel framed and sided building is 40 feet wide, 75 feet long, and 16 feet tall and is attached to a 12 inch thick concrete floor slab supported by concrete footings. The building has a sheet metal roof which supports the Permanent Ventilation System discharge stack.

The Permanent Ventilation System was designed to provide ventilation to the Supernatant Treatment System Support Building, the Supernatant Treatment System valve aisle, the Supernatant Treatment System pipeway, and the HLW tanks. A skid-mounted, Permanent Ventilation System Stack Monitoring Building is located near the east end of the building.

Equipment Shelter and Condensers. The Equipment Shelter is a one-story concrete block building lies immediately north of the Vitrification Facility, as shown in Figures 3-29

[3] Portions of the trench contain only two piping runs; the section connecting to the Vitrification Facility contains all six runs.

and 3-30. It is 40 feet long, 18 feet wide, and 12 feet high and has a concrete floor six inches thick, with a small extension on the west side.

This structure houses the Waste Tank Farm ventilation system that was formerly used to ventilate the four waste storage tanks and the Supernatant Treatment System vessels in HLW Tank 8D-1.

The condensers are located immediately west of the Equipment Shelter. They were designed to condense the overheads from Tanks 8D-1 and 8D-2, which were originally designed to be in a self-boiling condition during NFS operations. The Equipment Shelter and condensers would be removed during Phase 1 of the proposed decommissioning.

Con-Ed Building. The Con-Ed Building is a concrete block building located on top of the concrete vault containing Tank 8D-3 and Tank 8D-4, as shown in Figures 3-29 and 3-30. This building, which is 10 feet wide, 13 feet long, and 11 feet high, houses the instrumentation and valves used to monitor and control the operation of Tanks 8D-3 and 8D-4. This building would be removed during Phase 1 of the proposed decommissioning.

Supernatant Treatment System Support Building. This building is located adjacent to and above Tank 8D-1. It is a two-story structure that contains equipment and auxiliary support systems needed to operate the Supernatant Treatment System. The upper level is a steel framework structure covered with steel siding. The lower level of the building was constructed with reinforced concrete walls, floors, and ceilings.

This building contains a control room; heating, ventilation and air conditioning equipment; utilities; and storage tanks for fresh water and fresh zeolite to support Supernatant Treatment System operations. A shielded valve aisle is located on the lower level of the support building, adjacent to Tank 8D-1.

The Supernatant Treatment System pipeway is located on top of the Tank 8D-1 vault. This concrete and steel structure contains the Supernatant Treatment System piping and structural members that support the Supernatant Treatment System equipment located in Tank 8D-1.

WMA 4: Construction and Demolition Debris Landfill Area

WMA 4, which includes the Construction and Demolition Debris Landfill, is a 10-acre area in the northeast portion on the north plateau of the WVDP as shown in Figure 3-8. The landfill, which was utilized as described in Section 2, is the only waste management unit in WMA 4. It would be monitored and maintained during Phase 1 of the proposed decommissioning.

WMA 5: Waste Storage Area

The facilities in WMA 5 are shown in Figure 3-35 and are described below. WMA 5 facilities within the scope of this plan are:

- Lag Storage Addition 4 and its associated Shipping Depot;
- The Remote-Handled Waste Facility;

- Concrete slabs and foundations for the Lag Storage Building, Lag Storage Additions 1, 2, and 3, Chemical Process Cell Waste Storage Area; and
- Several hardstands consisting of compacted gravel pads.

Lag Storage Addition 4. Lag Storage Addition 4 is a clear-span structure, with a pre-engineered steel frame and steel sheathing. Approximately 291 feet long, 88 feet wide and 40 feet high, it rests on a seven-inch concrete slab. It is similar to Lag Storage Addition 3, except that it includes a shipping depot, a container sorting and packaging facility, and a covered passageway between the two storage areas. The shipping depot is connected to Lag Storage Addition 4 and is a 91 feet by 85 feet metal frame structure. This facility and its concrete floor slab would be removed during Phase 1 of the proposed decommissioning.

Remote-Handled Waste Facility. The Remote-Handled Waste Facility is located in the western portion of WMA 5 as shown in Figure 3-35. It is a metal-sided, steel-frame building that includes a Receiving Area, a Buffer Cell, a Work Cell, a Waste Packaging Area, an Operating Aisle, and a load-out /truck bay. Figure 3-36 shows the facility under construction and Figure 3-37 shows the layout of the first floor.

The Receiving Area includes a 20-ton bridge crane that also provides access into the adjacent Buffer Cell. The Buffer Cell is an air lock between the Receiving Area and the contaminated Work Cell. The Work Cell is the primary work area, with provisions for fully remote handling, surveying, segmenting, decontaminating, and repackaging operations. This shielded space is 55 feet by 22 feet by 26 feet high, and is served by a 30-ton bridge crane.

Any spent decontamination solutions generated during operations are transferred to below-grade wastewater storage tanks located in a vault below the building for management before treatment. These tanks and vault would be removed during Phase 1 proposed decommissioning.

The Waste Packaging Area includes capability to load both waste drums and boxes. The Operating Aisle houses two waste processing and packaging work stations and one waste sampling transfer work station. Each work station includes a shield window in the shield wall, and controllers for remotely operating facility equipment.

This facility and its concrete floor slab would be removed during Phase 1 of the proposed decommissioning.

Lag Storage Building Slab. The Lag Storage Building was a sheet metal structure built in 1984 to store LLW. It was supported by a clear span frame and anchored to a 140 feet long by 60 feet wide concrete slab foundation. The slab surface was coated with an acid-resistant, two-coat, application of epoxy sealer. It was demolished down to its concrete floor slab in October 2006.

Lag Storage Addition 1 Slab. Lag Storage Addition 1 was a pre-engineered steel frame and fabric structure built in 1987 to store containerized LLW. It was 191 feet long by 55 feet wide by 23 feet high. It was removed down to its grade level floor in October 2006.

Lag Storage Addition 2 Foundation. Lag Storage Addition 2 was a tent structure that was built in 1988 and dismantled in 1993 after it was damaged by high winds. The foundation consists of eight inches of crushed stone covering an area 65 feet by 200 feet.

Lag Storage Addition 3. Lag Storage Addition 3, like Lag Storage Addition 4, is a clear-span structure, with a pre-engineered steel frame and steel sheathing, about 291 feet long, 88 feet wide and 40 feet high, on a seven-inch concrete slab. It is scheduled to be removed down to its concrete floor slab during the work to achieve the interim end state.

Hardstands. Several compacted gravel pads or hardstands are located within WMA 5:

- The Lag hardstand, also known as the old/new hardstand storage area, is located southwest of Lag Storage Additions 3 and 4 and is used to store packaged equipment and containers of LLW;
- The cold hardstand area, which is located west of the Construction and Demolition Debris Landfill, has been used as a nonradioactive material staging and storage area;
- The vitrification vault and empty container hardstand is located north and west of the hazardous waste storage lockers; and
- The HLW tank pump storage vault area.

Chemical Process Cell Waste Storage Area. This waste storage area is a structure used to store equipment removed from the Chemical Process Cell. It is a 200 feet by 70 feet by 30 feet high galvanized steel-panel enclosure with a gravel pad floor. It will be removed down to its gravel pad during the work to achieve the interim end state.

Hazardous Waste Storage Lockers. Four steel hazardous waste storage lockers are located east of the Waste Tank Farm. Each locker measures eight feet by 16 feet by eight feet high and is used for short-term storage of hazardous waste. The lockers will be removed during the work to achieve the interim end state.

WMA 6: Central Project Premises

Facilities in WMA 6, the Central Project Premises shown in Figure 3-38, include the rail spur, the above ground petroleum storage tank, the Sewage Treatment Plant, the New Cooling Tower, the two Demineralizer Sludge Ponds, the Equalization Basin, the Equalization Tank, the South Waste Tank Farm Test Tower, the Road-Salt and Sand Shed, and the LLW Rail Packaging and Staging Area.

WMA 6 facilities within the scope of this plan are:

- Sewage Treatment Plant,
- Equalization Basin and Tank,
- Demineralizer Sludge Ponds,
- South Waste Tank Farm Test Tower,

- Concrete slab for the Old Warehouse, and
- The Cooling Tower basin.

Rail Spur. The rail spur runs about 8,000 feet from the south side of the Process Building to where it connects to the main line of the railroad. Figure 3-39 shows the tracks near the Process Building. The rails are cast iron and the ties are creosote pressure-treated wood. Low-level radioactive contamination identified in soil along a section of dual track east of the Old Warehouse is discussed in Section 4.2.

Sewage Treatment Plant. The Sewage Treatment Plant is a wood frame structure 41 feet by 44 feet by 15 feet high, with metal siding and roofing. The base of the facility is concrete and crushed stone. The Sewage Treatment Plant is used to treat sanitary waste and it contains six in-ground concrete tanks, one above-ground polyethylene tank, and one above-ground stainless steel tank.

Equalization Basin. The Equalization Basin is a lined 75 feet wide, 125 feet long, by 10 feet deep basin excavated into the sand and gravel layer. It has been used for non-radioactive discharges.

Equalization Tank. The Equalization Tank is a 20,000-gallon underground concrete tank immediately north of the Equalization Basin that serves as a replacement for the Equalization Basin.

Demineralizer Sludge Ponds. The north and south demineralizer sludge ponds are separate, unlined basins excavated in the sand and gravel layer. They are approximately 100 feet long, 50 feet wide, and five feet deep. They were used to receive water softener regeneration waste, clarifier overflow and blow-down, boiler blow-down, sand filter backwash, and demineralizer regeneration waste from the Utility Room.

The north pond is nearly filled with sediment. Both ponds are radiologically contaminated. As of 2004, the ponds were no longer in service.

Old Warehouse Slab. The Old Warehouse was a pre-engineered steel building with three sections. The main warehouse section was 80 feet by 144 feet by approximately 21 feet high at the roof peak. A 38 feet by 42 feet by 15 feet high room was attached to the north end of the building that housed a radiological counting facility. A double-wide office trailer was located on a concrete foundation wall at the south end of the building. The Old Warehouse was removed down to its concrete floor slab at grade in May 2007.

New Cooling Tower. The new cooling tower, shown in Figure 3-40, is 20 feet by 20 feet by 11 feet high and it stands on a concrete basin. The floor of the basin is an eight-inch-thick concrete slab. The facility will be removed, leaving the basin in place, during work to achieve the interim end state.

Waste Tank Farm Test Towers. The Waste Tank Farm Test Towers are pre-engineered structures erected as a stack of modules including ladders, handrails, and grating. The exterior "skin" is fabric. The north Tower was 16 feet by 16 feet by 57 feet high. The south Tower is 16 feet by 16 feet by 48 feet high. The north tower was removed to its foundation in October 2006. The south tower would be removed during Phase 1 of the proposed decommissioning.

Road-Salt and Sand Shed. The Road-Salt and Sand Shed is a storage bin and a sand stall resting on asphalt pavement. It is constructed with a wooden frame covered with galvanized steel siding. This facility will be removed during work to achieve the interim end state.

LLW Rail Packaging and Staging Area. The LLW Rail Packaging and Staging Area covers approximately 27,000 square feet east of and adjacent to the railroad tracks at the south end of WMA 6. The area contains two eight-inch-thick reinforced concrete pads and another section covered with crushed limestone.

WMA 7: NDA and Associated Facilities

WMA 7, shown in Figures 3-8 and Figure 3-41, includes the NDA and ancillary structures. The NDA is a near-surface radioactive waste disposal facility about 400 feet wide and 600 feet long. The only WMA 7 facility within the scope of this plan is the NDA Hardstand gravel pad.

The NDA is divisible into three distinct areas: (1) the NFS waste disposal area containing shallow special holes and deep burial holes, (2) the WVDP disposal trenches and caissons, and (3) the area occupied by the Interceptor Trench Project. Other structures and facilities include the Liquid Pretreatment System, the NDA Hardstand, an inactive plant water line, a leachate transfer line, and a former lagoon located beneath the former Interim Waste Storage Facility floor slab. This floor slab was removed in May 2008 as required for the planned installation of the geomembrane cover over the NDA.

The NDA was operated by NFS under license from the NRC for disposal of solid radioactive waste exceeding 200 mrem/h from fuel reprocessing operations. Section 2.4.2 describes the contents of the NDA and the estimated amount of radioactivity it contains.

Descriptions of the various features of the NDA follow:

NFS Deep Holes. About 6,600 cubic feet of leached cladding from reprocessed fuel, also known as hulls, are buried in approximately 100 deep disposal holes located in the eastern portion of the U-shaped area. Most of these holes are 2.7 feet by 6.5 feet by 50 to 70 feet deep.

The hulls were contained in 30-gallon steel drums stacked three abreast in the deep holes. Three of these drums contain irradiated, unreprocessed fuel with damaged cladding from the N-Reactor at the Hanford Site. The deep holes also contain LLW generated during fuel reprocessing.

NFS Special Holes. Approximately 230 NFS Special Holes are located in the northern and western portions of the U-shaped NFS burial area. The special holes are typically about 20 feet deep, with various lengths and widths; most are about 12 feet wide and 20 to 30 feet long.

The length and width of each special hole were varied according to the quantity of waste requiring disposal at each disposal event, and the dimensions of large waste items such as failed equipment. Miscellaneous wastes, other than leached hulls or related spent fuel debris, were packaged in several types of containers, including steel drums, wooden crates, and cardboard boxes.

At least 22 1,000-gallon tanks containing a mixture of spent n-dodecane and tributyl phosphate in absorbent material were disposed in several special holes during the late 1960s and the early 1970s (Blickwedehl et al. 1987). Eight of these tanks in special holes 10 and 11 were believed to be the source of n-dodecane and tributyl phosphate detected in a nearby monitoring well in the NDA on November 1983.

The following actions were taken by the WVDP between October 1985 and May 1987 to mitigate the migration of the n-dodecane and tributyl phosphate from special holes 10 and 11 (Blickwedehl et al. 1987):

- The eight 1,000-gallon tanks containing the n-dodecane/tributyl phosphate contaminated absorbents were removed.
- The tanks were size-reduced, contaminated absorbents and soils removed, and all waste packaged for disposal.
- Liquid n-dodecane and tributyl phosphate was removed and solidified into a qualified waste form suitable for disposal.
- Special holes 10 and 11 were backfilled.

Approximately 9,700 cubic feet of packaged contaminated soil, contaminated absorbents, size-reduced tanks, and solidified n-dodecane and tributyl phosphate were generated during this removal activity.

WVDP Trenches. The twelve WVDP trenches contain approximately 200,000 cubic feet of LLW resulting from decontamination activities performed between 1982 and 1986. Most of these wastes are in the parcel of land located inside the U-shaped disposal area used by NFS.

The WVDP Trenches are typically about 30 feet deep and about 15 feet wide. The lengths vary from 30 feet to 250 feet. Trenches 9 and 11 have composite liners and caps. All other WVDP Trenches are capped with clay.

WVDP Caissons. Four steel-lined concrete caissons – cylindrical concrete vaults seven feet in diameter and 60 feet deep – were constructed by the WVDP near the eastern and southern corners of the NDA. WVDP disposal records indicate approximately 823 cubic feet of waste in drums was placed in Caisson 1. The WVDP disposal records do not indicate that any waste was placed in the other three caissons. The caissons are plugged with concrete for shielding and covered with a plastic shield to prevent rainwater infiltration.

Interceptor Trench and Liquid Pretreatment System. The Interceptor Trench and associated Liquid Pretreatment System were installed after groundwater contaminated with tributyl phosphate, n-dodecane, and several radionuclides was detected in a well in the NDA. The purpose of the project was to intercept potentially contaminated groundwater migrating from the NDA.

The trench is located on the northeast and northwest boundaries of the disposal area. The base of the trench extends to a minimum of one foot below the interface of the weathered Lavery till with the unweathered Lavery till.

The trench is drained by a drainpipe that directs accumulated water to a collection sump. The collection sump has a submersible pump to transfer groundwater to the Liquid Pretreatment System. As of 2008, no groundwater has ever been transferred to the Liquid Pretreatment System.

Liquid that collects in the sump is routinely sampled, analyzed, and transferred to the Low Level Waste Treatment Facility in WMA 2 for treatment and release. Treated wastewater is discharged from Lagoon 3 in WMA 2 to Erdman Brook through the SPDES permitted outfall.

The liquid pretreatment system consists of seven tanks made of carbon steel: one 5,000-gallon holding tank, two 1,000 gallon pre-filtration holding tanks, two 700-gallon tanks containing granular activated carbon, and two 1,000-gallon post-filtration holding tanks. The granular activated carbon tanks are housed in a wooden shed 12 feet long by 10 feet wide. The other five tanks are located in a Quonset-style building.

Groundwater Barrier Wall. In July 2008, a subsurface groundwater barrier wall was installed on the southwest and southeast sides of the NDA to minimize groundwater migration into the disposal area (Figure 3-41). This barrier wall is a soil-bentonite slurry wall with a maximum hydraulic conductivity of 1E-07 cm/s that is keyed at least five feet into the underlying unweathered Lavery till. The slurry wall is approximately 850 feet long, three feet wide, and is 15 to 20 feet deep.

Geomembrane Cover. In the fall of 2008, the NDA was covered with XR-5, an ethylene inter-polymer alloy geomembrane, to limit infiltration of precipitation into the disposal area. Prior to the installation of the XR-5 geomembrane, imported backfill was placed on the surface of the NDA and the surface was graded to form a suitable foundation for the installation of the XR-5 geomembrane.

NDA Hardstand. The NDA Hardstand, located near the southeast corner of the NDA, was an interim storage area where radioactive waste was staged before being disposed. The NDA Hardstand originally was a three-sided structure with cinder block walls, located on a sloped pad of crushed rock 20 feet wide and 20 feet long. The NDA Hardstand is radiologically contaminated. The block walls were removed down to crushed rock pad in September 2006. The crushed rock pad would be removed during Phase 1 of the proposed decommissioning.

Inactive Plant Water Line. An eight-inch diameter cast iron water line from the plant runs along the southwestern border of the NDA. It was formerly used to supply clean water from the reservoirs to the Process Building, but was taken out of service in 1986 and capped with cement.

Leachate Transfer Line. The leachate transfer line is a two-inch diameter polyvinylchloride pipeline that runs along the northeast and northwest sides of the NDA, and continues northward across WMA 6 and terminates at Lagoon 2 in WMA 2. It was originally used to transfer liquids from the SDA lagoons via a pumphouse next to the NDA hardstand, to Lagoon 1

The total length of the line is 4,000 feet. The section of the transfer line from the SDA to the interceptor trench sump is inactive and the two ends are capped. The section of the line from the northeast corner of the NDA to Lagoon 2 is currently used to transfer groundwater from the NDA interceptor trench sump.

Former Lagoon. This lagoon, formerly used by NFS for collecting surface water runoff, was located in the northeastern portion of the NDA. Around 1972 it was filled with radiologically contaminated soil from cleanup after a HEPA filter was dropped at the NDA during disposal operations.

WMA 8: SDA

The SDA, which is shown on Figure 3-8, is not within the scope of this plan.

WMA 9: Radwaste Treatment System Drum Cell

WMA 9 is located south of WMA 7 and it contains the Radwaste Treatment System Drum Cell (Figure 3-42).

Drum Cell. The Drum Cell was built in 1987 to store radioactive waste solidified in cement and packaged in square 71-gallon drums. It is a pre-engineered metal building 375 feet long, 60 feet wide, and 26 feet high. The facility consists of a base pad, concrete shield walls, remote waste handling equipment, container storage areas, and a control room within the weather structure. The base pad consists of concrete blocks set on a layer of compacted crushed stone, underlain by geotextile fabric and compacted clay. Concrete curbs to support the drum stacks lie on top of the base pad.

All of the drums stored in the Drum Cell were removed in 2007 and disposed of at off-site LLW disposal facilities. The Drum Cell would be removed during Phase 1 of the proposed decommissioning.

Subcontractor Maintenance Area. The Subcontractor Maintenance Area is a compacted gravel pad measuring approximately 20 feet by 30 feet located in the northwest corner of WMA 9. Prior to 1991, it was used by construction subcontractors to clean asphalt paving equipment with diesel fuel. In November 1991, the area was remediated by removing the upper six inches of soil and replacing it with clean gravel. The removed soil was tested for toxicity characteristic leaching procedure parameters and found to be nonhazardous solid waste. Since 1991, the area has been used as a staging area for heavy equipment and construction materials (stone, gravel). The gravel pad would be removed during Phase 1 of the proposed decommissioning.

NDA Trench Soil Container Area. The NDA Trench Soil Container Area is a gravel pad storage area located on the north side of WMA 9. It was used to store roll-off containers containing soil excavated during the installation of the NDA Interceptor Trench which was completed in 1990. The containers were covered with tarps to prevent infiltration of precipitation and the rear gate was equipped with a rubber gasket to prevent the discharge of any soil or liquid. The roll-off containers and their contained soil have been removed and disposed of offsite. The gravel pad would be removed during Phase 1 of the proposed decommissioning.

WMA 10: Support and Services Area

WMA 10, shown in Figure 3-43, covers approximately 25 acres on the north plateau and south plateau, and includes: (1) the Administration Building, (2) the Expanded Laboratory, (3) the New Warehouse, (4) the security gate house, (5) the Meteorological Tower, (6) the main parking lot, and (7) the south parking lot. In addition, concrete slabs and foundations from several removed structures remain in place, along with the former Waste Management Storage Area.

The WMA 10 facilities within the scope of this plan are the New Warehouse, the former Waste Management Storage Area, and the remaining concrete floor slabs and foundations.

Administration Building. The administration building is a single-story structure 130 feet long and 40 feet wide, 10 feet high at the eaves, and 11.7 feet high at the peak. The concrete base is nine inches thick. Construction materials include the concrete foundation, wood frame, metal siding, and metal roofing.

The administration building was built during the 1960s. The trailers were added beginning in 1982, and an addition to the west side of the building was added during the early 1980s. The trailers were removed in 2005. The addition to the administration building is approximately 94 feet long and 30 feet wide with a concrete base six inches thick. This facility will be removed to grade during the work to achieve the interim end state.

Meteorological Tower. The meteorological tower is located south of the administration building. Constructed of steel, it stands approximately 200 feet high on a concrete foundation. It has three main support columns with interior trusses and is anchored with five support cables. A stand-by generator and electrical boxes rest on a concrete pad.

Security Gatehouse and Fences. The main security gatehouse is located adjacent to the Administration Building. It was constructed in 1963. The gatehouse is 34 feet long, 20 feet wide, and nine feet high at the edge of the roof. Construction materials include a concrete foundation, concrete block walls, a concrete slab floor, and a built-up roof with metal deck.

A barbed wire security fence runs along the perimeter of the Center property line and the public roads running through it. The fencing has a total running length of approximately 24 miles.

A steel security fence surrounds the WVDP, the SDA, and miscellaneous other locations. It is made of galvanized chain link with galvanized steel pipe posts, with a spacing of 10 feet. The fence is seven feet high with a total length of 4.7 miles. Three strands of barbed wire are stretched across the top of the fence. Figure 3-5 shows the location of the fence around the project premises.

Expanded Lab. The Expanded Laboratory is located south of the Administration Building. It was constructed during the early 1990s. The laboratory is 92 feet long and 50 feet wide, and consists of eight one-story modular units supported by 72 concrete piers. It was manufactured from light wood framing, metal roofing, and siding. An addition, 20 feet wide and 50 feet long on a concrete foundation wall, was built on the east side of the laboratory. This facility will be removed to grade during the work to achieve the interim end state.

New Warehouse. The New Warehouse was built during the 1980s and is located east of the administration building. It is a pre-engineered steel building, 80 feet wide, 250 feet long, and 21.5 feet high at the roof peak, resting on about 40 concrete piers and a poured concrete foundation wall. The concrete floor is underlain with a gravel base.

Former Waste Management Storage Area. This area is a lay-down area associated with the New Warehouse.

Parking Lots and Roadways. Two parking lots are located off Rock Springs Road: the Main Parking Lot and the South Parking Lot.

The Main Parking Lot has a total paved surface area of 180,000 square feet and is covered with asphalt underlain with gravel. The South Parking Lot with approximately 80,000 square feet of parking area is also paved with asphalt. A guardrail approximately 1,200 feet long borders the lot along its southern, eastern and western sides.

Roadways are constructed of a stone sub-base approximately eight-inches thick, covered with asphalt approximately four-inches thick. The total area of pavement is approximately 1,296,000 square feet.

WMA 11: Bulk Storage Warehouse and Hydrofracture Test Well Area

The facilities within WMA 11, as shown in Figure 3-9 are not within the scope of this plan.

WMA 12: Balance of the Site

The facilities within WMA 12, as shown in Figure 3-9, are not within the scope of this plan.

3.1.4 Surrounding Communities, Businesses, and Transportation System

The Center is located in a rural area with few population centers (Figures 3-1 and 3-2). The nearest incorporated village is Springville, 3.5 miles north of the WVDP. The hamlet of West Valley and the communities of Riceville and Ashford Hollow also lie within a five-mile radius of WVDP.

Businesses, farms, and community centers within a 3.1-mile radius of the WVDP site in 2004 are listed in Table 3-1. Additional businesses, community centers and manufacturing facilities between 3.1-and 5 mile radii in 2008 included several retail stores, small manufacturing facilities, a concrete supplier, a nursery, a hospital, and two nursing homes.

Table 3-1. Businesses, Farms, and Community Centers within a 3.1- Mile Radius of the WVDP Site

Sector Direction	Facilities	Distance from Stack (miles)
	Businesses	-
NE	Split Rail Farm – Horse boarding and breeding	1.42
W	Storage Warehouse	2.36
W	NORCO Propane Co./Pioneer Propane	2.34
W	Countryside Car Center	2.37
WSW	Country Gifts and Storage	2.35
WSW	Starcrest Homes (Home Business) & U-Haul	2.34
WSW	Heritage Pipe Organ	2.43
WSW	(Riefler Inc.)	2.78
ESE	Harrigan Realty – Attorney at Law	2.13
NW	Springville Country Club	3.04
WSW	M&M Holland Propane	2.40
W	L. A. Hazard	2.27
SE	Gerwitz and McNeil Electric	2.01
W	Ashford Auto and Marine Repair	2.31
SE	Fox Valley Greenhouse	1.83
NW	Jack R. Preston's AutoBarn	0.94
SW	Phillip's Christmas Tree and Wreath	3.01
N	Codd's Flower Shop	1.57
NNW	Model Shop	1.28
W	House of Steel	2.26
N	Schichtel's Nursery – Bond Rd	1.56
WNW	Schichtel's Nursery – Peters Rd	2.62
	Farms	-
S	Tom Stuebchen - Fruit Trees	2.28
S	Charles Schichtel – Dairy Farm	2.32

Table 3-1. Businesses, Farms, and Community Centers within a 3.1- Mile Radius of the WVDP Site

Sector Direction	Facilities	Distance from Stack (miles)
N	Clemence and Claudia Wolniewicz - Grain and Hay	2.45
NNW	David Reed – Dairy Farm	2.33
SE	Wayne Widrig – Dairy Farm	1.80
SE	Gary Feldman – Dairy Farm	3.11
WNW	Willard and Ann Miller – Dairy Farm	2.55
SE	Kevin Hebdon – Dairy Farm	2.95
WNW	David Cobo – Farm	1.15
WSW	Timothy Klahn – Dairy Farm	2.51
	Community Centers	-
SE	American Legion	3.00
E	Islamic Academy	2.91
N	Springfield Field and Stream	3.09
WNW	Trinity Lutheran	1.19
ENE	Cattaraugus County Houndsmen and Conservation Club	1.62
E	Riceville Community Church	2.83
SE	Ashford Municipal Building	1.71

A small military research installation is located in Cattaraugus County approximately 3.1 miles northeast of the WVDP. This facility was used to conduct research for the U.S. Department of Defense Air Force Automatic Liquid Agent Detector Program.

Transportation System

Transportation facilities near the Center include highways, transport repair and refueling services, rail lines, and aviation facilities.

The primary method of transportation near the site is motor vehicle traffic on the highway system shown in Figure 3-2. In Cattaraugus County, all roads with the exception of those within the cities of Olean and Salamanca are considered rural roads.

Rural principal arterial highways connect population and industrial centers. These include U.S. Route 219, located 2.6 miles west of the site, Interstate 86, located approximately 21.7 miles south of the site, and the New York State Thruway (I-90), approximately 21.7 miles north of the site. Traffic volume along the section of U.S. 219 west of the site between New York Route 39 and the Cattaraugus County Line averaged 9966 vehicles per day in 2002 (NYDOT 2005). Construction of a 4.2 mile extension of U.S.

Route 219 began in 2007.

Collectors are roads from smaller communities and industrial centers to the rural principal arterial highways. They frequently are intra-county in nature and serve short hauls and cross-county traffic. There are three county collector roads within 1.2 miles of the site. Schwartz Road and Rock Springs Road serve as the principal site access roads. State Route 240, also identified as County Route 32, is 1.2 miles northeast of the site. The average annual daily traffic volume on State Route 240 near the site was 978 vehicles in 2002 (NYDOT 2003).

Dutch Hill Road, approximately one mile west of the WVDP, is an oil and stone chip surface on a gravel base designed to accommodate local, lightweight vehicles. Edies Road is of similar construction. Mill Street is asphalt paved over a gravel base located on unstable soils.

Railroad service in a north-south direction is provided to the central part of Cattaraugus County. The Buffalo and Pittsburgh Railroad transects the Center approximately 0.5 mile east of the project premises at its nearest point. This rail line is now abandoned north of the Center. The Center is served by a railroad siding from this line, often referred to as the rail spur.

There are no commercial airports in the site vicinity. The only major aviation facility in Cattaraugus County is the Olean Municipal Airport, located in the Town of Ischua, 21 miles southeast of the site, which does not offer regularly scheduled commercial air service. The nearest major airport is Buffalo Niagara International Airport, 34 miles north of the site.

3.2 Population Distribution

Local population information was obtained from a demographic survey performed in the area of the WVDP in 2002 (URS 2002) and regional population information from the 2000 U.S. census (Census Bureau 2003). This demographic survey referenced in Sections 3.2 and 3.3 has not been updated as of 2008. For analysis purposes, the area surrounding the WVDP is divided into 16 compass-direction sectors, with the WVDP main stack as the reference point.

3.2.1 Local Population Data

The 2002 demographic survey was performed out to a 3.1-mile radius from the WVDP Main Plant stack and included all permanent structures that may be inhabited in that area. Results of this survey appear in Tables 3-2 and 3-3.

In 2002, approximately 1,050 people lived within a 3.1-mile radius of the site. The largest numbers of individuals were located east of the site. Figure 3-44 shows the results of the demographic survey by compass vectors.

Table 3-2. 2002 Resident Population Estimates by Directional Sector Within a 3.1-Mile Radius of the Main Plant Stack (URS 2002)

Sector		Radius (miles)					
		0.3-0.6	0.6-1.2	1.2-1.9	1.9-2.5	2.5-3.1	TOTAL
A	N	0	0	19	17	18	54
B	NNE	0	0	19	52	34	105
C	NE	0	3	17	0	21	41
D	ENE	0	2	27	0	19	48
E	E	0	0	38	55	81	174
F	ESE	0	0	4	48	15	67
G	SE	0	0	6	29	30	65
H	SSE	0	0	0	26	24	50
I	S	0	0	6	12	8	26
J	SSW	0	0	2	10	19	31
K	SW	0	0	9	0	43	52
L	WSW	0	0	9	14	4	27
M	W	0	8	35	21	15	79
N	WNW	0	29	41	4	24	98
O	NW	0	9	65	13	2	89
P	NNW	0	6	14	19	11	50
TOTALS		**0**	**57**	**311**	**320**	**368**	**1,056**

The nearest residences are located 0.76 to 1.94 miles from the WVDP site as shown in Table 3-3. The numbers of wells or springs used as drinking water within 3.1 miles of the WVDP are listed in Table 3-4. The information in the table is not inclusive of every well used for water consumption because the survey was subject to residential participation.

Table 3-3. Nearest Residences by Sector (URS 2002)

Compass Direction	Distance (mi)	Residence Location
WNW	0.76	6491 Boberg Rd.
NW	0.83	10493 Rock Springs Road
W	1.09	10314 Dutch Hill Rd.
NNW	1.17	10596 Rock Springs Rd.
NE	1.20	10653 Rte. 240
ENE	1.22	10625 Rte. 240
SW	1.33	10086 Dutch Hill Rd.
WSW	1.33	10122 Dutch Hill Rd.
S	1.42	9911 Rock Springs Rd.

Table 3-3. Nearest Residences by Sector (URS 2002)

Compass Direction	Distance (mi)	Residence Location
E	1.53	5761 Heinz Rd.
N	1.53	10927 Bond Road
NNE	1.63	10845 Rte. 240
ESE	1.63	5579 Buttermilk Rd
SSW	1.76	10043 Dutch Hill Rd.
SE	1.80	5768 Fox Valley Rd.
SSE	1.94	5872 Fox Valley Rd.

Table 3-4. Number of Residential Wells or Springs used for Drinking Water by Sector within a 3.1-Mile Radius of the Main Plant Stack

Sector	Direction	Number of Wells or Springs(1)
A	N	14
B	NNE	23
C	NE	5
D	ENE	10
E	E	36
F	ESE	20
G	SE	8
H	SSE	12
I	S	7
J	SSW	11
K	SW	20
L	WSW	9
M	W	22
N	WNW	24
O	NW	27
P	NNW	11
TOTAL		**259**

NOTE: (1) Numbers of wells and springs estimated based upon resident interviews in URS 2002.

3.2.2 Population Distribution

The Center lies within Cattaraugus and Erie counties. Regional population data within a 50-mile radius of the WVDP was obtained from the 2000 U.S. Census.

Summary of Current Population In and Around the Site

The 1960 through 2000 resident populations of towns and villages within 10 miles of the WVDP are presented in Table 3-5[4]. The populations of New York and Pennsylvania counties within 50 miles of the WVDP are presented in Table 3-6.

Erie County had a population of 950,265 in 2000, which is a 10.7 percent decline from 1960. Although both Erie County and the City of Buffalo have experienced a population decline, populations in the rural townships south of Buffalo – such as Orchard Park, Hamburg, East Aurora, and West Falls – have increased. The population of southern Erie County near the WVDP site is concentrated primarily in small villages and along roadways, much like in Cattaraugus County. Traditionally, the majority of people residing in these areas work in agriculture or nearby small industries.

Table 3-5. Locations and Populations of Towns and Villages Partially or Totally Within 10 Miles of the Site (from 2000 census)

TOWN/ VILLAGE(1)	DISTANCE/ DIRECTION (Miles)	POPULATION					POP. DENSITY per sq.mi.	1960-1990 % CHG.	1990-2000 % CHG.
		1960	1970	1980	1990	2000			
Ashford (T)	Note (4)	1,490	1,577	1,922	2,162	2,223	43	45.1	2.82
Concord (T)	3.0N	6,452	7,573	8,171	8,387	8,526	122	30.0	1.66
Springville (V)(2)	3.5N	3,852	4,350	4,285	4,310	4,252	N/A	11.9	-1.35
Sardinia (T)	4.0 NNE	2,145	2,505	2,792	2,667	2,692	54	24.3	0.94
Yorkshire (T)	3.5 NNE	2,012	2,627	3,620	3,905	4,210	114	94.1	7.81
Delevan (V)(3)	8.9 ENE	777	994	1,113	1,214	2,321	N/A	56.2	91.2
Machias (T)	4.0 ESE	1,390	1,749	2,058	2,338	2,482	61	68.2	6.16
Franklinville (T)	7.8 SSE	3,090	2,847	3,102	2,968	3,128	60	-3.9	5.39
Ellicottville (T)	12.0 S	1,968	1,779	1,677	1,607	1,738	39	-18.3	8.15
Mansfield (T)	7.5 SSW	632	605	784	724	800	20	14.6	10.50
East Otto (T)	3.0 SW	701	910	942	1,003	1,105	27	43.1	10.17
Otto (T)	7.5 WSW	715	731	828	777	831	26	8.7	6.95
Collins (T)	7.5 WNW	6,984	6,400	5,037	6,020	8,307	173	-13.8	37.99
North Collins(T)	8.9 NW	3,805	4,090	3,791	3,502	3,376	79	-8.0	-3.60
TOTAL (OR AVERAGE)		**31,384**	**33,393**	**34,724**	**36,060**	**39,418**	---	**14.9**	**14.9**

NOTES: (1) (T) indicates town and (V) indicates village.
(2) Springville village population is included in the town of Concord.
(3) Delevan village population is included in the town of Yorkshire.
(4) The WVDP is located within the geographical boundary of the Town of Ashford.

[4] In New York state, a town is the major subdivision of each county and a village is an unincorporated area, usually within a town.

Population Density

Using the 2000 census data, the maximum population density of 173 persons per square kilometer occurs between 20 and 30 miles from the site. Table 3-5 includes the population densities of towns within 10 miles of the WVDP site.

Table 3-6. Populations of Selected Municipalities, Counties, and States within 50 Miles of the Site (1960-2000) (from U.S. Census, years cited)

MUNICIPALITY/ COUNTY/STATE[1]	POPULATION					% Change 1960-2000
	1960	1970	1980	1990	2000	
NEW YORK (S)	16,782,304	18,241,391	17,558,072	17,990,455	18,976,457	13.1
Cattaraugus (C)	80,187	81,666	85,697	84,234	83,955	4.7
Erie (C)	1,064,688	1,113,491	1,015,472	968,532	950,265	-10.7
Hamburg (M)	41,288	47,644	53,270	53,735	56,259	36.3
Orchard Park (M)	15,876	19,978	24,359	24,632	27,637	74.1
Buffalo (M)	532,759	462,768	357,870	328,123	292,648	-45.1
Allegany (C)	43,978	46,458	51,742	50,470	49,927	13.5
Wyoming (C)	34,793	37,688	39,895	42,507	43,424	24.8
Chautauqua (C)	145,377	147,305	146,925	141,895	139,750	-3.9
Livingston (C)	44,053	54,041	57,006	62,372	64,328	46.0
Genesee (C)	53,994	58,722	59,400	60,060	60,370	11.8
Niagara (C)	242,269	235,720	227,101	220,756	219,846	-9.3
Steuben (C)	97,691	99,546	99,135	99,088	98,726	-1.1
PENNSYLVANIA (S)	11,319,366	11,800,766	11,866,728	11,881,643	12,281,054	8.5
Warren (C)	45,582	47,682	47,449	45,050	43,863	-3.8
McKean (C)	54,517	51,915	50,635	47,131	45,936	-15.7
Potter (C)	16,483	16,395	17,726	16,717	18,080	9.7

NOTE: (1) (M) indicates municipality, (C) indicates county, and (S) indicates state.

Transient Population

The transient population around the site includes daily and seasonal transients including the workforce at the WVDP. In 2008, an average of 300 employees was working at the site during daytime hours.

This transient population is projected to vary in future years according to the activities on site. The seasonal transient population is associated with the area's numerous small recreation sites. Where significant, this transient population is included in the distribution and projection figures.

Future Projected Population

According to the Greater Buffalo-Niagara Regional Transportation Council, the total Concord/Springville population is expected to reach 10,000 by the year 2020, a gain of almost 10 percent per decade. It is projected that the present 50/50 population split will continue, with Springville having 5070 people and the unincorporated areas of the town 4930 in 2020 (ECPD 1999). Population projections for Cattaraugus County were prepared by Cornell University in September of 2002 and are available for public viewing on the New York State Information System website (http://www.nysis.cornell.edu/cattaraugus.pdf). Projected population change for Cattaraugus County is as follows:

2005 - 83,881	2010 - 83,674	2015 - 83,359
2020 - 82,815	2025 - 81,989	2030 - 80,886

Population trends may be influenced by the expansion of Route 219 through Cattaraugus County. The baseline population projections are projections illustrating the impact of recent rates of population change. Census 2000 county populations have been projected using current life expectancy and survival rates, age specific fertility rates, and rates of net migration. The rates of net migration have the greatest impact on changes in population size. These net migration rates are based on an analysis of total population change between the 1990 census and the 2000 census.

3.3 Current and Future Land Use

This section describes current land use on the site and in the vicinity in detail, and future land use on site and in the vicinity within the limitations of available information.

3.3.1 Current Land Use

Detailed information on current land use is available from a number of sources.

Onsite Land Use

The project premises have served only industrial uses since the reprocessing plant was built in the 1960s. The balance of the Center, often referred to as the retained premises, has served only as a buffer area for the plant since that time. In 2008, no definitive information on plans for future use of the Center was available.

Land Use in Vicinity of the WVDP

Land use within five miles of the WVDP site is predominantly associated with agriculture, arboriculture, and forestry. The major exception is the Village of Springville, in which many areas are devoted to residential, commercial, and industrial land uses. Other major non-agricultural land uses within five miles of the site are:

- Hamlet of West Valley – residential/commercial/land use, 3.4 miles to the southeast;

- Cattaraugus County Forest – forestry/recreation, 3.7 miles to the south;
- Campground – five miles to the southwest;
- Machine shop – industrial land use, four miles to the northwest;
- Two retail shopping complexes - commercial land use - four miles to the north northwest; and
- Warehouse – commercial land use, 3.8 miles to the north-northwest in the village of Springville.

Cattaraugus County ranks fifth in the state for number of farms and eleventh in the state for the amount of land in farming. Approximately 24 percent of the county's total acreage is farmland (NYASS 2005). Production and sale of important agricultural commodities in Cattaraugus County are shown in Table 3-7. The dairy industry is the dominant agricultural activity, with meat production occurring on a smaller scale.

Table 3-7. Leading Agricultural Products in Cattaraugus County[1]

Product	2002 Sales in $1000s	Percent of Total Sales	County Rank in New York
Dairy Products	36,486	63	19
Nursery and Greenhouse	9,676	17	5
Cattle and Calves	4,832	8	22
Hay & Silage	1,976	3	28
Grains and Dry Beans	1,628	3	22
Other Products	3754	6	
Total Sales	58,352	-	22

NOTE: (1) From NYASS 2005.

Farming Statistics

In 2002, a livestock and crop production survey within a 3.1-mile radius of the WVDP was taken in conjunction with the population survey. The results of this survey are shown in Tables 3-8 and 3-9.

Table 3-8. 2002 Consumable Animal Population Estimates[1] by Sector within a 3.1-Mile Radius of the Main Plant Stack (URS 2002)

Sector	Direction	Dairy Cattle	Beef Cattle	Goats	Sheep	Pigs	Fowl[2]
A	N	0	0	0	0	0	0
B	NNE	0	11	0	0	0	0
C	NE	0	23	0	0	0	0
D	ENE	12	11	15	12	5	20

Table 3-8. 2002 Consumable Animal Population Estimates[1] by Sector within a 3.1-Mile Radius of the Main Plant Stack (URS 2002)

Sector	Direction	Dairy Cattle	Beef Cattle	Goats	Sheep	Pigs	Fowl[2]
E	E	17	31	0	7	0	0
F	ESE	0	0	0	0	0	6
G	SE	135	0	0	15	0	32
H	SSE	0	0	0	0	0	0
I	S	100	12	0	0	0	0
J	SSW	60	45	0	0	2	4
K	SW	3	0	0	0	2	17
L	WSW	0	5	0	0	0	0
M	W	0	36	5	0	2	21
N	WNW	70	0	0	0	0	9
O	NW	5	0	0	0	1	13
P	NNW	60	0	0	30	0	20
TOTALS		**462**	**174**	**20**	**64**	**12**	**142**

NOTES: (1) Numbers of animals are estimated based upon resident interviews and site reconnaissance.
(2) Fowl includes: Chickens, Ducks, Geese, Turkey, Ostrich (4) and Emu (1).

Dairy and beef cattle farming dominate within 3.1 miles of the WVDP. The majority of livestock production occurs northwest and southeast of the WVDP. Farming within 3.1 miles of the site typically occurs northwest and south and east of the site. The principal use of farmland is hay and pasture land. Hay and pasture lands account for approximately 57 percent of land used for agricultural purposes. The production of corn and oats accounts for 45 percent of agricultural land use.

Land-use surrounding the Center property – based on county land-use maps and tax parcel information – is shown in Figure 3-45.

Table 3-9. 2002 Crop Estimates in Acres by Sector within a 3.1-Mile Radius of the Main Plant Stack (from URS 2002)

Sector	Direction	Corn	Oats	Hay & Pasture	Ground Fruit[1]	Fruit Trees[2]	Garden Vegetables[3]
A	N	60	0	0	1	0	0.4
B	NNE	0	0	0	0	0	1.8
C	NE	0	0	0	0	0	0.5
D	ENE	0	0	0	0	0.2	1.1
E	E	0	0	0	0	0	1.3

Table 3-9. 2002 Crop Estimates in Acres by Sector within a 3.1-Mile Radius of the Main Plant Stack (from URS 2002)

Sector	Direction	Corn	Oats	Hay & Pasture	Ground Fruit(1)	Fruit Trees(2)	Garden Vegetables(3)
F	ESE	0	0	100	0	0	0.2
G	SE	83	34	250	0	0	1.7
H	SSE	0	0	30	0	0	0.4
I	S	50	50	100	1	0	1.2
J	SSW	30	30	50	0	0	0.8
K	SW	0	0	0	0	0	1.0
L	WSW	0	0	0	0	0	0.0
M	W	0	0	80	0	0	0.8
N	WNW	230	0	100	0	0	0.7
O	NW	0	0	0	0	0	1.0
P	NNW	0	0	0	0	0	0.8
TOTALS		**453**	**114**	**710**	**2**	**0.2**	**13.7**

NOTES: (1) Ground Fruit includes: blueberries, raspberries, strawberries, and grapes.
(2) Fruit Trees includes: apples and pears
(3) Garden vegetables included: beans, cabbage, corn, cucumbers, peas, potatoes, pumpkins, tomatoes, squash, and zucchini.

Agricultural lands cultivated to produce fruits and vegetables represent less than one percent of the total agricultural acreage within 3.1 miles of the site. Fruit and vegetable fields tend to be smaller than dairy fields, and are not distributed in proportion to the occurrence of farmland. In general a few towns contain a disproportionately large share of these lands. Crops include lettuce, cabbage, broccoli, spinach, snap beans, tomatoes, sweet corn, potatoes, grapes, and apples. Total land area devoted to such production in Erie and Cattaraugus counties is estimated at 10,189 acres and 2,319 acres, respectively.

3.3.2 Summary of Anticipated Land Uses

The project premises will be available for only limited future uses in the coming decades. The ability to anticipate land use in the vicinity in future years is limited by the limited available information from planning boards.

Future Use of Project Premises and the Center

Future use of the retained premises would depend upon the wishes of NYSERDA as the property owner and would need to be consistent with institutional controls, where applicable. As of 2008, no definitive information on NYSERDA plans for future use of the Center was available. However, the Southern Tier West Regional Planning and Development Board has an ongoing West Valley Redevelopment Strategy Project in response to the ongoing decommissioning of the WVDP.

Future Use of Land in the Vicinity

It is expected that future land uses in the vicinity of the Center will be similar to the historical land uses summarized in Section 3.3.1. Information from local, regional, and State planning boards is limited. On June 9, 1999 the Town of Concord and the Village of Springville held a public hearing to review a draft of the joint comprehensive plan (ECPD 1999). The vision of the plan was expressed as follows:

> "The Concord/Springville community values and wishes to preserve the scenic beauty, farmland, hamlets, and unique natural environment of the Town of Concord. It also wishes to enhance and strengthen the Village of Springville as the civic, cultural and economic center of Concord and the surrounding non-town area, and maximize its location at the southern gateway to Erie County."

Proposed developments related to this vision included:

- A 50-acre planned business park adjacent to US Route 219;
- Revitalization of downtown Springville;
- A new planned residential area in the northeastern section of the Village,
- Upgrading of the Town and Village Hall facilities; and
- Park and recreation improvements, which included a new park at Scoby Hill Dam and a new greenway along Spring Brook.

The greenway development would include a four-mile-long park area bordering Spring Brook from Middle Road to Cattaraugus Creek at Felton Bridge on Mill Street. This park would include nature trails, bicycle paths, canoe landings, and picnic areas.

The new park at Scoby Hill Dam would include a canoe landing, fishing access, and recreational use. Further recreational development is proposed to encourage the development of hiking/biking trails, golf, snowmobiling, and skiing.

Additional proposals utilized the abandoned Buffalo-Pittsburgh Railroad line from Springville to Salamanca to be developed either as a tourism train, connected with a railroad museum in Salamanca, or as a extensive bike trail as part of the "rails to trails" program.

Industrial and business development would be encouraged at or near current locations (along Cascade Drive and near the railroad tracks), with the exception of a planned new business park located near the Zoar Valley Road, with a connector road intended to the future Route 219. If Route 219 were to be extended down to Salamanca, certain land adjacent the route would be developed for business and/or industrial use (Ashford 1994).

Sand and gravel mining is a growing industry within the area with nine areas now designated for mining. Future intentions are to develop this industry to promote economic development in the area (Bishop, et al. 2004).

Cattaraugus County

The 1994 Comprehensive Master Plan anticipated much of its land use based on the extension of Route 219 and the development of the nuclear fuel industry through the WVDP. Given these assumptions, industrial and business development was planned to occur near the Route 219 extension and on some Center property.

Parcels reserved for industry in the future land use plan are located near the following roads: Henrietta Road (300 acres), Schwartz Road (50 acres), Route 219 (80 acres), Thomas Corners (350 acres), and within the Town of Ashford (265 acres). The closest business development complex to the WVDP property would be the Ashford Business and Education Park at the location of the Ashford Office Complex. The intersection of Route 219 and Schwartz Road, and Thomas Corners have been intended for residential development (Ashford 1994).

The Record of Decision on the Route 219 expansion was published in April 2003. The New York Department of Transportation selected the freeway alternative, which proposes a four-lane freeway from Springville to Salamanca. Construction of the Route 219 expansion began in 2007.

Since the Comprehensive Master Plan was published, gravel mining has expanded rapidly. In 1993, 53 parcels of land totaling 3,455 acres were assessed for mining and quarrying in the Route 16 corridor of Cattaraugus County. This number increased to 76 parcels totaling 4,502 acres in 1999. In 2000, there were 49 active mining permits covering 1,030 acres.

Issues raised by concerned citizens have resulted in the Town of Yorkshire adapting zoning plans to remediate gravel mining activities. As of October 2002, the Town of Ashford had not adapted any zoning regulations.

3.4 Meteorology and Climatology

This section begins with a description of the general climate in the region, followed by a discussion of severe weather phenomena. Weather-related radionuclide transmission factors and site deterioration factors are then described. Finally, site meteorology is discussed, along with air quality in the area.

3.4.1 The General Climate of Western New York

Western New York is exposed to a variety of air masses that create a moist continental climate. Cold dry air masses that form over Canada reach the area from the northwest. Prevailing winds from the southwest and south bring warm, humid air masses from the Gulf of Mexico and neighboring waters of the subtropical Atlantic Ocean. On occasion, cool, cloudy, and damp weather affects Western New York through air flow from the east and northeast.

Western New York is affected by a variety of cyclonic and anti-cyclonic pressure systems as they move across the continent. Continental storms and frontal systems move frequently across or near this region. In addition, Western New York usually feels the effects of well-developed storms moving up the Atlantic Coast.

Temperature

The coldest winter temperature normally varies between -10 °F to -20 °F in the southwestern highlands (WVNSCO 2007). Extreme winter temperatures as cold as -40 °F have been recorded in the higher elevations of Cattaraugus County (WVNSCO 2007). Severe winter cold with below-zero minimums and/or lengthy periods of continuous temperatures below freezing occur between early December and mid-March. Winter thaws typically result in temperatures in the 40s to low 50s for a few days at a time, with rare maximums in the 60s.

The summer seasons are cool with the temperature typically ranging from 60 °F at night to the low 80s in the afternoon (WVNSCO 2007). On the average, temperatures of 90 °F or higher are recorded on five days or less per year at the higher elevations and along the shore of the Great Lakes (WVNSCO 2007). Such temperatures occur between early June and early September. Readings of 100 °F or higher are rare. It is sunny for 65 percent of the total daylight hours on the average during the summer (WVNSCO 2007).

Temperatures from mid-September to mid-October frequently rise to the 60s and 70s in the daytime and cool to the 30s and low 40s at night. The comparatively warm waters of the Great Lakes reduce cooling at night to the extent that freezing temperatures in lakeside counties are normally delayed until mid-October or later.

Precipitation

Lake Erie and Lake Ontario exert a major controlling influence on the climate of the region. In winter, cold air crossing unfrozen lake water picks up moisture and releases it as snow as the air stream moves inland over higher terrain. Heavy snow squalls frequently occur, producing from one to two feet of snow and occasionally as much as four to seven feet. Cattaraugus County and Erie County are generally subject to lake-effect snows in November and December, but as the lake gradually freezes lake-effect snow becomes less frequent. The snow season normally begins in mid-November and extends into mid- or late-April.

Winter precipitation is heaviest east of Lake Erie, where the average total snowfall is in excess of 120 inches (WVNSCO 2007). Summer season precipitation ranges from 10 to 12 inches with the rainfall distribution pattern reflecting the influences of the cool Lake Ontario waters to the north and the hilly terrain in the Southern Tier (WVNSCO 2007). Rains resulting from warm fronts are usually light but last for several days; cold fronts often cause heavier rainfall in shorter periods.

3.4.2 Severe Weather Phenomena

Figures 3-46 through 3-48, provided by the National Weather Service observing station in Buffalo, show the distribution patterns of tornadoes (1950-2002), thunderstorm winds (1955-2002), and hail events (1955-2002) for western and north central New York. The National Weather Service has not updated these figures as of 2008. Corresponding charts depict distribution of events by month, time, and rating of severity.

Severe weather phenomena occurred during the 1993-2002 period as follows:

- Six tornadoes;
- Seventy-five thunderstorm wind or hail events (where thunderstorm winds measured 58 mph or greater or produced damage, or where hail measuring 0.75-inch or larger fell);
- Seven injuries due to lightning strikes;
- Forty-nine flood or flash flood events (about one-third due to ice jams);
- Twenty-eight high wind events (high winds caused by large-scale, synoptic low pressure systems);
- Three ice storms (with ice accumulations of one-half inch or greater);
- One blizzard in March 1993 (with winds or frequent gusts of 35 mph or greater and visibilities of less than one-fourth mile sustained for three hours or more); and
- Sixty-six snowstorms (with seven inches or more of snow within a 12- hour period, or nine inches or more of snow within 24 hours, about two-thirds due to lake-effect snows.)

Additional historical meteorological data is provided in WVNSCO 1993b, which summarizes regional meteorological information, analyzes trends, and correlates meteorological data collected by the National Weather Service with data collected at the site's regional and primary monitoring stations.

3.4.3 Weather-Related Radionuclide Transmission Factors

Winds at the site are generally from the west and south at about 10.3 miles per hour (4.6 m/s) and 9.6 miles per hour (4.3 m/s) respectively, based on data from 1991-2002. Figure 3-49 depicts the average wind vectors on site.

The strongest winds occur from November through March and are generally southwesterly to west-southwesterly. The weakest winds occur from May to October and are generally southwesterly to southerly (WVNSCO 1993).

Average and extreme duration of precipitation events are not measured at the WVDP. Only annual, monthly, or daily precipitation data are available, recorded as inches fallen in a 24-hour period.

3.4.4 Weather-Related Site Deterioration Parameters

Routine and extreme weather-related site deterioration parameters are considered in this section.

Routine Parameters

Note that precipitation intensity is indicated by information provided in Section 3.4.5. The hourly average maximum recorded wind speed in the area was 35.3 miles per hour in December of 1987 (WVNSCO 1993).

Wind vectors were addressed in Section 3.4.3. Temperature gradients were discussed in Section 3.4.1. Limited data are available on pressure gradient variation: reported barometric pressure measurements in 1991 and 1992 have ranged from lows of 29.51 in March of 1991 and 28.17 in May of 1992 to highs of 30.67 in December of 1991 and 30.43 in January of 1992 (WVNSCO 1993b).

Extreme Parameters

Most extreme weather-related deterioration events that occurred during the 1993 – 2002 period were summarized in Section 3.4.2. Regarding extreme air pollution, the WVDP and Cattaraugus County are considered “in attainment” or “unclassifiable” with respect to the National Ambient Air Quality Standards for criteria pollutants. As of 2002, no extreme air pollution violations have been identified within Cattaraugus County.

3.4.5 Site Meteorology and Climatology

Site topographic features previously discussed produce locally significant variations in climate. Meteorological data are collected both on site and at a nearby meteorological station on Dutch Hill Road. Wind speed and direction, barometric pressure, temperature, dewpoint, and rainfall are measured on site. Wind speed and direction are measured at the regional location.

Temperature

The average monthly temperatures recorded at site from 1984 – 2002 are listed below:

January: 24.26 °F	May: 55.22 °F	September: 58.82 °F
February: 25.34 °F	June: 63.86 °F	October: 48.74 °F
March: 32.36 °F	July: 67.46 °F	November: 38.66°F
April: 44.6 °F	August: 66.02 °F	December: 28.22°F

Extreme temperatures have been as high as 98.6 °F and as low as -43.6 °F.

Precipitation and Wind Vectors

Average annual precipitation for the site is 39.4 inches, including an average 120 inches of snow, based on 1985 – 2002 data, and is evenly distributed throughout the year. Winds are generally from the west and south at about 10.3 miles per hour (4.6 m/s) and 9.6 miles per hour (4.3 m/s) respectively, as previously noted.

Severe Weather Phenomena

According to U.S. Weather Bureau meteorological analysis, the theoretically greatest precipitation (probable maximum precipitation) that could be expected over the applicable drainage area in a 24-hour period is 24.9 inches. Factors figuring into this estimate include the size of the 1,200-acre drainage area, its topography, and seasonal effects. The highest measured 24-hour total as of 2003 was five inches.

Atmospheric Water Vapor

There are diurnal and seasonal variations in relative humidity, according to measurements made at the Buffalo National Weather Station office. Humidity during predawn hours ranges from 35 to 83 percent throughout the year. Afternoon humidity varies from 55 to 60 percent during the summer (June-August) months and from 18 to 25 percent during winter (December - February).

Figure 3-50 illustrates the percent frequency of occurrence of ceilings (defined as cloud cover of 5/8 or greater) less than 3,000 feet and/or visibility less than three miles at Buffalo and Niagara Falls, the closest locations with this data. The cycle of maximum and minimum occurrence should be approximately the same at West Valley. (WVNSCO 1993)

The normal annual number of hours of sunshine is approximately 2,100. In summer the daily value is approximately nine hours and in winter the normal is 3.5 hours.

Fog

Fog has a well-defined seasonal cycle with annual maximums occurring during the winter months. Buffalo has a normal expectation of ten days per year of dense fog; light fog occurs much more frequently.

Atmospheric Stability

Measurements of temperature, wind speed, and wind direction made at the 10-meter and 60-meter heights at the on-site meteorological tower are used for determining wind patterns and for determining atmospheric stability characteristics at the site. Seven Pasquill-Gifford atmospheric stability categories (A through F) have been determined for the site based on vertical temperature differences (temperature lapse rates, ΔT) calculated from temperatures measured at the 197 feet (60-meter) and 33 feet (10-meter) heights at the onsite meteorological tower.

These stability class conditions determine how a parcel of air would react when it is displaced adiabatically (ΔT/ΔZ method), i.e., without exchanging heat. Stability classifications were determined in accordance with the methodology described in NRC Regulatory Guide 1.23 (NRC 2007) on onsite meteorological programs and Regulatory Guide 1.145 (NRC 1982) on atmospheric dispersion models. Hourly-averaged values of temperature obtained at the 197 feet (10-meter) and 33 feet (60-meter heights) at the tower were used in the calculations. The temperature differences were derived from temperature data collected at the on-site meteorological tower, from January 1, 1994, through December 31, 1998 (Spector and Grant 2003).

Joint frequency distributions of wind speed and direction for each stability class are tabulated in Table 3-10 for measurements at a height of 33 feet (10 meters) and Table 3-11 for measurements at a height of 197 feet (60 meters) (Spector and Grant 2003). These joint frequency distributions were derived from data collected at the on-site meteorological tower from January 1, 1994, through December 31, 1998. Wind directions are grouped into 16 principal directions (22.5-degree sectors centered on true north, northeast, and so on). Wind speeds are classified into seven wind speed categories. Calms are distributed, in the form of hourly-averaged wind speeds, into the first wind speed category representing the 0-0.5 m/s speed bin (Spector and Grant 2003).

Table 3-10. Wind Speed and Direction Frequency Distributions at 10 Meters (January 1, 1994 through December 31, 1998, based on Spector and Grant 2003, Attachment G)

Stability Class	Wind Speed (m/s)	Direction From															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
A	0.0-1.5	0	0	0	0	0	0	0	0.005	0.01	0.005	0.002	0.005	0.02	0	0.002	0
	1.5-3.0	0.051	0.044	0.032	0.027	0.039	0.017	0.022	0.015	0.022	0.027	0.039	0.024	0.027	0.054	0.113	0.047
	3.0-6.0	0.049	0.029	0.024	0.029	0.022	0.015	0.024	0.024	0.051	0.039	0.034	0.007	0.007	0.098	0.592	0.164
	6.0-9.0	0	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0.005	0.015
	9.0-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0.0-1.5	0	0.005	0.007	0.005	0	0	0.002	0.005	0	0.005	0.002	0	0.002	0.002	0	0
	1.5-3.0	0.059	0.069	0.054	0.032	0.037	0.024	0.037	0.047	0.056	0.083	0.122	0.064	0.083	0.164	0.291	0.083
	3.0-6.0	0.044	0.037	0.024	0.01	0.017	0.01	0.039	0.098	0.103	0.064	0.066	0.024	0.034	0.149	0.59	0.233
	6.0-9.0	0	0	0	0	0	0	0.005	0	0.007	0	0	0	0	0.002	0.002	0.005
	9.0-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0.0-1.5	0.002	0.022	0.012	0.007	0.005	0.007	0.012	0.005	0.012	0.007	0.007	0.007	0.005	0.02	0.017	0.01
	1.5-3.0	0.174	0.095	0.081	0.044	0.042	0.054	0.095	0.095	0.166	0.181	0.25	0.118	0.174	0.35	0.497	0.233
	3.0-6.0	0.073	0.027	0.027	0.015	0.049	0.034	0.108	0.103	0.181	0.071	0.073	0.047	0.051	0.176	0.835	0.289
	6.0-9.0	0	0	0	0	0.01	0	0.005	0.022	0	0	0	0	0	0.005	0.01	0.012
	9.0-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0.0-1.5	0.321	0.34	0.223	0.22	0.252	0.343	0.468	0.441	0.695	0.72	0.629	0.615	0.832	1.05	0.906	0.36
	1.5-3.0	1.031	0.639	0.416	0.348	0.394	0.769	1.616	1.307	2.274	2.296	1.785	1.227	2.025	3.529	6.305	1.542
	3.0-6.0	0.308	0.113	0.071	0.286	0.313	0.495	1.709	1.951	1.506	0.693	0.443	0.235	0.524	1.809	4.447	1.205
	6.0-9.0	0	0	0	0.02	0.002	0.005	0.279	0.661	0.061	0.002	0.002	0	0	0.002	0.02	0.01
	9.0-12.0	0	0	0	0	0	0	0.01	0.071	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0.007	0	0	0	0	0	0	0	0
E	0.0-1.5	0.093	0.093	0.078	0.132	0.233	0.279	0.673	1.408	1.983	1.092	0.686	0.654	0.71	0.776	0.428	0.147
	1.5-3.0	0.02	0.02	0.022	0.02	0.037	0.179	1.06	1.694	2.191	0.705	0.144	0.1	0.162	0.448	0.654	0.083
	3.0-6.0	0.002	0	0	0	0.01	0.017	0.487	1.165	0.771	0.095	0.007	0.007	0.007	0.005	0.069	0.007
	6.0-9.0	0	0	0	0	0	0	0.007	0.23	0.024	0	0	0	0	0	0	0
	9.0-12.0	0	0	0	0	0	0	0	0.027	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	0.0-1.5	0.039	0.024	0.049	0.042	0.103	0.235	0.546	1.741	1.547	0.676	0.406	0.272	0.166	0.069	0.049	0.056
	1.5-3.0	0	0.002	0	0	0.002	0.034	0.176	0.333	0.24	0.022	0.002	0.01	0.017	0.005	0.015	0.01
	3.0-6.0	0	0	0	0	0	0.002	0.007	0.024	0	0	0	0	0	0	0	0
	6.0-9.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9.0-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	0.0-1.5	0.012	0.04	0.015	0.029	0.039	0.13	0.637	2.931	1.704	0.411	0.218	0.125	0.039	0.01	0.02	0.022
	1.5-3.0	0	0	0	0	0.002	0.007	0.066	0.208	0.054	0	0	0.002	0.002	0	0	0
	3.0-6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.0-9.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9.0-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3-11. Wind Speed and Direction Frequency Distributions at 60 Meters (January 1, 1994 through December 31, 1998, based on Spector and Grant 2003, Attachment H)

Stability Class	Wind Speed (m/s)	Direction From															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
A	0.0-1.5	0	0	0	0	0.002	0	0.002	0.002	0	0	0	0	0.002	0.002	0	0
	1.5-3.0	0.017	0.007	0.007	0.015	0.022	0.01	0.005	0.007	0.005	0.005	0.012	0.012	0.01	0.017	0.019	0.022
	3.0-6.0	0.005	0	0	0	0	0	0.002	0.002	0.017	0.053	0.051	0.027	0.039	0.211	0.296	0.099
	6.0-9.0	0.005	0	0	0	0	0	0.002	0.002	0.017	0.012	0.029	0.012	0.01	0.17	0.143	0.051
	9.0-12.0	0	0	0	0	0	0	0	0	0.002	0	0	0	0.002	0.005	0.007	0.002
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0.0-1.5	0.007	0	0.002	0	0	0.005	0	0.005	0	0.002	0.002	0	0	0	0	0
	1.5-3.0	0.034	0.051	0.046	0.019	0.017	0.022	0.017	0.015	0.019	0.07	0.012	0.022	0.039	0.075	0.075	0.056
	3.0-6.0	0.053	0.051	0.039	0.024	0.034	0.01	0.036	0.07	0.083	0.109	0.175	0.102	0.092	0.386	0.408	0.175
	6.0-9.0	0	0	0	0	0	0.002	0.012	0.029	0.017	0.036	0.029	0.024	0.046	0.133	0.124	0.017
	9.0-12.0	0	0	0	0	0	0	0	0	0.005	0.002	0	0.002	0	0.015	0.002	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0.0-1.5	0.005	0.002	0.01	0.002	0.002	0.007	0.002	0	0.01	0.005	0.005	0.002	0	0.002	0.007	0.01
	1.5-3.0	0.126	0.067	0.068	0.034	0.034	0.034	0.066	0.309	0.036	0.068	0.073	0.07	0.085	0.116	0.129	0.129
	3.0-6.0	0.109	0.053	0.041	0.034	0.051	0.036	0.097	0.092	0.148	0.26	0.294	0.172	0.279	0.645	0.631	0.238
	6.0-9.0	0	0	0	0.002	0.017	0.01	0.01	0.034	0.027	0.022	0.041	0.032	0.034	0.192	0.099	0.036
	9.0-12.0	0	0	0	0	0.007	0	0.002	0.015	0	0	0	0	0.005	0.029	0.002	0
	<12.0	0	0	0	0	0	0	0	0.002	0	0	0	0	0	0	0	0
D	0.0-1.5	0.199	0.204	0.18	0.184	0.15	0.206	0.209	0.092	0.102	0.058	0.07	0.112	0.119	0.119	0.17	0.163
	1.5-3.0	0.757	0.568	0.468	0.255	0.306	0.531	0.9	0.551	0.393	0.587	0.99	1.063	1.281	1.42	1.272	0.755
	3.0-6.0	0.636	0.405	0.24	0.473	0.519	0.682	1.628	1.662	1.153	2.203	3.237	2.587	4.215	5.63	3.458	1.138
	6.0-9.0	0.034	0.002	0.15	0.024	0.029	0.08	0.548	0.784	0.675	0.495	0.718	0.439	1.228	1.815	0.781	0.112
	9.0-12.0	0	0	0	0.007	0.002	0	0.129	0.495	0.131	0.015	0.005	0.005	0.058	0.078	0.019	0
	<12.0	0	0	0	0	0	0	0.015	0.109	0.012	0	0	0	0	0	0	0
E	0.0-1.5	0.113	0.104	0.087	0.097	0.133	0.269	0.544	0.403	0.158	0.095	0.92	0.073	0.078	0.102	0.114	0.136
	1.5-3.0	0.175	0.083	0.078	0.085	0.143	0.294	1.23	0.818	0.432	0.422	0.371	0.485	0.446	0.4	0.325	0.158
	3.0-6.0	0.024	0.01	0.017	0.034	0.034	0.102	1.104	1.301	1.269	1.767	1.429	0.604	0.726	0.694	0.488	0.15
	6.0-9.0	0	0	0	0	0.015	0.002	0.121	0.502	0.548	0.33	0.167	0.015	0.017	0.024	0.015	0
	9.0-12.0	0	0	0	0	0	0	0	0.184	0.068	0	0	0	0	0.002	0	9
	<12.0	0	0	0	0	0	0	0	0.034	0.002	0	0	0	0	0	0	0
F	0.0-1.5	0.102	0.049	0.068	0.068	0.095	0.175	0.908	1.109	0.175	0.046	0.063	0.066	0.044	0.063	0.104	0.107
	1.5-3.0	0.019	0.01	0.07	0.007	0.17	0.085	0.946	0.694	0.243	0.211	0.112	0.136	0.121	0.133	0.126	0.083
	3.0-6.0	0	0	0	0	0	0.015	0.393	0.325	0.34	0.279	0.16	0.073	0.053	0.61	0.85	0.032
	6.0-9.0	0	0	0	0	0	0	0.007	0.019	0.002	0	0	0.002	0	0	0	0
	9.0-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	0.0-1.5	0.036	0.046	0.068	0.041	0.066	0.153	0.769	1.344	0.24	0.067	0.061	0.078	0.049	0.051	0.075	0.058
	1.5-3.0	0.005	0.002	0	0.005	0.002	0.029	0.895	1.24	0.417	0.277	0.211	0.165	0.09	0.061	0.107	0.039
	3.0-6.0	0	0	0	0	0	0.005	0.216	0.267	0.296	0.403	0.119	0.017	0.019	0.015	0.015	0.002
	6.0-9.0	0	0	0	0	0	0	0	0	0.002	0.002	0	0	0	0	0	0
	9.0-12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<12.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Air Quality

The EPA regulates National Ambient Air Quality Standards for criteria pollutants as defined in the Clean Air Act Titles I through VI, which are designed to protect human health and welfare from adverse effects. Cattaraugus County falls within the Southern Tier West Intrastate district (Air Quality Control Region 164), with the following status of attainment: "Better than National Standards/Unclassifiable (cannot be classified)."

Radiological emissions are regulated under the National Emission Standards for Hazardous Air Pollutants regulations. Non-radiological air emissions are regulated by the NYSDEC whose regulations dictate monitoring and compliance of stationary and mobile sources of air pollution. The WVDP was approved for a capping plan for non-radiological emissions. There were no cases where air permit or regulatory criteria were exceeded during calendar year 2007. (WVES and URS 2008)

3.5 Geology and Seismology

The geology and seismology of the site and surrounding areas are described in this section.

3.5.1 Regional Physiography

The Center is located within the glaciated northern portion of the Appalachian Plateau Province, a maturely dissected upland region underlain in western New York by shales and siltstones of Devonian age. This region is bounded on the north by the Erie Ontario Lowlands, on the east by the Tughill Upland, on the south by the unglaciated Appalachian Plateau, and on the west by the Interior Lowlands (Figure 3-51).

The Appalachian Plateau of western New York has been subjected to multiple glaciations during the Wisconsinan glacial period 38,000 to 14,500 years ago, that resulted in the deepening and oversteepening of many pre-glacial valleys and in the accumulation in those valleys of as much as 500 feet of glacial tills, lacustrine, and glaciofluvial sediments. The Center is situated within one of these north-trending valleys (Figure 3-3).

3.5.2 Site Stratigraphy

The Center is located in a glacial valley filled with upwards of 500 feet of Pleistocene age glacial tills, lacustrine, and glaciofluvial sediments that were deposited during the Wisconsinan glacial period. The thickness of glacial deposits at the site ranges from five feet or less on the uplands to 500 feet along the axis of the valley. These glacial sediments were deposited on shales and siltstones of the Middle Devonian Conneaut and Canadaway Groups which comprise the uppermost portion of the Paleozoic bedrock that underlies the Center.

The Paleozoic section in the vicinity of the Center is approximately 7,500 feet thick and is comprised predominantly of shales, siltstones, sandstones, carbonates, and evaporites of Cambrian through Devonian age (Table 3-12). Bedrock stratification in the area is nearly flat and essentially undeformed. However, bedrock is tilted to the south at an average dip of six to eight meters per kilometer (approximately 32 to 42 feet per mile). The Paleozoic bedrock underlying the Center was deposited on a basement of older Precambrian-age rocks that are part of the Grenville Orogenic Belt which extends from eastern Canada, through the United States, and into Mexico.

Table 3-12. Generalized Paleozoic Stratigraphic Section for Southwestern New York[1]

System	Series	Group	Unit	Lithology	Thickness (ft)
Pennsylvanian		Pottsville	Olean	Ss, Cgl	75 – 100
Mississippian		Pocono	Knapp	Ss, Cgl	50 – 100
Devonian	Upper	Conewango		Sh, Ss, Cgl	700
		Conneaut	Chadakoin	Sh, Ss	700
		Canadaway	Undiff	Sh, Ss	1100 – 1400
			Perrysburg	Sh, Ss	
		West Falls	Java	Sh, Ss	375 – 1250
			Nunda	Sh, Ss	
			Rhinestreet	Sh, Ss	
		Sonyea	Middlesex	Sh	0 – 400
		Genesee		Sh	0 – 450
	Middle		Tully	Ls	0 – 50
		Hamilton	Moscow	Sh	200 – 600
			Ludlowville	Sh	
			Skaneateles	Sh	
			Marcellus	Sh	
			Onondaga	Ls	30 – 235
	Lower	Tristates	Oriskany	Ss	0 – 40
		Helderberg	Manlius	Ls	0 – 10
			Rondout	Dol	
Silurian	Upper		Akron	Dol	0 – 15
		Salina	Camillus	Sh, Gyp	450 – 1850
			Syracuse	Dol, Sh, Salt	
			Vernon	Sh, Salt	
		Lockport	Lockport	Dol	150 – 250
		Clinton	Rochester	Sh	125
			Irondequoit	Ls	
	Lower		Sodus	Sh	75
			Reynales	Ls	
			Thorold	Ss	2 – 8

Table 3-12. Generalized Paleozoic Stratigraphic Section for Southwestern New York[1]

System	Series	Group	Unit	Lithology	Thickness (ft)
		Medina	Grimsby	Sh, Ss	75 – 160
			Whirlpool	Ss	0 – 25
Ordovician	Upper		Queenston	Sh	1100 – 1500
			Oswego	Ss	
			Lorraine	Sh	900 – 1000
			Utica	Sh	
	Middle	Trenton-Black River	Trenton	Ls	425 – 625
			Black River	Ls	225 – 550
	Lower	Beekmantown	Tribes Hill /Chuctanunda	Ls	0 – 550
Cambrian	Upper		Little Falls	Dol	0 – 350
			Galway (Theresa)	Dol, ss	575 – 1350
			Potsdam	Ss, Dol	75 – 500
Precambrian				Meta Rx	

NOTE: (1) From Jacobi and Fountain 1993.

LEGEND: Cgl = conglomerate, Dol = dolomite, Gyp – gypsum, Ls = limestone, Sh = shale, Ss = sandstone, Meta Rx = metamorphic rocks

Site Glacial Stratigraphy

The WVDP is underlain by upwards of 500 feet of Pleistocene-age glacial sediments that were deposited in a northwest-trending bedrock valley (Figure 3-52). The principal glacial units are identified below.

Surficial Sand and Gravel Unit

The surficial sand and gravel unit is a silty, sandy gravel deposit that incorporates two overlapping units of different ages and origins. The older unit, the slack-water sequence, is a Wisconsinan glaciofluvial deposit deposited in Buttermilk Creek Valley by draining glacial meltwaters of Lavery-age ice. The younger unit, the thick-bedded unit, is a post-glacial Holocene-age alluvial fan deposited by streams entering Buttermilk Creek Valley.

This unit is found at grade in the north plateau area of the Center where it has a maximum thickness of 41 feet in the center of the plateau. The sand and gravel unit thins to a few feet towards the northern, eastern, and southern margins of the north plateau where it has been truncated by the downward erosion of stream channels bounding the north plateau. The Process Building, Vitrification Facility, and adjacent facilities were built on these alluvial and glaciofluvial deposits (Figure 3-5).

The composition of the sand and gravel unit varies, but on the average it is a mixture of gravel (41 percent), sand (40 percent), silt (11 percent), and clay (8 percent). X-ray diffraction analysis indicates the mineralogy of this unit is dominated by quartz, illite, chlorite, and plagioclase with subordinate amounts of calcite and dolomite.

Surficial sands and gravels that are equivalent to the surficial sand and gravel unit in the north plateau are located in a number of areas within the Center (Figure 3-53). These sands and gravels have been quarried for gravel in three locations within the Center. Two of the gravel pits are located west of the Process Building on the west side of Rock Springs Road (Figure 3-8). These gravel pits are no longer in operation and were closed in accordance with NYSDEC regulations. The third gravel pit was located on the southeastern margin of the Center (Figure 3-9). This gravel pit was quarried by the Town of Ashford. The three gravel pit quarries do not contain any residual radioactive contamination from NFS or WVDP operations.

Lavery Till

The Lavery till is predominantly an olive-gray, silty-clay, glacial till with lenses of sand, gravel, silt, and rhythmic clay-silt laminations (Albanese, et al. 1983). This unit underlies the surficial sand and gravel unit in the north plateau and is exposed at the surface in the south plateau (Figure 3-53). As noted previously, the Lavery till is the host unit for both the SDA and the NDA.

The thickness of the Lavery till ranges from a few feet at its western margin to upwards of 130 feet to the east towards Buttermilk Creek. The Lavery till is a mixture of clay (50 percent), silt (30 percent), sand (18 percent), and gravel (two percent) (WVNSCO 1993e). The mineral composition of the till largely resembles that of local bedrock.

On the south plateau, the upper three to 16 feet of the Lavery till is weathered to a brown color and it contains root tubes and numerous fractures whose number decrease with depth. This upper layer is referred to as the weathered Lavery till and it is principally found in the south plateau of the Center. The weathered Lavery till is either absent or only a few inches thick on the north plateau.

X-ray diffraction analysis indicates the mineralogy of the weathered Lavery till is composed mainly of illite, quartz, calcite, kaolinite, plagioclase feldspar, and dolomite in decreasing quantities. The mineralogy of the unweathered Lavery till is composed mainly of quartz, illite, calcite, and kaolinite in decreasing abundance.

A borrow pit excavated into the Lavery till is located on the south plateau east of the SDA between Franks Creek and Buttermilk Creek (Figure 3-9). Clay was excavated from this pit beginning in the 1970's to provide clay fill for use at the SDA. The borrow pit did not contain any residual radioactive contamination from NFS or WVDP operations. The pit covered an area of less than one acre and it was closed by backfilling and grading in accordance with the NYSDEC Mined Land Reclamation Program in the early 2000's.

Lavery Till-Sand Unit

The Lavery till-sand unit is a lenticular shaped, silty, sand layer that is locally present within the Lavery till in the north plateau of the Center, immediately southeast of the

Process Building. It is thought to be either a pro-glacial sand deposit or a reworked kame deposit.

The till-sand is limited in areal extent, occurring on the north plateau in an east-west band approximately 750 feet wide. It lies within the upper 20 feet of the Lavery till (Figure 3-6) and is up to seven feet in thickness.

Kent Recessional Sequence

The Kent Recessional Sequence underlies the Lavery till on both the north and south plateaus and it includes both lacustrine and kame delta deposits; it is 30 to 60 feet thick at the WVDP. Lacustrine strata composed of laminated silt and clay forms the lower 30 feet of the Kent Recessional Sequence, which is present in the subsurface across the entire WVDP.

The lacustrine section is interpreted as forming in a pro-glacial lake that formed after the recession of the Kent ice margin (LaFleur 1979). The lacustrine section is composed mainly of quartz, illite, calcite, dolomite, and plagioclase feldspar in decreasing abundance. Calcite and dolomite together make up 12 to 20 percent of the lacustrine section by weight.

The lacustrine section in the eastern portion of the WVDP is overlain by upwards of 30 feet of sand and gravel believed to represent several kame deltas. (Figure 3-6) Several of these kame deltas are exposed along Buttermilk Creek and extend into the WVDP west of the NDA (Bergeron, et al. 1987).

The kame deltas were deposited during pauses in the recession of the Kent glacier through a pro-glacial lake that allowed the accumulation of kame deltas over lakebed silts and clays. This unit is underlain by at least two older silty-clay tills, the Kent till and the Olean till, which also are separated by similar lacustrine and glaciofluvial deposits (LaFleur 1979).

3.5.3 Site Geomorphology

Karst terrains are not developed at the Center as there are no occurrences of carbonate bedrock in the vicinity of the site. Natural subsidence of surficial soils has not been observed at the Center. However, small scale subsidence has been observed over some of the burial holes in the NDA and SDA during their operating history which are believed related to collapse and compaction of buried waste.

Geomorphological studies at the WVDP have focused on the major erosional processes acting on Buttermilk Creek and Franks Creek drainage basins near the WVDP. This section describes these processes – channel incision, slope movement, and gullying – and details where they occur. The erosion rates from these processes have been measured at numerous locations throughout the drainage basins, as summarized in Table 3-13. Results vary based on location and methodology used in the measurements.

Channel Incision

The streams in the vicinity of the WVDP are at a relatively young stage of development and are characterized by steep profiles, V-shaped cross-sections, and little or no floodplains. At this stage, streams are able to move large quantities of sediment and erode their channels, a process referred to as channel incision or stream downcutting. The channel incision process is greatest during high-flow, high-energy rainfalls from prolonged soaking storms and brief, high-intensity thunderstorms.

These streams are also actively elongating their stream course or profiles through erosion upstream, a process referred to as headward advance. Headward advance starts when the movement of channel sediment is blocked by debris in the stream channel, which results in an abrupt change in the longitudinal profile of the stream bed, referred to as a knickpoint.

The stream erodes the knickpoint area by carrying away the fine-grained sediment downstream and leaving coarse-grained sediment at the base of the knickpoint, which is agitated by stream turbulence and creates a scour pool. The knickpoint migrates upstream because of the movement of the gravel and cobbles, which erodes the knickpoint at its base.

The shape of the channel cross-section changes from a U-shape, or flatbottom, with a low erosion rate to a V-shaped channel with a higher erosion rate. The knickpoint migration rate has been measured at 10.7 feet per year along Erdman Brook and 7.5 feet per year along Franks Creek (WVNSCO 1993d).

Slope Movement

Slope erosion within the Buttermilk Creek and Franks Creek drainage basin has been dominated by the formation of slump blocks along the stream valley wall. Slumps develop when water infiltrates into fractures within stream banks, causing an increase in soil pore pressures, which reduces the soil strength until the slope slumps down into the stream valley. Slumps also occur on the outside of a stream meander loop, where the increased stream flow velocity undercuts the base of the slope, decreasing the slope stability and accelerating the slumping process.

Three slump blocks have been identified along Franks Creek, one on Erdman Brook, and one on Quarry Creek. The blocks vary in length from about five feet to greater than 100 feet and tend to be about three to four feet in height and width when they initially form (WVNSCO 1993d).

On the basis of data collected from 1982 to 1991, the rate of downslope movement within the slump blocks on Erdman Brook is reported to range from 0.09 and 0.16 feet per year, which equates to a stream valley rim widening rate of approximately 0.07 to 0.12 feet per year.

Gullying

The steep walls of the stream channels within the Buttermilk Creek and Franks Creek drainage basin are susceptible to gully formation. Gullies are most likely to form along stream banks, where slumps and deep fractures are present, groundwater seeps are flowing, and the toe of the slope intersects the outside of a stream meander loop.

Gully formation occurs during thaws and after thunderstorms, where a concentrated stream of water flows over the side of a plateau, which is great enough to promote entrainment and removal of soil particles from the base of the gully. Surface water runoff into the gully contributes to gully growth by removing fallen debris at the base of the scarp.

More than 20 major and moderate-sized gullies have been identified near the WVDP. The initiation and growth of gullies may be the most rapid means for eroding the north and south plateaus. Gully advance was calculated at 1.2 feet per year near the SDA on the south plateau, and at 2.2 feet per year for two areas on the north plateau (WVNSCO 1993d).

Table 3-13. Summary of Erosion Rates Near the WVDP

Location	Erosion Rate (m/y)	Reference	Method
Sheet and Rill Erosion	0 to 0.0045	URS 2001	Erosion frame measurements (11-year average rate)
Deepening of Buttermilk Creek	0.0015 to 0.0021	LaFleur 1979	Carbon-14 date of terrace - depth of stream below terrace
Deepening of Buttermilk Creek	0.005	Boothroyd, et al. 1982	Carbon-14 date of terrace - depth of stream below terrace
Deepening of Quarry Creek, Franks Creek, and Erdman Brook	0.051 to 0.089	Dames & Moore 1992	Difference from 1980 to 1990 in stream surveys
Downcutting of Buttermilk Creek	0.0032	USGS 2007	Optically stimulated luminescence age dating of 9 terraces along Buttermilk Creek
Buttermilk Creek Valley Rim Widening	4.9 to 5.8	Boothroyd, et al. 1979	Downslope movement of slump block over 2 years
Valley Rim Widening of Buttermilk and Franks Creeks and Erdman Brook	0.05 to 0.13	McKinney 1986	Extrapolate Boothroyd data for 500 years
Erdman Brook Valley Rim Widening	0.02 to 0.04	Dames & Moore 1992	Downslope movement of stakes over 9 years
Downcutting of Franks Creek	0.06	Dames & Moore 1992	Stream profile, knickpoint migration 1955 to 1989
SDA Gully Headward Advancement	0.4	Dames & Moore 1992	Gully advancement Soil Conservation Service TR-32 method
NP3 Gully Headward Advancement	0.7	Dames & Moore 1992	Gully advancement Soil Conservation Service TR-32 method
006 Gully Headward Advancement	0.7	Dames & Moore 1992	Gully advancement Soil Conservation Service TR-32 method

Slope Stability

Landslides provide an active mechanism to headward erosion for altering the landform in Buttermilk Creek Valley. Since landslides typically occur on slopes that have a relief of more than 10 feet, all currently eroding surfaces except the upland flats have potential for landslide development. Landslides range from three feet to 65 feet in height. Landsliding has been recognized since the mid-1970s along the small streams bordering the burial areas.

Stratigraphy affects both landslide location and development. Landsliding takes place along Buttermilk Creek where the Lavery till unit is dissected and the underlying lower sand and gravel of the Kent Recessional Sequence is exposed. These unconsolidated sands and gravels are removed by stream erosion, leaving the overlying till unsupported, followed by bank collapse, bringing down large blocks of the valley wall.

Landslides on the smaller streams draining the WVDP tend to occur as the channel cuts downward through the Lavery till, increasing the steepness of the stream banks, which eventually results in a series of short slide blocks. The blocks tend to be less than four feet high and occur along the slope from the edge of the plateau to the edge of the stream channel.

Creep occurs on the slopes of Buttermilk Creek and its tributaries at relatively slow rates of a few centimeters per year. A slope may have surface layers a few centimeters thick that move a few centimeters per year. If highly charged with water, the surface soils may liquefy and then move down-slope as mudflows. These mudflows occur most frequently in conjunction with landsliding.

Down-slope movement of till in the Buttermilk Creek Valley by landslides, slumping, and earthflow appears to be a continuous process measured at an average rate of five feet per year (Boothroyd, et al. 1982). The average volume of material delivered to Buttermilk Creek has been estimated to be 5,250 cubic feet per year (Boothroyd, et al. 1982).

Landslide mapping and monitoring suggests areas most susceptible to failure have the following characteristics: surface slopes exceeding eight degrees, slopes composed of silty and clayey tills or alluvial fan material, an active stream channel at the foot of slope, and little or no vegetative cover or heavy overburden (WVNSCO 1993c).

3.5.4 Regional Structure and Tectonics

The bedrock in the immediate vicinity of the Center is composed of interbedded shales, siltstones, and sandstones of the Upper Devonian Canadaway and Conneaut Groups (Rickard 1975). These and underlying Paleozoic sediments were deformed by compressive stresses originating from the Pennsylvanian-Permian Alleghanian orogeny which was the last major orogenic episode affecting the Appalachian mountain belt.

The major manifestations of this Alleghanian deformation are the prominent regional folds, thrust faults, and metamorphism that are found to the southeast in the Appalachian Valley and Ridge, Blue Ridge, and Piedmont Provinces (Figure 3-51). However, Alleghanian deformation did extend into the Appalachian Plateau Province of western New York where geologic structure such as joints, low amplitude folds, and thrust faults with small stratigraphic separation were developed in Paleozoic bedrock.

Alleghanian Folds and Thrust Faults

The Alleghanian deformation within the Appalachian Plateau of western New York principally affected the Upper Silurian Salina Group and overlying Devonian-age rocks (Table 3-14). During the Alleghanian orogeny, Paleozoic strata overlying the Salina Group was detached from underlying older strata by a decollement in the Salina Group. The stratigraphic section overlying this decollement was deformed, shortened, and translated to the northwest during the Alleghanian orogeny. The deformation of the strata overlying the decollement was manifested in the development of thrust faults, folds, and systematically oriented bedrock fractures.

The thrust faults that splayed off of the Salina decollement into the Lower to Middle Devonian section displaced and folded overlying bedding, producing an arcuate fold belt in western and central New York (Figure 3-54). The trend of this fold belt changes across New York State. Anticline fold axes, which trend roughly northeast-southwest in Chautauqua, Cattaraugus, and Allegany Counties, are observed to rotate to the east and become more east-west trending in Steuben and Chemung Counties.

These folds have low amplitudes with limb dips that are generally 1 to 2□ (Wedel 1932, Engelder and Geiser 1980). The low amplitudes of these folds are related to the small amount of stratigraphic separation that occurs across the thrust faults forming these folds. Higher amplitude folds, with corresponding higher limb dips and larger amount of separation across thrust faults, are found in the Valley and Ridge Province of Pennsylvania (Figure 3-51).

The Bass Islands Trend, a northeast trending, oil and gas producing structure extending from northeastern Ohio into western New York, is an example of an Alleghanian foreland fold and thrust structure. The Bass Islands Trend extends from the southwest corner of New York State, through Chautauqua Lake, northwestern Cattaraugus County, and into southern Erie County (Figure 3-55). The Bass Islands Trend is a regional fold that formed as the result of a thrust fault ramping up-section from the Salina Group into the overlying Lower Devonian section.

Bedrock mapping in the south branch of Cattaraugus Creek, approximately 12 miles west of the WVDP, indicates the presence of northeast-striking inclined bedding, folds, and faults which are attributed to faults associated with the Bass Islands Trend (Baudo and Jacobi 1999, Jacobi and Zhao 1999). Recent field mapping in the Ashford Hollow quadrangle, in which the Center is located, indicates the presence of northwest and northeast striking fractures that represent typical Alleghanian age cross-fold and fold-parallel fracture sets (Tober and Jacobi 2000).

Table 3-14. Summary of Observed Faults on Seismic Lines WVN-1 and BER83-2A[1]

Seismic Line	Shot Point Location Top of Fault	Displacement (feet)	Shot Point Location Base of Fault	Fault Apparent Dip Angle	Fault Type	Displace Trenton
WVN-1	155.5		156.5	82.1E	Reverse	No
	204.5	75	206.0	85.4E	Normal	No
	241.5	35	239.0	84.6W	Reverse	No
	265.0	23	264.5	88.9W	Reverse	?
	467.0	47	465.0	81.4W	Normal	No
	478.5	23	484.0	81.7E	Reverse	No
	486.0	35	502.0	50.9E	Reverse	No
	522.5	47	506.5	62.9W	Reverse	?
	557.0					
	601.0	70	585.0	61.3W	Reverse	Yes
	621.5	35	622.0	88.0E	Normal	No
	633.0	58	631.0	86.2W	Reverse	Yes
	668.5	58	667.5	87.7W	Reverse	Yes
	699.0	10	699.5	88.7E	Reverse	?
	740.0	28	737.5	87.6W	Normal	Yes
	766.0	287	764.5	88.6W	Normal	Yes
	797.5	57	792.0	65.7W	Reverse	No
	871.0	48	859.5	65.0W	Normal	Yes
BER83-2A	412.0	51	421.5	75.9S	Normal	Yes
	451.5	38	457.0	84.3S	Normal	Yes
	452.5	102	457.0	85.3S	Normal	Yes
	519.0		521.0	81.0S	Normal	No
	681.0		684.0	84.3S	Normal	No
	709.5	13	714.0	85.0S	Normal	Yes
	748.0		752.0	83.4S	Normal	No
	779.5	26	791.5	70.1S	Reverse	No
	800.0	39	822.0	60.7S	Reverse	No
	828.0	12	842.0	87.2S	Normal	No

NOTE: (1) From Bay Geophysical 2001.

The presence of northeast trending fracture intensification domains suggest thrust faults associated with the Bass Island Trend or other Alleghanian thrust faults may extend eastward into the Ashford Hollow quadrangle (Tober and Jacobi 2000). Alleghanian folds and thrust faults are no longer tectonically active or seismically active. As a result there is no rate of deformation associated with these structures.

Bedrock Fractures

Fractures are ubiquitous in the Paleozoic bedrock of western New York. Systematically oriented fracture or joint sets have been identified in the Paleozoic bedrock of the Appalachian Plateau of western New York (Engelder and Geiser 1980, Fakundiny, et al. 1978, Geiser and Engelder 1983, McKinney, Gross and Engelder 1991, Jacobi, et al. 1996, Zhao and Jacobi 1997). These joint sets are part of a regional fracture system that formed primarily in response to compressive stresses originating during the Pennsylvanian-Permian Alleghanian Orogeny. However, other joint sets identified in bedrock in western New York may have originated in response to the contemporary east-northeast regional stress field currently affecting eastern North America (Engelder and Geiser 1980, Geiser and Engelder 1983, Gross and Engelder 1991), or post-Precambrian movements along the Clarendon-Linden Fault System (Jacobi, et al. 1996, Zhao and Jacobi 1997).

Three vertical joint sets in Paleozoic bedrock from western New York, including rocks from the Upper Devonian Canadaway and Conneaut Groups have been identified (Engelder and Geiser 1980). Two of these joint sets, trending approximately north 45° west (N45W) and N45E, were produced from the compressive stresses generated during the Alleghanian orogeny (Figure 3-54).

The N45E joint set parallels fold axes in the Appalachian plateau and formed during the Alleghanian-age compression that produced these folds. The N45W joint set is generally perpendicular to fold trends in this area and was produced before the folding of bedrock in the Appalachian Plateau (Figure 3-54). A third set trending N60E is found throughout New York and probably formed under the current east-northeast regional compressive stress field. These joints sets are cells found in the Devonian bedrock in and around the Center.

Eight systematic joint sets were identified in rocks from the Canadaway and Conneaut Groups in Allegany County (Engelder and Geiser 1980, Zhao and Jacobi 1997). The strike of these joint sets ranged from west-northwest to east-northeast and they were produced at various stages of the Alleghanian deformation that affected western New York. The orientation of these joint sets reflects changes in the orientation of the principal stresses that were associated with the deformation of the Appalachian plateau of western New York, beginning with north-northwest trending cross fold joints followed by the progressive development of joint sets to the east and west.

Regional Northwest Trending Lineaments and Structures

Regional northwest trending lineaments have been identified across the eastern United States based on analyses of regional gravity and magnetic anomaly trends. These lineaments are typically hundreds of kilometers in length and are believed to be the surface expression of regional crustal fracture zones that extend into the crust and which juxtapose rocks of differing densities and magnetic susceptibility. Examples of these lineaments include the Tyrone-Mt. Union lineament in Pennsylvania and the Lawrenceville-Attica lineament in New York (Figure 3-56).

The Tyrone-Mt. Union lineament is believed to extend southeast from Lake Erie to beyond the Atlantic coastline of the United States where it is thought to coincide with transform faults associated with the mid-Atlantic ridge system. Subsurface geologic mapping and analysis of regional magnetic and gravity patterns suggest significant lateral displacement of at least 31 to 37 miles across this lineament.

The Lawrenceville-Attica lineament in western New York extends northwest from Lawrenceville, New York through Attica, New York and into western Lake Ontario. The Lawrenceville-Attica lineament may be contiguous with the Georgian Bay Linear Zone, a northwest-trending zone extending from Georgian Bay in southern Ontario southeastward in western New York State.

The Georgian Bay Linear Zone is an 18.6-mile wide structural zone that extends from Georgian Bay to the southeast across southern Ontario, western Lake Ontario, and into western New York (Figure 3-56). The Georgian Bay Linear Zone has been delineated by a set of northwest-trending aeromagnetic lineaments, one of which parallels the straight eastern shoreline of Georgian Bay.

A variety of neotectonic structures and features have been identified in surficial bedrock and in lake bed sediments within the Georgian Bay Linear Zone. These include faults and bedrock pop-ups and linear pockmarks and linear acoustic backscatter anomalies imaged on seismic sidescan profiles in lake bed sediments that may represent bedrock fractures and faults.

Clarendon-Linden Fault System

The Clarendon-Linden Fault System is located approximately 19 miles east of the Center (Figure 3-56) and is comprised of at least five north-south striking, high-angle faults which extend southward from Lake Ontario through Orleans, Genesee, and Wyoming Counties, and into Allegany County.

Stratigraphic relationships indicate that the overall sense of movement across the Clarendon-Linden Fault System is consistent with reverse faulting from east to west with up to 330 feet of stratigraphic separation across the Clarendon-Linden Fault System. Recent bedrock mapping and soil gas surveying in Allegany County suggests the Clarendon-Linden Fault System extends further south into Allegany County based on the presence of at least seven north-south striking fracture intensification domains and associated soil gas anomalies.

The southwest trending Attica Splay has been interpreted to splay off of the western north-south trending fault approximately 0.75 mile south of Batavia (Figure 3-56) and to continue to the southwest through Alexander and Attica, New York to a point approximately 1.25 miles northwest of Varysburg, New York. Seismic reflection data suggest the presence of at least two east-dipping faults extending from the Precambrian basement into the Paleozoic section forming a graben structure with a stratigraphic separation of 74 - 148 feet (Fakundiny, et al. 1978). The eastern fault is a reverse fault showing east to west movement and the western fault is a normal fault showing west to east movement.

Seismic reflection profiling suggests that the faults comprising the Clarendon-Linden Fault System are contiguous with faults located within the Grenville Province Central Metasedimentary Belt which underlies the Paleozoic bedrock of western New York. The Central Metasedimentary Belt has been subdivided into two distinct terrains, the Elzevir terrain and the Frontenac terrain, which are separated by the Elzevir-Frontenac Boundary Zone, a northeast trending six- to 22-miles wide crustal shear zone. The eastern boundary of the Elzevir-Frontenac Boundary Zone, which is known as the Maberly shear zone in southern Ontario, appears contiguous with the Clarendon-Linden Fault System in Western New York.

The Clarendon-Linden Fault System has been active at least since the Middle Ordovician and has displayed a complicated movement history alternating from normal or extensional faulting, to reverse or compressional faulting during the Paleozoic. The episodic movement along the Clarendon-Linden Fault System during the Paleozoic occurred in response to orogenic induced subsidence of the Appalachian basin. Normal faulting with down-to the-east motion occurred when the basin axis was located east of the Clarendon-Linden Fault System. Reverse faulting with east to west movement sense occurred when the basin axis was located west of the Clarendon-Linden Fault System.

WVDP Seismic Reflection Survey

In June 2001, the WVDP collected nearly 18 miles of seismic reflection data along an east-west line in southern Erie County, approximately 5 miles north of the Center (Bay Geophysical 2001). (See Figure 3-57.) This seismic survey was designed to image any north or northeast-trending structures in the Precambrian basement and overlying Paleozoic bedrock.

The WVDP also reviewed approximately 16 miles of reprocessed seismic reflection data collected in 1983 along a north-south line along Route 219 in Erie and Cattaraugus Counties. This line was reviewed to evaluate whether any east-west trending structures were present in the Precambrian basement and Paleozoic bedrock near the Center.

Both seismic lines indicate the presence of numerous high-angle faults originating in Grenville-age basement which extend up-section into Middle Ordovician or Middle Devonian strata. (See Figure 3-57) The majority of these faults terminate near the Middle Ordovician Trenton Group. These faults have apparent dips of 50 to 8945° to the west, east, or south, show reverse and normal offset of bedding, and have up to 300 feet of stratigraphic separation.

Strata overlying some of the fault terminations are folded above the Middle Devonian Onondaga Formation, suggesting that these faults were emplaced or reactivated after the deposition of the uppermost folded unit. The most recent period of movement along these faults cannot be determined based on a lack of definitive age-dating relationships. Two faults near Sardinia, New York were interpreted to continue up-section through the Middle Devonian Onondaga Formation. These west-dipping normal faults show up to 300 feet of estimated stratigraphic separation (Figure 3-57).

A series of east- and south dipping high-angle faults spaced at intervals of 500 to 4,500 feet were interpreted in the Silurian to Devonian section northwest of Springville, New York. These faults originate in the Silurian Salina Group and cut up-section to the northwest through the Middle Devonian Onondaga Formation. These are believed to be thrust faults associated with the Bass Islands Trend.

3.5.5 Historical Seismicity

Earthquake catalogs maintained by the U.S. Geological Survey's National Earthquake Information Center were used to identify historical earthquakes with a magnitude of three or greater and a Modified Mercalli Intensity of IV or more within a 200-mile radius of the site. Three of the National Earthquake Information Center earthquake catalogs were queried to obtain information on earthquake activity in western New York. These included the Preliminary Determination of Epicenters, the Significant U.S. Earthquakes, and the Eastern, Central, and Mountain States of the United States catalogs. The historical seismicity search also utilized historical events identified in the Safety Analysis Report for Waste Processing and Support Activities (WVNSCO 2007). Historical seismicity within 200 miles of the site is summarized in Table 3-15. Table 3-15 also lists the date, location, time, depth, intensity, magnitude, distance, and information source.

From 1840 to 2003, there have been 45 recorded earthquakes with epicentral magnitudes of 3 or greater and Modified Mercalli Intensity of IV or greater within 200 miles of the WVDP. None of these earthquakes were reported to have caused landsliding or liquefaction events in the vicinity of the site. The geographic distribution of this seismicity is shown on Figure 3-55.

Table 3-15. Historical Seismicity Within 320 Kilometers (200 Miles) of Site[(1)]
(Only events with a magnitude ≥ 3 or a MMI intensity ≥ IV are listed)

Date	Latitude (°N)	Longitude (°W)	Origin Time	Depth	Intensity (MMI)	Magnitude (m_b)	Distance (km)	NEIC Catalog
1840 9/10	43.20	79.90	-	-	5←	-	113.7	Unk
1853 3/12	43.70	75.50	-	-	6←	-	302.3	Unk
1853 3/13	43.10	79.40	-	-	5←	-	74.9	Unk
1857 10/23	43.20	78.60	2015	-	6←	4.3 FA	83	USHIS
1873 7/6	43.00	79.50	-	-	6←	-	73.6	Unk
1900 4/9	41.40	81.90	14	-	6←	3.4 FA	293	USHIS
1906 6/27	41.40	81.60	-	-	5	4.2	269.8	Unk
1912 5/27	43.20	79.70	-	-	5←	-	100.6	Unk

Table 3-15. Historical Seismicity Within 320 Kilometers (200 Miles) of Site[(1)]
(Only events with a magnitude ≥ 3 or a MMI intensity ≥ IV are listed)

Date	Latitude (°N)	Longitude (°W)	Origin Time	Depth	Intensity (MMI)	Magnitude (m_b)	Distance (km)	NEIC Catalog
1914 02/10	44.98	76.92	1831	-	7	5.20 FA	313	Unk
1927 1/29	40.90	81.20	-	-	5	-	275.8	Unk
1928 9/9	41.50	82.00	21	-	5	3.70 FA	297	SRA
1929 8/12	42.91	78.40	112448.70	9	8←	5.20 Mn	54*	SRA/ USHIS
1929 12/2	42.80	78.30	-	-	5←	-	47.4*	Unk
1932 1/21	41.10	81.50	-	-	5	-	280.9	Unk
1934 10/29	42.00	80.20	-	-	5←	-	134.9	Unk
1938 7/15	40.68	78.43	224612	-	6←	3.30 FA	233	SRA/ USHIS
1943 3/09	41.63	81.31	032524.90	7	5	4.50 Mn	238	SRA/ USHIS
1951 12/03	41.60	81.40	0702	-	4	3.20 FA	246	SRA
1954 2/21	41.20	75.90	-	-	+7←	-	288.5	Unk
1955 5/26	41.50	81.70	-	-	5	3.8	272.0	Unk
1955 6/29	41.50	81.70	-	-	5	3.8	272.0	Unk
1955 8/16	42.90	78.30	-	-	5	-	53.5*	Unk
1958 5/1	41.50	81.70	-	-	5	4.0	272.0	Unk
1962 3/27	43.00	79.30	-	-	5←	3.0	61.0	Unk
1963 01/30	44.00	75.90	1450	-	4	3.00 ML	281	SRA
1964 02/13	40.38	77.96	194640.80	1	5	3.30 Mn	237	SRA
1964 05/12	40.30	76.41	064510.70	1	6	4.50 mb	303	SRA/ USHIS
1965 07/16	43.20	78.50	110655	-	4	3.50 ML	84	SRA
1965 08/28	43.00	78.10	0155	-	4	3.10 ML	75	SRA
1966 1/1	42.84	78.25	132339	0	6←	4.70 mb	54*	SRA/ USHIS
1967 6/13	42.84	78.23	190855.50	1	6←	4.40 Mn	54*	SRA/ USHIS
1980 6/6	43.56	75.23	131552	1	5	3.80 UK	304	PDE
1980 6/6	43.57	75.14	131552.90	1	5	3.80 Mn	311	SRA

Table 3-15. Historical Seismicity Within 320 Kilometers (200 Miles) of Site[(1)]
(Only events with a magnitude ≥ 3 or a MMI intensity ≥ IV are listed)

Date	Latitude (°N)	Longitude (°W)	Origin Time	Depth	Intensity (MMI)	Magnitude (m_b)	Distance (km)	NEIC Catalog
1983 10/4	43.44	79.79	171840	2	4	3.10 Mn	144	PDE
1986 1/31	41.65	81.16	164642.30	2	6	5.00 mb	226	SRA/ USHIS
1986 1/31	41.65	81.16	164643.33	10	6	5.00 mb	226	PDE
1987 7/13	41.90	80.77	054917.43	5	4	3.80 Mn	185	PDE
1991 1/26	41.54	81.45	032122.61	5	5	3.40 Mn	253	PDE
1991 8/15	40.79	77.66	071607.15	1	5	3.00 Mn	202	PDE
1992 3/15	41.91	81.25	061355.22	5	4	3.50 Mn	222	PDE
1993 10/16	41.70	81.01	063005.32	5	4	3.60 Mn	212	PDE
1995 5/25	42.99	78.83	142232.69	5	4	3.00 Mn	62	PDE
1998 9/25	41.49	80.39	195252.07	5	6	5.20 Mn	179	PDE
2001 1/26	41.94	80.80	030320.06	5	5	4.40 Mn	186	PDE
2003 6/30	41.80	81.20	192117.20	4	4	3.60 Mn	223	PDE
2005 10/20	44.68	80.48	211628.75	11		4.20 Mn	316	PDE
2006 6/20	41.84	81.23	201118.54	5		3.80 Mn	239	PDE
2007 3/12	41.28	81.38	231816.41	5		3.70 Mn	271	PDE

NOTE: (1) From earthquake catalogs of the U.S. Geological Survey's National Earthquake Information Center.

LEGEND: ←Could have been felt at site * Associated with Clarendon-Linden Structure

Origin time is the time the earthquake occurred.

PDE = NEIC Preliminary Determination of Epicenters
USHIS = NEIC Significant U.S. Earthquakes
SRA = NEIC Eastern, Central, and Mountain States of the United States
MMI = Modified Mercalli Intensity
Mn = Nuttli magnitude
ML = Local magnitude
Mb = Compressional Body Wave (P-wave) Magnitude
FA = Felt Area Magnitude
UK = Unknown Magnitude

The Buffalo-Lockport earthquake of October 23, 1857 affected an area of approximately 18,000 square miles. The epicentral intensity of VI was felt in an area 75 miles long, from north-northeast to south-southwest, and 62 miles wide. This earthquake was felt at Hamilton, Petersborough, and Port Hope in Ontario and at Rochester, New York, Warren, Pennsylvania, and Dayton, Ohio.

The August 12, 1929 earthquake occurred near Attica, New York, about 30 miles northeast of the WVDP. The affected area of approximately 50,000 square miles included parts of Canada. The ear thquake was felt most strongly in the eastern part of the city of Attica and immediately to the east. There was less effect on structures immediately to the south of the epicenter, but changes in groundwater conditions were noted. Based on the reported damage, an epicentral intensity of VII and a Compressional Body Wave magnitude m_b = 5.2 was assigned to the 1929 Attica event (WVNSCO 2007).

The Attica earthquakes of January 1, 1966 (Modified Mercalli Intensity VI) were felt over approximately 3,500 square miles of western New York, northwestern Pennsylvania, and southern Ontario, and the main shock was most strongly felt at Varysburg, about eight miles southwest of Attica. The Attica earthquake of June 13, 1967 (Modified Mercalli Intensity VI) was felt over an area of about 3,000 square miles in western New York. Slight damage was sustained at Attica and at Alabama, New York, where the shock was felt by many people. Focal mechanism solutions of these earthquakes indicate focal depths of approximately 1.2 to 1.9 miles and a combination of right-lateral strike-slip and reverse faulting on planes parallel to the northerly trend of the Clarendon-Linden Structure (Herrmann 1978).

3.5.6 Evaluation of Seismic Hazard

A site-specific probabilistic seismic hazard analysis of the Center was performed to estimate the levels of horizontal ground motions that could be exceeded at specified annual return periods at the site (Wong, et al. 2004). The hazard for the site was computed for a hard rock condition. Site response analyses were also performed for the north and south plateau areas of the site to evaluate the potential ground motion amplification resulting from soils and unconsolidated sediments that underlie the site, such as the Surficial Sand and Gravel Unit, Lavery till, and Kent Recessional Sequence.

A total of 19 seismic sources were included in the probabilistic hazard analysis, including four fault systems or fault zones and 15 regional seismic source zones. The fault systems considered in the analysis included the Clarendon-Linden fault zone, the Charleston fault zone, the New Madrid fault system, and the Wabash Valley fault system. The analysis considered the Southern Great Lakes seismic source zone in which the Clarendon-Linden fault zone is located. Regional seismic source zones were included in the analysis to incorporate the hazard associated with earthquakes affiliated with buried or unknown faults.

Peak horizontal ground acceleration and 0.1 and 1.0 second horizontal spectral accelerations) were calculated for bedrock at the Center for three DOE-specified return periods (Table 3-16). Figure 3-58 shows the various hazard curves for peak ground acceleration at the site including the mean and median curves. The hazard curves for the 1.0 second SA are shown in Figure 3-59.

The analysis indicates the largest contributor to the hazard at the Center is the Clarendon-Linden fault zone at almost all return periods, whereas seismicity within the

Southern Great Lakes seismic source zone is the second most important contributor to seismic hazard at the site (Figure 3-60).

Table 3-16 Site-Specific Mean Spectral Accelerations on Hard Rock (g's)[1]

Return Period (yrs)	PGA	0.1 sec SA	1.0 sec SA
500	0.04	0.07	0.02
1,000	0.05	0.11	0.03
2,500	0.10	0.20	0.06

NOTE: (1) From Wong, et al. 2004.
LEGEND: PGA = peak ground acceleration, SA = spectral acceleration.

Site response analyses were performed for the north and south plateau areas for return periods of 500 and 2,500 years to evaluate potential ground motion amplification resulting from the unconsolidated glacial sediments underlying these areas (Tables 3-17 and 3-18). The increased peak ground acceleration in the north plateau evaluation suggests slight amplification of ground motions in the north plateau area of the site (Tables 3-16 and 3-17). The south plateau evaluation suggests ground motions for the 500 year return period are deamplified whereas ground motions are slightly amplified for the 2,500 year return period (Tables 3-16 and 3-18).

Table 3-17 Site-Specific Mean Spectral Accelerations on Soil (g's) for the North Plateau[1]

Return Period (yrs)	PGA	0.1 sec SA	1.0 sec SA
500	0.05	0.09	0.04
2500	0.14	0.24	0.11

NOTE: (1) From Wong, et al. 2004.
LEGEND: PGA = peak ground acceleration, SA = spectral acceleration.

Table 3-18 Site-Specific Mean Spectral Accelerations on Soil (g's) for the South Plateau

Return Period (yrs)	PGA	0.1 sec SA	1.0 sec SA
500	0.03	0.08	0.05
2500	0.11	0.22	0.14

NOTE: (1) From Wong, et al. 2004.
LEGEND: PGA = peak ground acceleration, SA = spectral acceleration.

3.6 Surface Hydrology

3.6.1 Hydrologic Description

The WVDP watershed is drained by three named streams: Quarry Creek, Franks Creek, and Erdman Brook (see Figure 3-3). Erdman Brook and Quarry Creek are tributaries to Franks Creek, which in turn flows into Buttermilk Creek. The WVDP drainage basin is approximately 1,200 acres.

The point where all surface runoff from the site reaches a single stream channel (the watershed outfall) is located at the confluence of Franks Creek and Quarry Creek, north of the main project facilities. On the WVDP site, numerous drainage ditches and culverts direct flow away from roadways and facilities to the channels of the stream headwaters that are located on or around the site. The most significant of these ditches and culverts would be those associated with the site railroad spur and Rock Springs Road.

Erdman Brook has a 140-acre drainage area and drains the central portion of the developed project premises, including a large portion of the disposal areas, the areas surrounding the lagoon system, the Process Building, warehouse areas, and a major part of the parking lots. Following treatment, the project's waste waters are also discharged to this brook.

Erdman Brook flows from a height of over 1,400 feet above mean sea level west of Rock Springs Road to 1,305 feet above mean sea level at the confluence with Franks Creek northeast of the lagoons. It flows through the project facilities for about 3,000 feet.

Quarry Creek drains the largest area of the three named streams (740 acres) and receives runoff from the HLW Tank Farm, the north half of the northern parking lot, and the Lag Storage Buildings. It flows from an elevation of 1,930 feet west of Dutch Hill Road to 1,245 feet at its confluence with Franks Creek. The segment that flows along the north side of the project is about 3,500 feet in length.

Franks Creek has a drainage area of 295 acres and receives runoff from the east side of the project, including the Drum Cell, part of the SDA, and the Construction and Demolition Debris Landfill. Franks Creek flows into Buttermilk Creek about 2,000 feet downstream of its confluence with Quarry Creek. It flows from an elevation of 1,790 feet above mean sea level west of Rock Springs Road, to 1,245 feet at the Quarry Creek confluence, to 1,180 feet at the Buttermilk Creek confluence. About 6,000 feet of its length lies adjacent to WVDP facilities. (WVNSCO 1993c)

Buttermilk Creek, shown in Figure 3-2, roughly bisects the Center property and flows in a northwestwards direction to its confluence with Cattaraugus Creek at the northwest end of the Center. Several tributary (perennial) streams flow into Buttermilk Creek in the Center (Figure 3-61).

The flow length of Buttermilk Creek through the Center is about 4.7 miles. Within the Buttermilk Creek watershed, a small 18-acre sub-basin on the east side of Buttermilk Creek drains the area around the Bulk Storage Warehouse, which was used for general equipment and furniture storage.

Buttermilk Creek lies in a deep, narrow valley cut into glacial deposits, with a downstream portion down-cut to shale bedrock. The reach of stream to the east of the WVDP facilities has down-cut through the Lavery till and the underlying Kent Recessional Sequence, and is presently incising the Kent till. The Kent Recessional Sequence is discussed below.

The stream invert drops from an elevation of 1,310 feet above mean sea level at the southern Center boundary, to 1,215 feet at the northern edge of the Project facilities, to 1,110 feet at the confluence with Cattaraugus Creek. The drainage area of the Buttermilk Creek basin has been estimated to be 19,600 acres (Boothroyd, et al. 1982).

Buttermilk Creek flows at an average rate of 46 cubic feet per second to its confluence with Cattaraugus Creek.

Peak flows were 340.3 cubic feet per second at the confluence of Quarry Creek and Franks Creek, 161 cubic feet per second where Franks Creek leaves the project premises, and 60 cubic feet per second in Erdman Brook downstream of the SDA. Peak flow measured at the U.S. Geological Survey USGS gauge station at the Bond Road Bridge over Buttermilk Creek (which operated from 1962 to 1968) was 3,910 cubic feet per second on September 28, 1967. The historic high-water level of 1,358.6 feet above mean sea level in the reservoirs was recorded on the same day.

Cattaraugus Creek flows westward generally at a rate of 353 cubic feet per second from the Buttermilk Creek confluence to Lake Erie, 39 miles downstream. The total drainage area is estimated to be 524 square miles. A gauging station has been maintained at Gowanda, New York since 1939. The drainage basin to this point is estimated to be about 432 square miles. The drainage area of Cattaraugus Creek upstream of the Buttermilk Creek confluence is an estimated 220 square miles.

A small hydroelectric dam and water impoundment is located on Cattaraugus Creek about 1,000 feet upstream of where the Scoby Road bridge was located, southwest of Springville, New York. Neither Buttermilk Creek nor Cattaraugus Creek downstream of the WVDP are used as a regular source of potable water. Cattaraugus Creek downstream of Buttermilk Creek is a popular fishing and canoeing/rafting waterway. As such, Cattaraugus Creek water, fish, and sediments are monitored as part of the WVDP environmental monitoring program.

The WVDP obtains potable and process water from two water supply reservoirs located south of the main plant facilities (see Figure 3-12). The reservoirs were formed by damming headwater tributaries to Buttermilk Creek and collect drainage from numerous small streams over a 3,100-acre drainage basin, of which 2,000 acres drain directly to Reservoir 1 and 1,100 acres drain directly to Reservoir 2. The storage capacity of the reservoirs is 19,815,435 cubic feet at 1,353 above sea level, and 17,857,265 cubic feet at 1,350.5 above sea level. An emergency spillway is located at the south end of Reservoir 1.

As explained in Section 3.1.3, the Low Level Waste Treatment Facility includes four in-series lagoons (lagoons 2, 3, 4, and 5). The largest is Lagoon 3, which has a capacity of 467,900 cubic feet. Lagoon 3 is the final lagoon in the system before the wastewater is discharged into Erdman Brook.

The site Sewage Treatment Plant discharges to a gully that flows into Erdman Brook. A former equalization basin for the Sewage Treatment Plant in 2004 served as a sludge pond for utility room discharges.

3.6.2 WVDP Effluents

WVDP effluents discharged to surface waters must meet limits prescribed by the NYSDEC for non-radiological parameters in a State Pollutant Discharge Elimination System permit and by DOE for radiological parameters. Discharges are monitored to ensure that all standards are met. Monitoring is performed at the point of effluent discharge and several surface water drainage locations. There are two permitted discharge locations at the WVDP:

- Outfall 007 (WNSP007) with an average daily flow of approximately 10,000 gallons (WVES and URS 2008). This outfall includes waters from the site sanitary and industrial wastewater treatment facility, and
- Outfall 001 (WNSP001) is batch discharged from lagoon 3. Approximately seven batches are discharged annually, totaling approximately 13.5 million gallons per year, including water from the Low Level Waste Treatment Facility.

3.6.3 Influence of Flooding on Site

Cattaraugus and Buttermilk Creeks lie in deep, narrow valleys. Therefore, the effects on the WVDP of flooding by these creeks are negligible, as supported by historical data. Figure 3-4 shows the 100-year floodplains.

Franks Creek, Quarry Creek, and Erdman Brook are also located in deep valleys. Historical evidence and computer modeling indicate that flood conditions, including the probable maximum flood, will not result in stream flows overtopping their banks and flooding the plateau.

Peak discharges of the probable maximum flood were generated for the sub-areas constituting the watershed using the SCS TR-20 computer modeling program (USSCS 1983). These discharges were then used to determine the depth of flow at four stream locations adjacent to site facilities. The results of these analyses demonstrate that the depths of flow associated with the probable maximum flood on area streams are well below the elevations of site facilities.

The lowest portion of the Process Building is approximately 1,390 feet above mean sea level, whereas under probable maximum flood conditions, the nearest stream would rise to only 1347.2 feet. However, indirect damage from the erosion effects of high stream flows and excessive slope saturation during flood conditions is a possibility. The facilities likely to be most affected by bank failure and gully head advancement due to extreme precipitation are Lagoons 2 and 3, the NDA, and site access roads in several places.

Constriction of the stream channels is not likely to result in flooding due to elevation differences between channel beds and site facilities.

3.6.4 Water Use

Current Water Use of Buttermilk Creek

The project premises lies entirely within the Buttermilk Creek watershed. The Center property is adjacent to Buttermilk Creek nearly the entire stream length from its intersection with the Buffalo and Pittsburgh Railroad to its outlet into Cattaraugus Creek, approximately 3,000 feet upstream of the Felton Bridge. There is no public or private use of stream water within the Center property.

Current Water Use of Cattaraugus Creek

From the Buttermilk Creek outlet, Cattaraugus Creek flows approximately 38.5 miles to Lake Erie. The use of water within Cattaraugus Creek varies along the length of the stream.

Downstream of the Buttermilk outlet, Cattaraugus Creek flows through the Zoar Valley Multiple Use Area, Deer Lick Nature Sanctuary, the town of Gowanda, the Cattaraugus Indian Reservation, the town of Versailles, the town of Irving, and the town of Hanover, and outlets into Lake Erie at the hamlet of Sunset Bay. Cattaraugus Creek is not used as a source of public drinking water, as noted previously. Land use adjacent to Cattaraugus Creek is comprised of agricultural, forest, residential, recreational, and commercial. Some water is taken from Cattaraugus Creek for irrigation purposes.

The segment of Cattaraugus Creek which flows through the Zoar Valley Multiple Use Area is used for unsupervised swimming, rafting, and canoeing where water depth permits. Motorized boating is generally limited to within two miles of Lake Erie. Sunset Bay at the mouth of Cattaraugus Creek is a dense residential area with mixed recreation such as swimming beaches, marinas, boating and fishing.

Cattaraugus Creek downstream of the Springville dam provides habitat for lake-based fisheries, is a popular recreational fishing area, and is a top salmonid spawning stream within the Lake Erie drainage basin. Since 1994, New York has stocked Cattaraugus Creek with walleye, steel head trout, and brown trout.

Current Water Use of Lake Erie

Lake Erie is used for transportation, industrial, commercial, and recreational purposes. Recreational activities include sailing, boating, jet skiing, fishing, and swimming beaches.

Recent information on commercial fishing in the New York waters of Lake Erie is contained in the New York State Department of Environmental Conservation (NYSDEC) Annual Report to the Great Lakes Fishery Commission's Lake Erie Committee (NYSDEC 2004).

This report indicates that rainbow smelt currently are the target of a major commercial fishing industry on the Ontario, Canada side of Lake Erie, but are fished less in the United States waters. Since 1960, New York commercial fishing efforts have focused on walleye and yellow perch. However, yellow perch and walleye production from New York is a small fraction (less than five percent) of total Lake Erie landings for those species.

Open lake sport fishing in 2003 measured 352,128 angler-hours, the second lowest total in 16 years. Peak fishing activity occurred in July and Dunkirk Harbor was the most frequently used access site. Harvested fish include walleye, smallmouth bass, yellow perch, and lake trout. Electro-fishing surveys within Cattaraugus Creek document high densities of spawning-phase walleye, and continued stocking efforts are planned.

3.7 Groundwater Hydrology

Groundwater hydrology in the WVDP area is summarized below.

3.7.1 Description of the Saturated Zone

The subsurface of the WVDP has been investigated since the early 1960's, resulting in hundreds of borings and installation of groundwater wells and other subsurface monitoring equipment. As explained previously, the hydrogeology of the WVDP site includes a sequence of glacial sediments underlain by shale bedrock. In chronologically descending order, this sequence is composed of an alluvial-glaciofluvial sand and gravel unit on the north plateau underlain by a sequence of up to three relatively impermeable glacial tills of Lavery, Kent, and possibly Olean age, separated by stratified fluvio-lacustrine deposits, which are in turn underlain by shale bedrock.

The sediments above the Kent till – the Kent Recessional Sequence, the weathered and unweathered Lavery till, the Lavery till-sand, and the surficial sand and gravel – are generally regarded as containing all of the potential routes for the migration of contaminants (via groundwater) from the WVDP site. Figures 3-5 and 3-6 are generalized cross-sections across the north and south plateaus showing the relative locations of these sediments. The Lavery till, the Kent Recessional Sequence, and the Kent till are common to both the north and south plateaus. Detailed geologic cross sections have been constructed using lithologic data collected from boreholes installed from 1961 to the present.

The WVDP does not use groundwater for drinking or operational purposes, nor does it discharge effluent directly to groundwater. No public water supplies are drawn from groundwater downgradient of the WVDP or from Cattaraugus Creek downstream of the WVDP. However, groundwater upgradient of the WVDP is used for drinking water by local residents.

Sand and Gravel Unit

As explained previously, the sand and gravel unit is unique to the north plateau and is a silty sand and gravel layer composed of younger Holocene alluvial deposits, the thick-bedded unit, that overlie older Pleistocene-age glaciofluvial deposits, the slack-water sequence. Together these two layers range up to 41 feet in thickness near the center of the plateau and pinch out along the edges of the plateau, where they have been truncated by the sidewall of the bedrock valley or the downward erosion of stream channels.

Disturbed materials and fill from construction activities also exist to varying depths on the developed portions of the north plateau. These are typically composed of re-compacted original sediment.

Depth to groundwater within the sand and gravel unit varies from 0 to 16 feet, being deepest generally beneath the central area of the north plateau, decreasing to the west, east, and north, and intersecting the ground surface farther northeastward toward the security fence.

Groundwater in this unit generally flows northeastward toward Franks Creek (Figure 3-62). Groundwater near the northwestern and southeastern margins of the sand and gravel layer also flows radially outward toward Quarry Creek and Erdman Brook, respectively.

In areas upgradient of the north plateau groundwater plume, recharge is limited by run-off diversions and culverts that channel surface flow to distant parts of the plateau. There is minimal groundwater flow downward into the underlying Lavery till. The overall hydraulic gradient across the north plateau has been calculated at 0.031; gradients up to 0.049 and as little as 0.026 exists in localized areas. An average groundwater velocity of 61.0 feet per year has been calculated for this unit (WVNSCO 1993e).

Recharge to the north plateau has been estimated as ranging from 3.0 inches to 13.5 inches and averaging 6.8 inches per year. Precipitation and bedrock underflow are the largest contributors to this recharge. Discharge occurs through evapotranspiration and drainage to streams, seeps, and springs along the edge of the north plateau, with a negligible amount as downward flow into the underlying Lavery till.

Weathered and Unweathered Lavery Till

Groundwater flow in the weathered till has both horizontal and vertical components. Groundwater typically flows laterally across the south plateau before moving downward or discharging to nearby incised stream channels. A lateral groundwater velocity has been calculated at 4.4 feet per year in this unit.

Groundwater elevation contours of the weathered Lavery till illustrate a potentiometric surface that dips generally to the northeast (Figure 3-63), with the exception of the northern section of the NDA, which is controlled by the operation of the interceptor trench. Groundwater in areas next to the trench flows directly toward and into the trench. Once inside the trench, laterals along the bottom of the trench drain the water toward the manhole sump (monitoring location NDATR on Figure 3-63), where it is pumped regularly to Lagoon 2.

On the north plateau, the weathered Lavery till is much thinner or nonexistent, and the sand and gravel unit typically immediately overlies the unweathered Lavery till, as noted previously. Hydraulic head distributions in the unweathered Lavery till indicate that groundwater flow is predominantly vertically downward at a relatively slow rate, toward the underlying Kent Recessional Sequence. A vertical groundwater velocity of 0.2 feet per year has been calculated for this unit.

Lavery Till-Sand Unit

The Lavery till-sand is a sandy unit of limited areal extent that is up to 16 feet thick within the Lavery till, primarily beneath the southeastern portion of the north plateau. The potentiometric surface of the Lavery till-sand is characterized by a variably sloping surface that generally dips to the east and southeast across the entire unit towards Erdman Brook (See Figure 3-64). Surface discharge locations have not been identified.

Kent Recessional Sequence

The Kent Recessional Sequence is a fine-grained lacustrine unit of interbedded clay and silty clay layers locally overlain by coarse-grained glacial sands and gravels. These deposits are found below the Lavery till beneath most of the site and range up to 75 feet in thickness beneath the eastern portions of the site (WVNSCO 1993e).

Groundwater flow in the Kent Recessional Sequence is predominantly to the northeast, toward Buttermilk Creek (Figure 3-65). Recharge comes primarily from bedrock in-flow in the southwest, with limited recharge from the overlying Lavery till. The Kent Recessional Sequence discharges to Buttermilk Creek. Because of the limited recharge received from the overlying Lavery till, the upper portions of the Kent Recessional Sequence are unsaturated. The deeper portions are saturated, and the groundwater velocity has been calculated at 0.4 feet per year (WVNSCO 1993e).

Groundwater elevation contours of the Kent Recessional Sequence illustrate a potentiometric surface that dips to the northeast. The steepest gradient is found in the southwestern portion of the south plateau, where the shoulder of the underlying bedrock valley slopes steeply to the northeast. Toward the middle of the south plateau, the glacial sediments filling the valley thicken, and the groundwater contours flatten somewhat and begin to slope to the north-northeast.

Shale Bedrock

The bedrock underlying the site occurs as a U-shaped valley of upper Devonian shales and siltstones. The upper 10 feet of rock is weathered and fractured. Bedding in these units generally dips 0.5 degree southward.

3.7.2 Monitoring Wells

Monitoring Equipment Inventory

There are currently 286 wells, well points, piezometers, seepage points, manholes, and surface water elevation hubs in the WVDP groundwater monitoring equipment inventory. Of this total, 222 devices are actively used for various monitoring purposes, and 64 are considered inactive (i.e., not used for any purpose). A total of 235 monitoring devices have previously been removed from service via approved decommissioning protocols. The monitoring equipment inventory includes equipment installed since 1960.

Aquifer tests were performed at the WVDP to support development of the North Plateau Groundwater Recovery System and the pilot Permeable Treatment Wall in 1996 and in 2003, respectively. Slug tests are also routinely performed on selected groundwater monitoring wells as part of a site-wide well maintenance program. This information is used to determine if degradation of a well has occurred, indicating that redevelopment is needed.

3.7.3 Physical Hydrogeologic Parameters in the Saturated Zone

Saturated Hydraulic Conductivity

The WVDP performs hydraulic conductivity testing of selected wells on an annual basis in accordance with approved site procedures and good engineering practices. A rotational system of testing a different group of selected wells every year ensures that most wells are tested periodically.

A summary of averaged hydraulic conductivity results for the five hydrogeologic units, based on testing performed from 1987 through 2004, is provided in Table 3-19.

Table 3-19. WVDP Hydraulic Conductivity (K) Testing Summary Table(1)

Geologic Unit	Sub-Unit	Maximum K (cm/s)	Average K (cm/s)	Minimum K (cm/s)
Sand and Gravel Unit	Thick-Bedded Unit	3.78 E-02	4.43 E-03	1.25 E-04
	Slack Water Sequence	1.13 E-01	2.44 E-02	8.19 E-04
Weathered Lavery Till	NA	1.50 E-03	3.36 E-04	4.87 E-07
Unweathered Lavery Till	Upper 3 meters	na	1.00 E-06	na
	Below 3 meters	na	6.00 E-08	na
Lavery Till-Sand	NA	4.54 E-03	2.04 E-03	1.06 E-04
Kent Recessional Sequence	NA	1.62 E-03	7.03 E-04	2.98 E-06

NOTE: (1) From DOE and NYSERDA 2008.
LEGEND: NA = Not Applicable
na = not available

The WVDP does not regularly perform hydraulic conductivity tests on bedrock wells because so few onsite wells penetrate bedrock. The hydraulic conductivity of bedrock at the WVDP, based on values collected for similar rock types, is estimated to range from 1.0E-07 cm/s for unweathered rock to 1.0E-05 cm/s for the weathered zone (WVNSCO 1993e).

Transmissivity

The transmissivity of the sand and gravel unit varies across the north plateau due to the variability of its saturated thickness and hydraulic conductivity. The transmissivity ranges from 4.8 E-03 cm^2/s to 6.8 E-03 cm^2/s (WVNSCO 1993e).

3.7.4 Unsaturated Zone

Description of the Unsaturated Zone

The unsaturated zones (vadose zones) within the surficial sand and gravel layer and the weathered Lavery till have been characterized separately, due to their different lithologies.

Hydrologic data obtained from unsaturated zone monitoring arrays were used to determine response to wetting and drying events. These data indicate that a downward migrating wetting front is generated after significant precipitation, and is dependent upon the soil moisture, soil hydrogeology, and structural features in the soil. When the soil is near saturation, this front raises the water table; when the soil is dry, the front will either redistribute into or evapotranspire from the vadose zone before contacting the water table.

The vadose zone in the weathered Lavery till fluctuates an average of 10 feet (i.e., one foot to 11 feet from grade) and varies with the season; horizontal and vertical fracture flow occurs within the entire fractured zone during the wet season and in the lower weathered zone during the dry season.

Dry season matric potentials in the Lavery till create an upward flow gradient from grade to five feet, with widening fractures increasing this depth during the late discharge season. The capillary fringe of the Lavery till is approximately seven feet thick.

Due to a varying topography, the vadose zone of the sand and gravel layer fluctuates in thickness over a generally uniformly sloping water table that itself annually fluctuates an average of 30 inches. Water within this vadose zone flows vertically downward to the water table. Dry season and matric potentials in the surficial sand and gravel create an upward flow gradient from grade to 6.9 feet (WVNSCO 1993f). The capillary fringe of the sand and gravel varies between 8.3 inches to 16.7 inches, depending on local lithology (WVNSCO 1993f).

The unsaturated zone at the WVDP has been modeled with several different computer codes. Results of these efforts are available in WVNSCO 1992.

Water Budget within the Unsaturated Zone

Precipitation occurring from December through April is lost mainly to rapid runoff and infiltration. From May through November, precipitation is lost mainly to infiltration and subsequent evapotranspiration, with a minor portion going to runoff.

Maximum recharge to most soils occurs when the ratio of the infiltration rate to precipitation rate is equal to or less than 1.0. For dry Lavery till soils (<75 percent saturated), precipitation is almost immediately absorbed and stored in the soil as recharge. In wet or nearly recharged soils (>75 percent saturated), the capillary potential of the primary pores is low, and any fractures may show less conductivity due to soil swelling. Thus, for the same precipitation rate, the wet season infiltration rate is lower and recharge is governed by the saturated hydraulic conductivity of the soil matrix and, to a lesser extent, by any fracture flow. However, if the fractures are not yet fully closed (as occurs in the late fall), the absorptive capacity of the bulk soil volume can still be high, allowing horizontal flow of the meteoric water.

The local runoff to precipitation ratio is highest in spring since the ground is saturated from late fall rains, early winter snow melt, and spring rains that contribute new water to soil profile of high antecedent soil moisture. This ratio lowers throughout the late spring, summer, and early fall (April–October) due to a soil moisture deficit that is produced from increasing summer evapotranspiration rates, as indicated by tensiometric data.

3.7.5 Description of Unsaturated Zone Monitoring Stations

In addition to groundwater monitoring wells, the WVDP maintains 11 surface water monitoring hubs (SE001 through SE011) to collect surface water elevations in areas of the north plateau where the water table in the sand and gravel unit intersects the ground surface. This information is correlated with groundwater well data and is used to define the water table surface in areas where monitoring well coverage is sparse or nonexistent.

3.7.6 Physical Parameters

Total and Effective Porosity

Total porosity of the sand and gravel unit has been calculated and ranges from 21.0 percent to 22.8 percent with an average value of 21.9 percent (WVNSCO 1993e).

Specific Yield

The specific yield (S_y) of the sand and gravel unit has been calculated to range from 0.10 to 0.25 (WVNSCO 1993e). Lower values reflect areas of poor sorting, and higher values reflect areas characterized by well sorted sands and gravels.

Specific Storage

The specific storage of the unweathered Lavery till has been calculated through consolidation tests, and was observed to decrease with depth from a maximum of 1.6E-05 per cm (6.3E-06 per inch) to a minimum of 2.0 E-06 per cm (7.9E-07 per inch), with an average of 8.0E-06 per cm (3.15 E-06 per inch) (WVNSCO 1993e).

3.7.7 Numerical Analysis Techniques

Groundwater flow and contaminant transport models of the north plateau at the WVDP are being used to investigate the groundwater flow and contaminant transport at the site.

Boundary conditions for the model represent groundwater flow conditions across the model grid. The top of layer one is modeled as a free-surface boundary representing the water table. Inflow along the southwestern boundary is simulated with a general head boundary. The discharge boundary along the edge of the north plateau is simulated as a drain, which can be varied on a cell-by-cell basis and temporally. The Lavery till is modeled as a no-flow boundary. Recharge is primarily via precipitation. Groundwater discharge occurs through evapotranspiration and groundwater discharge to seeps and springs along the contact of the Lavery till with the sand and gravel unit and to wetlands, swale, and other manmade drains in the plateau. The model's finite-difference equations were solved using the preconditioned conjugate-gradient 2 method (PCG2) described by Hill (Hill 1990). The Sr-90 north plateau groundwater plume source was simulated by a one-time release in 1969 from the southwest corner of the Process Building in an early model, and by the observed 1994 plume concentration in the later model. The modeled source activity was 500 Ci of Sr-90. The later model uses the observed Sr-90 concentrations of 1994.

The Lavery till acts as an aquatard and does not adsorb significant amounts of Sr-90. The retardation factor, porosity values, bulk density values, and the distribution coefficient are constant over time. The half-life of Sr-90 is 28.1 years.

Model calibration was performed by comparing average observed water levels to model simulated hydraulic head values, and adjusting within reasonable limits to minimize the differences between the measured and simulated heads. The distribution of error between the observed head and simulated head is randomly distributed over the model area. The transport model was qualitatively calibrated by comparing the observed concentration of Sr-90 with the simulated concentration at two different stress periods.

3.7.8 Distribution Coefficients.

An important aspect of site hydrogeology is the mobility of a contaminant in the various soil layers under the influence of groundwater. The distribution coefficient, also called partition coefficient or K_d, is used to describe the decrease in concentration of a contaminant in solution through interactions with geologic media in a soil-groundwater system. The K_d is defined as the ratio of the concentration (or activity in the case of radionuclides) of a species sorbed on the soil, divided by its concentration (or activity) in solution under steady-state conditions. It is an empirical parameter and its use in a given situation implies that the soil-groundwater system under study is in equilibrium.

The set of elements whose sorption onto West Valley geologic media have been studied over the years is representative in several respects. First, most of the elements considered have radioisotopes typically identified as key in post-closure performance assessments. The elements considered are also representative in that, based on location in the periodic table, several potentially different chemical behaviors are considered, such as monovalent and multivalent cations, chelation, formation of anionic species, and actinides.

K_d values for several important radionuclides have been determined for materials from those geohydrological units of primary interest – the surficial sand and gravel unit on North Plateau, the weathered Lavery till, and the unweathered Lavery till. There are fewer results for the lacustrine unit and no data for the Kent Recessional till or bedrock.

Finally, K_d values at West Valley have been estimated by a variety of different techniques – batch studies, experimental sorption isotherms, column studies, and the analysis of contaminant migration in soil cores taken from the site.

K_d Studies at the Center

Five studies have been performed, as described below.

Brookhaven studies – Chemical Environment. K_d values for Cs, Co, Sr, Am, and Eu were determined in a series of experiments at the Brookhaven National Laboratory for four West Valley geochemical environments: the Lavery till, the lacustrine unit, overland flow, and the waste mass in the disposal trenches (Pietrzak et al. 1981). Samples of unweathered Lavery till collected at a depth of 35 feet in the SDA were tested for their sorption characteristics in the presence of trench leachate collected from sumps and well points. Batch K_d determinations were conducted in both oxic and anoxic environments. This study was sponsored by NRC.

A description of the equipment and procedures employed in the Brookhaven study, and preliminary results and conclusions, were reported in Columbo and Weiss 1979 and subsequently expanded by Pietrzak et al. 1981. The latter report includes K_d values for europium and americium as well as cesium, strontium, and cobalt, and discusses the observed effects of each of several variables on the sorption characteristics of the till.

In addition to quantifying distribution coefficients, the Brookhaven studies clearly demonstrate both the effects of anoxic or reducing environments on sorption, and the effect of complexing agents, i.e., organics in the trench water, on sorption. The studies also indicated that the soil disaggregation technique used in an experiment has an impact on the K_d. Hence, there is an element of uncertainty in the observed K_d values due to experimental method, as well as to natural variation, in the Brookhaven numbers.

NFS Sorption Studies – Variation With Depth. In 1974, Duckworth (Duckworth, et al. 1974) reported percentage sorptions for Cs-137, Sr-85, Ru-106, and Co-60 on a total of 37 samples of weathered and unweathered Lavery till taken from the SDA at depths of four to 51 feet. Iodine sorption percentages were also determined for 10 samples of weathered and unweathered till. Later, the WVDP used these data to calculate the distribution coefficients for the radioisotopes studied (WVNSCO 1993a).

The number and distribution of the samples tested clearly indicate differences between sorption on weathered and sorption on unweathered till but for not all radionuclides. This pattern is illustrated in Figures 3-66 through 3-68.

The right half of each figure shows stripplots[5] of the K_d values determined at four increasing depths: 10 feet, 25 feet, 30 feet, and 50 feet. The 10-foot K_d values are for weathered till and the remaining K_d values are for unweathered till. The left half of each figure shows the normal probability plot[6] of all of the K_d values where the weathered (10-foot) K_d values are solid black circles and the unweathered till K_d values are solid gray circles.

In the figures, cesium and strontium – and possibly iodine – show variation of the K_d with soil type (i.e., by depth). (The iodine data show a similar variation by soil type, but this trend is less statistically significant in light of the smaller number of samples involved.) Neither the ruthenium nor the cobalt K_d values vary with depth.

Finally, there is one drawback to this set of distribution coefficients: the longest contact time in the batch experiments was 16 hours, and it is unlikely that equilibrium was attained. However, shorter contact times lead, in principle to lower (more conservative) K_d values.

[5] Individual K_d determinations are plotted and grouped by weathered or unweathered.

[6] A normal probability plot presents the ordered values of the K_d versus the z-scores of the corresponding quantiles from the standard normal distribution. In these figures, the "Sample Quantiles" are just the K_d values and the "Theoretical Quantiles" are the z-scores. (A z-score is a measure of the distance in standard deviations of a sample from the mean.)

Oak Ridge National Laboratory Study - Competitive Sorption on the Lavery Till. Lavery Till samples from 1961 were submitted to Oak Ridge National Laboratory for batch-test radionuclide sorption studies. The locations and sampling depths were selected to provide coverage at both shallow to intermediate depths within the till, providing a comparison of the weathered and unweathered materials (WVNSCO 1993a).

The study results for cesium and strontium were numerically similar[2] to the results from Duckworth's data, showing that the Lavery till has a high affinity for cesium and a lower affinity for strontium. Cobalt-60 was almost completely sorbed by both weathered and unweathered tills with cobalt exhibiting no selectivity for either material.

Some tests were also run for ruthenium, but the results were not considered particularly meaningful because they were conducted using ruthenium which had percolated through the Oak Ridge soil and from which the sorbable and filterable portions had been removed. The Oak Ridge sorption percentages were much lower than those observed by Duckworth. Chelation or complexation of the ruthenium in the Oak Ridge solution is a plausible explanation for the lower sorption.

Competitive sorption effects – cesium/potassium and strontium/calcium – were also examined in the Oak Ridge study. In both cases, the presence of a competitor species slowed sorption. The introduction of potassium ions reduced the sorption of cesium by a factor of six. Similarly the sorption of strontium was found to be reduced fourfold by the presence of calcium in the leachate.

United States Geological Survey Estimates. U.S. Geological Survey studies (Prudic 1986) on groundwater flow and contaminant transport in till immediately adjacent to the SDA have also included estimates of K_d values for several elements – cesium, strontium, hydrogen, and carbon. In this study, the K_d values were inferred from travel distances from the trench. The results for the carbon, cesium and strontium are consistent with the Brookhaven results for unweathered till under anoxic conditions. The tritium is assumed to be in the form of tritiated water and to experience no sorption[3] (i.e., a K_d of 0).

WVDP – North Plateau Sand and Gravel. In 1995 Dames and Moore reported the results for radionuclide sorption onto samples of the surficial North Plateau sand and gravel (Aloysius 1995 and Dames and Moore 1995). K_d values were determined for strontium, technetium, iodine, cesium, europium, uranium, neptunium, plutonium and americium. Most of the determinations used either batch tests and/or plots of the sorption isotherms.

This study also examined several related phenomena of potential interest. The effect of having tributyl phosphate/n-dodecane present was investigated for both uranium sorption and americium sorption. No effects were observed for either radionuclide. Competitive effects between technetium and iodine were also studied, indicating that iodine is preferentially sorbed.

[2] The Oak Ridge tests were 24 hour batch tests. The Kd's were higher but still comparable.

[3] This neglects absorption into pore-space deadwater

At the present, Sr-90 is the primary radionuclide of interest in the north plateau surficial aquifer. For this reason, strontium's sorption behavior was studied in great detail by the investigators. In addition to batch and isotherm testing, the K_d of strontium was determined in column experiments and by the analyses of field data showing the distribution of Sr-90 in the surficial sand and gravel aquifer and the observed flow field of the aquifer. These dynamic estimates for the Sr-90 K_d were consistent with the batch and isotherm determinations.

The effect of the chemical environment on strontium sorption was also investigated. The K_d was found to be sensitive to small changes in pH and to increase with increasing pH. The strontium K_d was observed to increase with increasing ionic strength, but decrease with increasing calcium concentrations, i.e., the calcium is preferentially sorbed. These experimental findings were corroborated with geochemical modeling using the MINTEQA2 code.

Table 3-20 summarizes the distribution coefficients quantifying the sorption of fourteen elements onto West Valley soils. The primary Brookhaven references are not available and values have been taken from citing documents. Where possible, the values have been entered as ranges.

Table 3-20. Distribution Coefficients

Element	K_d(cm³/g)	Geohydrological Unit	Notes	Reference
Hydrogen	0	Unweathered Lavery Till	Assumed zero (tritiated water)	Prudic 1986
Carbon	0.7 - 1.1	Unweathered Lavery Till	Anoxic conditions, organic carbon	Prudic 1986
	3 – 12	Unweathered Lavery Till	Anoxic conditions, inorganic carbon	Prudic 1986
Cobalt	1 – 5	Unweathered Lavery Till	Anoxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	1.8 - 2.3	Unweathered Lavery Till	Oxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	6400	Unweathered Lavery Till	16 hr batch	WVNSCO 1993a
	5400	Weathered Lavery Till	16 hr batch	WVNSCO 1993a
Strontium	6.16	Surficial Sand and Gravel	North plateau	Aloysius 1995
	6.9 - 7.4	Unweathered Lavery Till	Anoxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	25 – 32	Unweathered Lavery Till	Oxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	1 – 7	Unweathered Lavery Till	In-situ assessment, SDA, anoxic conditions	Prudic 1986

Table 3-20. Distribution Coefficients

Element	K_d(cm³/g)	Geohydrological Unit	Notes	Reference
Strontium	30	Unweathered Lavery Till		WVNSCO 1993a
	130	Weathered Lavery Till		WVNSCO 1993a
Technetium	4.1	Unweathered Lavery Till	Regression fit of linear isotherm	Aloysius 1995
Ruthenium	1300	Unweathered Lavery Till		WVNSCO 1993a
	1200	Weathered Lavery Till		WVNSCO 1993a
Iodine	0.4 - 3.4	Lavery Till		WVNSCO 1993a
Cesium	48 – 260	Unweathered Lavery Till	Anoxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	100 – 200	Unweathered Lavery Till	Oxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	3350-4500	Unweathered Lavery Till		WVNSCO 1993a
	4900-8000	Weathered Lavery Till		WVNSCO 1993a
Europium	> 14,000	Surficial Sand and Gravel	Based on detection limit	Aloysius 1995
	600 – 2100	Unweathered Lavery Till	Anoxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	3700 – 4300	Unweathered Lavery Till	Oxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
Radium	195	Unweathered Lavery Till		Pietrzak, et al. 1981 cites Bergeron, et al. 1987
Uranium	9.1 - 9.6	Unweathered Lavery Till	Regression fit of linear isotherm	Aloysius 1995
	11.9	Unweathered Lavery Till	Regression fit of linear isotherm, TBP/n-dodecane present	Aloysius 1995
Neptunium	2.3	Surficial Sand and Gravel	Recommendation	Aloysius 1995
	0.5 - 5.2	Unweathered Lavery Till	Regression fit of linear isotherm	Aloysius 1995
	5.5 - 18.1	Weathered Lavery Till	Regression fit of linear isotherm	Aloysius 1995
Plutonium	2600	Surficial Sand and Gravel	Kinetic sorption experiment (120 hr batch)	Aloysius 1995
	27900	Unweathered Lavery Till	Kinetic sorption experiment (120 hr batch)	Aloysius 1995
	5 – 56	Unweathered Lavery Till	Anoxic trench water	Matuszek 1980
Americium	111000	Unweathered Lavery Till		Aloysius 1995
	77,000-272,000	Unweathered Lavery Till	In presence of TBP/ n-dodecane	Aloysius 1995

Table 3-20. Distribution Coefficients

Element	$K_d(cm^3/g)$	Geohydrological Unit	Notes	Reference
Americium	420 – 1000	Unweathered Lavery Till	Anoxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979
	4000 – 4700	Unweathered Lavery Till	Oxic trench water	Pietrzak, et al. 1981 and Columbo and Weiss 1979

NOTE: (1) Range reflects differences due to experimental technique employed for soil disaggregation.

3.7.9 Hydraulic Properties

Prudic noted the abundant fractures in the weathered Lavery till zone, indicating that fractures with oxidized walls, spaced a few meters apart, extended down to about 14.7 feet (Prudic 1986). The oxidized zones bordering the fractures, as well as thin coatings of manganese and/or iron oxide, calcite, root hairs, and thin gray (reduced) zones on the inner surfaces of some fractures, clearly suggest water movement along the fractures.

The WVDP has total porosity data from several investigations. Table 3-21 shows results from samples obtained during monitoring well installation in the 1989-1990 period as reported in WVNSCO 1993e, which are representative of the available data. In the case of samples from the sand and gravel layer, the weathered Lavery till, and the unweathered Lavery till, total porosity was calculated using the equation:

$$P = [\,1 - \rho / G\,] \times 100\ \%$$

where P = total porosity

ρ = bulk dry density

G = specific gravity

An estimated bulk dry density of 2.1 g/cm^3 was used in the calculations for the sand and gravel layer and1.6 g/cm^3 for the Lavery till, both weathered and unweathered.

Table 3-21. Total Porosity(1)

Geologic Unit	Range of Total Porosity (%)	Average Total Porosity (%)
Sand and Gravel(2)	21 to 22.8	21.9
Weathered Lavery Till(3)	40.3 to 41	40.7
Unweathered Lavery Till(4)	41.4 to 42.5	41.7
Lavery Till Sand(5)	NA	25
Kent Recessional Sequence(5)	NA	25

NOTES: (1) From WVNSCO 1993a. The total porosity values were determined from boring samples collected during monitoring well installation in 1989 and 1990.

(2) From Table 2-1 of WVNSCO 1993e.

(3) From Table 3-1 of WVNSCO 1993e.

(4) From table 4-1 of WVNSCO 1993e.

(5) Estimated based on particle size and sorting.

3.8 Natural Resources

This section describes existing and potential natural resources at and in the vicinity of the WVDP. These resources include natural gas and oil, sand/gravel/clay deposits, surface water, groundwater, timber and two renewable energy sources–geothermal and wind energy.

3.8.1 Natural Gas and Oil

New York has proven natural gas and oil resources (NYSDEC 2001). The New York State Department of Environmental Conservation estimates that the state's 2001 production was enough to heat approximate 353,000 homes. A significant portion of these resources are found in Chautauqua, Cattaraugus, and Erie Counties.

The annual production of natural gas and oil in New York State during 2001 is summarized in Table 3-22 along with production in nearby areas such as the Town of Ashford. New York produced 28 billion cubic feet of natural gas in 2001. Cattaraugus County and Erie County were the fourth and fifth largest producing counties in the state accounting for 9 percent of the production for that year. The largest Western New York producer of natural gas was Chautauqua County which was responsible for almost 23 percent of the State's production.

Table 3-22. 2001 Natural Gas and Oil Production in Cattaraugus and Erie Counties, and the State of New York(1)

Location	County	Gas (1000s ft^3)	Oil (barrels)	Active Gas Wells	Inactive Gas Wells	Active Oil Wells	Inactive Oil Wells
Ashford	Cattaraugus	20,879	1,065	13	4	2	0
East Otto	Cattaraugus	6,133		6	2	0	1
Ellicottville	Cattaraugus	6,344		16	0	0	0
Machias	Cattaraugus	220		1	1	0	0
Yorkshire	Cattaraugus	23,740		18	3	0	0
Colden	Erie	6,374		11	6	0	0
Sardina	Erie	19,228		11	3	0	0
Total		82,918	1,065	76	19	2	1
Total Cattaraugus County		1,383,691	116,373	427	175	1,557	440
Total Erie County		1,132,634	45	875	239	1	1
New York State		28,020,207	175,666	5,949	843	3,373	1,416

NOTE: (1) From NYSDEC 2001.

Cattaraugus County was the top oil producing county in New York in 2001 contributing more than 66 percent to the state total. However, less than one percent of the county's contribution came from the Town of Ashford's two active oil wells. There are no active wells in any of the towns adjacent to Ashford.

Figure 3-69 shows the locations of all of the known wells associated with the production of natural gas and oil in Western New York. Figure 3-70 shows production in the Town of Ashford in Cattaraugus. The approximate location of the WVDP is indicated on Figure 3-72 by the black **"WV."** These two graphics clearly indicate that production occurs in the immediate vicinity of the site, but the site lies on the fringes of known resources. Most of the gas production occurs in a band paralleling Lake Erie west of the site, and most of the oil production occurs in the southern part of Cattaraugus County near the Pennsylvania state line.

3.8.2 Mineral Resources

Sand, Gravel, and Clay

As described above, the WVDP site and surrounding valley area are underlain by a sequence of glacial tills comprised mainly of clays and silts separated by sands and gravels. These materials are a potential mineral resource, although a determination of their classification (USGS 1980) as resource, reserve, marginal reserve, or sub-economic resource has not been evaluated. In any event these materials are currently restricted by virtue of the restricted access to the Center.

Sand and gravel mines are New York's most common type of mine. Construction sand and gravel is a high-volume, low-value commodity. The industry is highly competitive. Production costs vary widely depending on geographic location, the nature of the deposit, and the number and type of products produced. Transportation is a major factor in the delivered price of construction sand and gravel, and because of the high cost of transportation, construction sand and gravel continues to be marketed locally (NYSDEC 2005).

In 2001, there were 1931 active sand and gravel mines in the state producing more than 30 billion metric tons worth at least $162 million. Data for production by mine for that year are not available. However, based on permitted acreage two of New York's seven largest producers have mines in the vicinity of the WVDP (NYSDEC 2005). One is in the adjacent town of Machias, and the other in nearby Sardinia. There are approximately 20 mine sites within six miles of the WVDP. Approximately half of those were active in 2001.

The major clay minerals found in the site tills are illite and chlorite. Such clays are not particularly valuable for ceramic or industrial applications. There is one regulated clay mine in the Town of Concord which is within six miles of the site.

3.8.3 Water Resources

Both surface water and groundwater resources are found at the WVDP (see Sections 3.6 and 3.7). Buttermilk Creek Basin is a proven surface water resource. Its headwaters are located in and adjacent to the southern part of the site, and the creek flows northwest through the site. Two small water reservoirs were constructed on headwater tributaries to supply both potable and process water to Center and WVDP facilities.

Groundwater within the Center and the WVDP is not utilized for any purpose, as noted previously. However, groundwater is a proven if limited resource in the West Valley area as indicated by the use of several off-site residential wells. Approximately 259 homes within a 3.1-mile radius of the WVDP utilize groundwater as a potable water source. These wells utilize groundwater from surficial sand and gravel aquifers of limited areal extent, as well as weathered bedrock aquifers. Significant quantitative characterization of groundwater is limited to the WVDP, specifically the north plateau and south plateau. That effort has focused on contaminant hydrology as opposed to water resource characterization.

Using knowledge of the groundwater in the vicinity of the WVDP, one basin-wide aquifer is postulated, the weathered and fractured bedrock system. Lying above the competent, low permeability shale bedrock and below the low-permeability glacial tills, this system is recharged from the upland slopes bordering the valley. Discharge is largely to Buttermilk Creek which has cut through the till to bedrock in the valley floor. Little if any connection of the West Valley fractured bedrock aquifer with similar systems in the Connoissarauley and Broad Valleys is expected due to the intervening shale uplands.

Aquifers associated with the glacial drift are sand and/or gravel units of limited areal extent. The surficial sand and gravel unit of the north plateau receives significant recharge from infiltrating precipitation, is highly permeable, and lies on top of low-permeability clayey/silty till. However, it has limited lateral extent and discharges along much of its perimeter.

Subsurface sand and/or gravel units also appear to be limited in extent. Recharge to these units is poorly understood. Given the low permeability of the clayey/silty tills in which they are embedded, some connections with and recharge from the upland fractured-rock flow system at the valley periphery is plausible.

In sensitivity analyses with the three-dimensional site groundwater model, simulations have been run with and without the subsurface till sand unit which is situated on the north plateau east of the Project facilities. The simulations showed little sensitivity to the presence of this unit and the model fit was slightly better when it was left out. These results suggest that the flow associated with this system is not a significant participant in the overall scheme and this inference, by extension, implies that the unit (and others like it) are limited as water resources.

Finally, it is noted that the West Valley aquifer system is part of the Cattaraugus Creek Basin Aquifer System, designated as a sole source aquifer. Similar to West Valley, the sand and gravel aquifers in this system used as water sources tend to be local and limited in spatial extent. Generally, the gradient from the Cattaraugus sand and gravel aquifers is downward toward the fractured bedrock system or laterally to surface waters.

3.8.4 Timber Resources

The region's (Southern Tier) specific soil and climate help to produce several commercial species of hardwood timber including maple, ash, red oak and black cherry. The estimated annual net growth of timber amounts to over 1.6 million tons a year (STPRDB 2003). At present, about one third of this amount is being removed through harvesting, leaving a significant potential for future economic development, including the potential for increased domestic secondary use and export use.

Much of the Center is forested characteristic of the region. A smaller portion of the WVDP is forest, however. The last sawtimber harvest occurred mid-century with cull, inferior, and smaller trees left. There has been no management in the interim. In 1978, the volume of sawtimber at the Center was estimated to be 3.2 million board feet having a total standing value of $313,000. Most of the value came from hardwoods. The annual growth rate was estimated to be low at 100 board-feet per acre per year. When corrected for inflation, the average stumpage rate of all eastern hardwoods increased by roughly 250 percent from 1978 to 1999 (Howard 2001). Neglecting new growth, degradation, the absence of management, changes in mix, etc., the current value of the Center forest would be $750,000.

3.8.5 Renewable Energy Resources

There are two renewable energy sources which are notable potential resources at or in the vicinity of the WVDP. These are geothermal energy and wind energy.

Geothermal

Geothermal energy is an inferred, i.e., unproven, resource at the Center. Recently development studies for the western Southern Tier (STPRDB 2003) have recognized the geothermal potential in that region. The reports indicate that low temperature geothermal wells are available in portions of Western New York. Analysis of bottom hole temperature data from Cambrian sandstones indicates the presence of extractable fluids in the low temperature geothermal target zone. The report notes that the potential of geothermal power has not yet been utilized in the region due to technological obstacles, high initial capital costs, and a reluctance to engage new resources. Low temperature geothermal resources may be used for direct heat, i.e., heat pumps, but not for the generation of electricity.

Wind

Recent work suggests that the hilltops to the west of the WVDP are suitable for the development of wind energy resources. In 2004, NYSERDA was engaged in wind energy research and recently has funded the development of wind resource maps for the entire state of New York (TrueWind 2005). Based on extensive meteorological data and numerical models, the maps rate every location in the state for wind energy potential. In these maps, locations along the ridge or hilltops separating West Valley from Connoissarauley Valley are rated as having a good potential for wind energy development.

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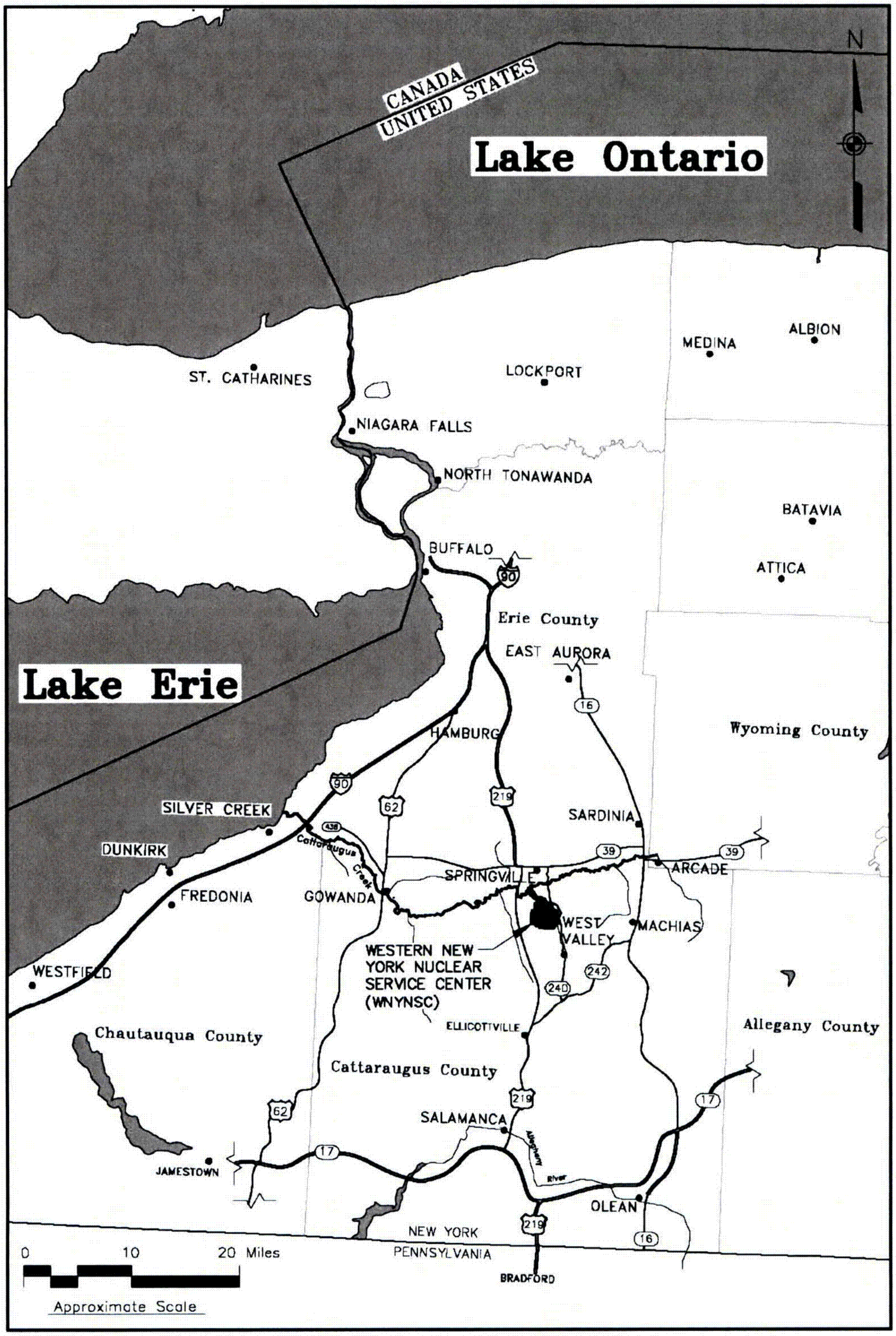


Figure 3-1. Location of the Center in Western New York

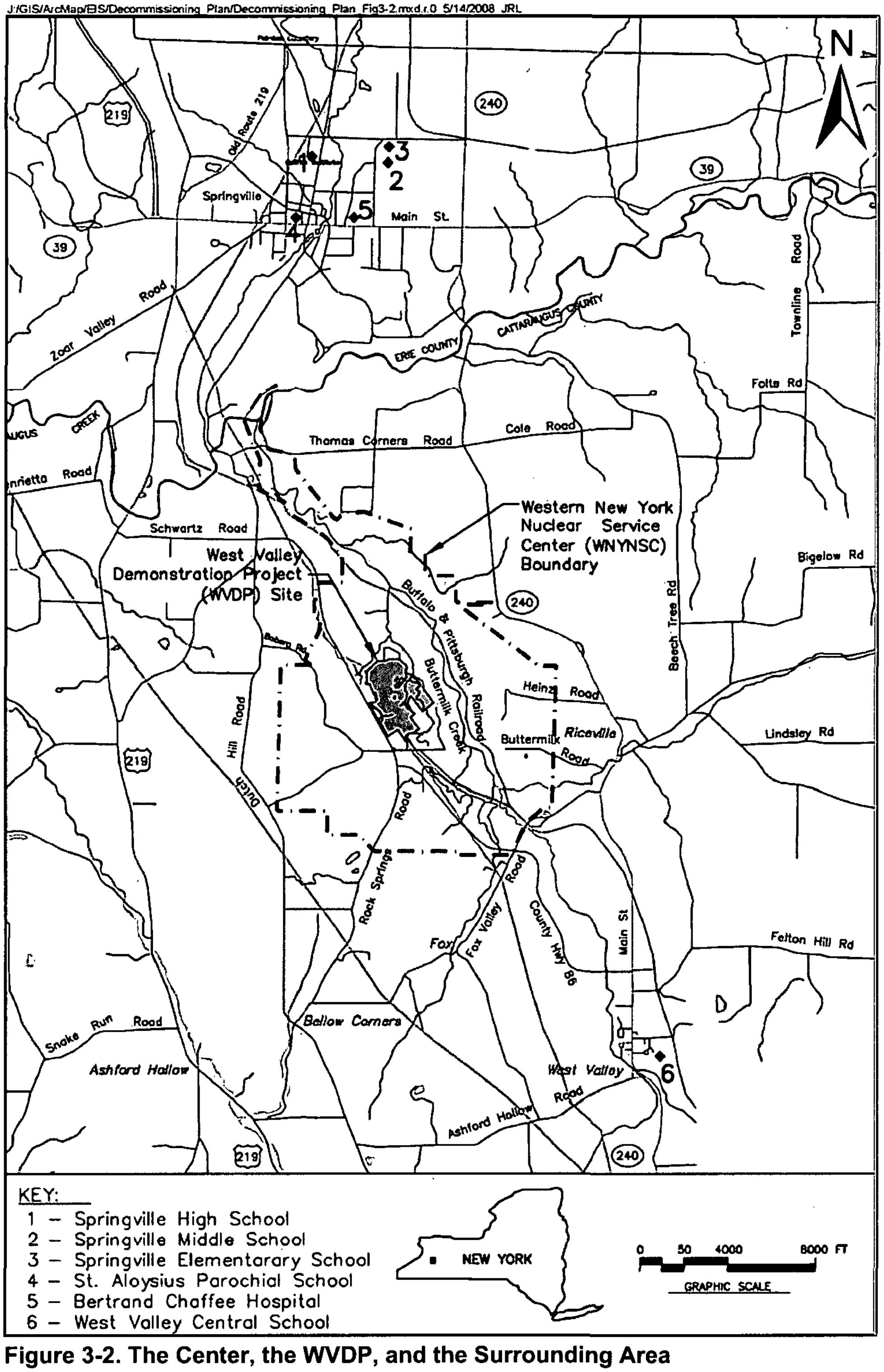


Figure 3-2. The Center, the WVDP, and the Surrounding Area

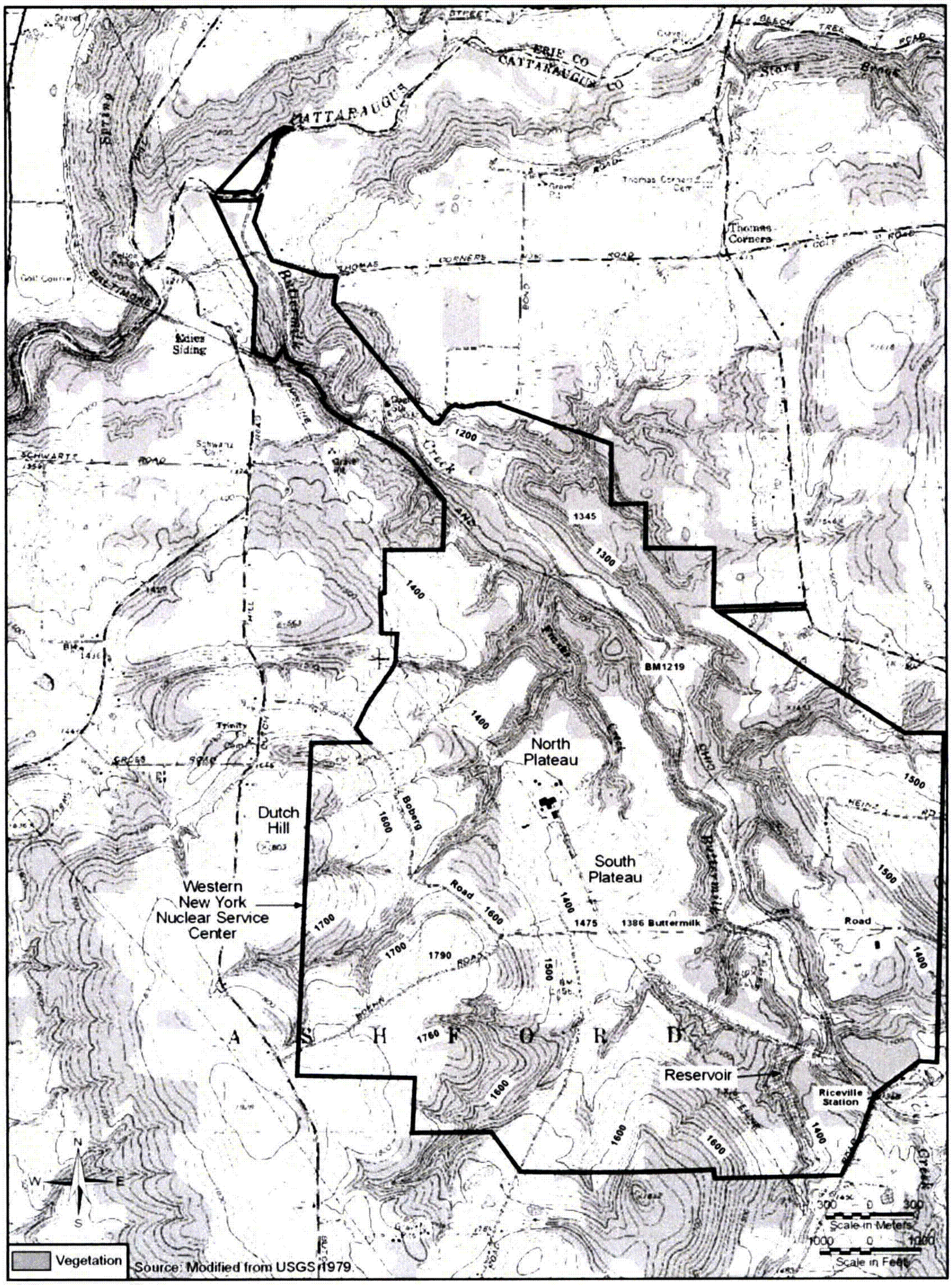


Figure 3-3. Topography of the Western New York Nuclear Service Center

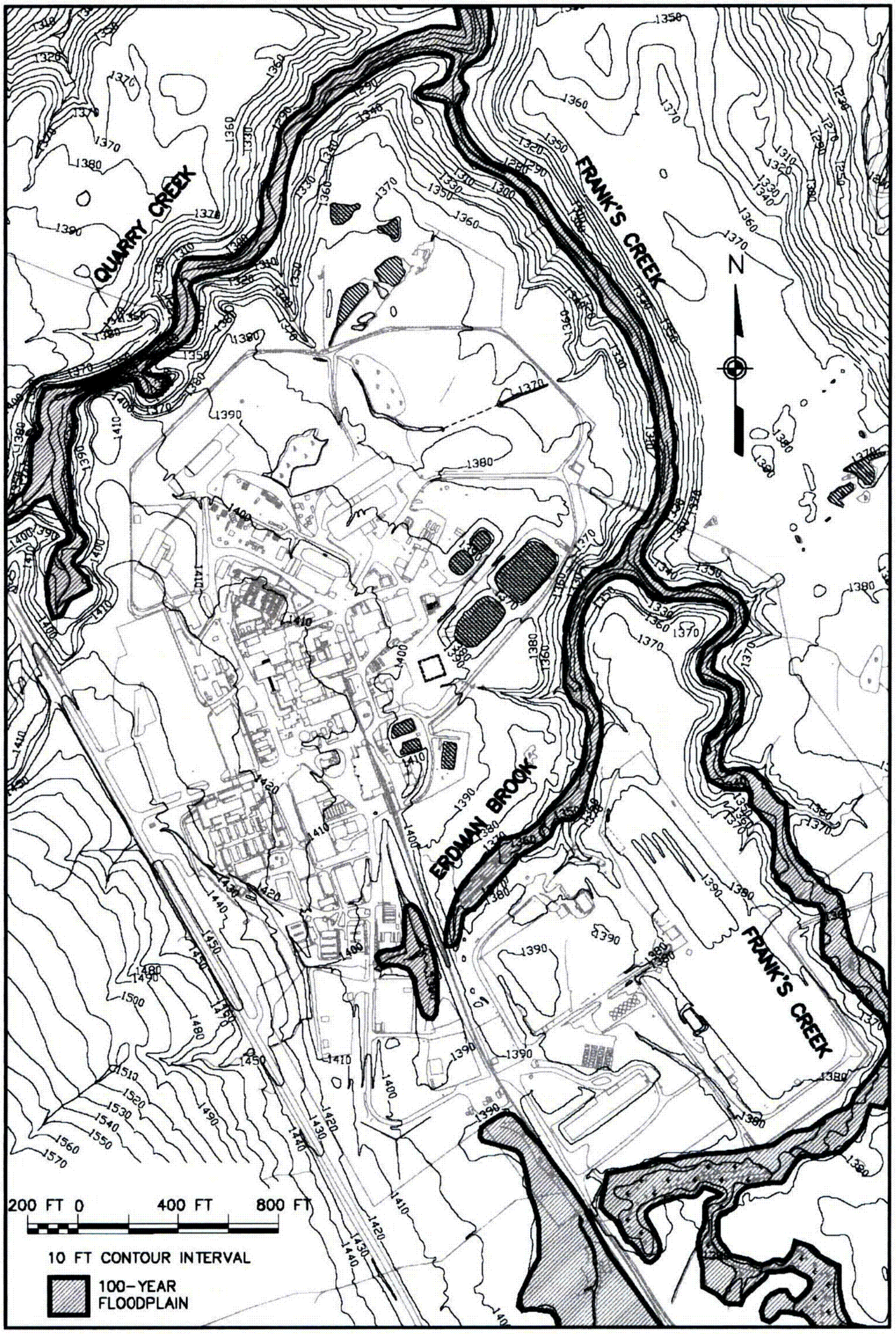


Figure 3-4. Topography of the Project Premises, Showing 100-Year Floodplain

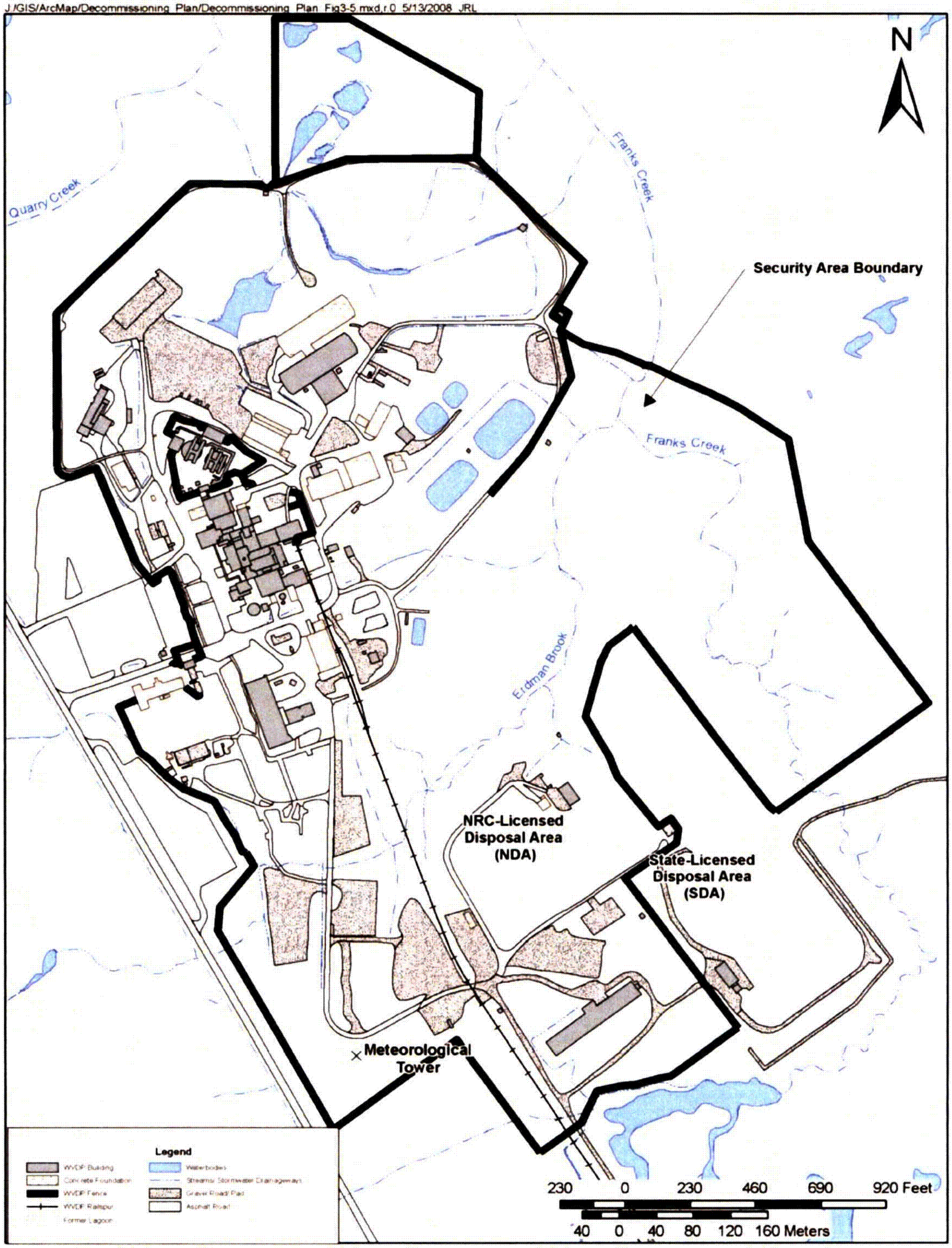


Figure 3-5. Security Fence Around WVDP Premises Boundary

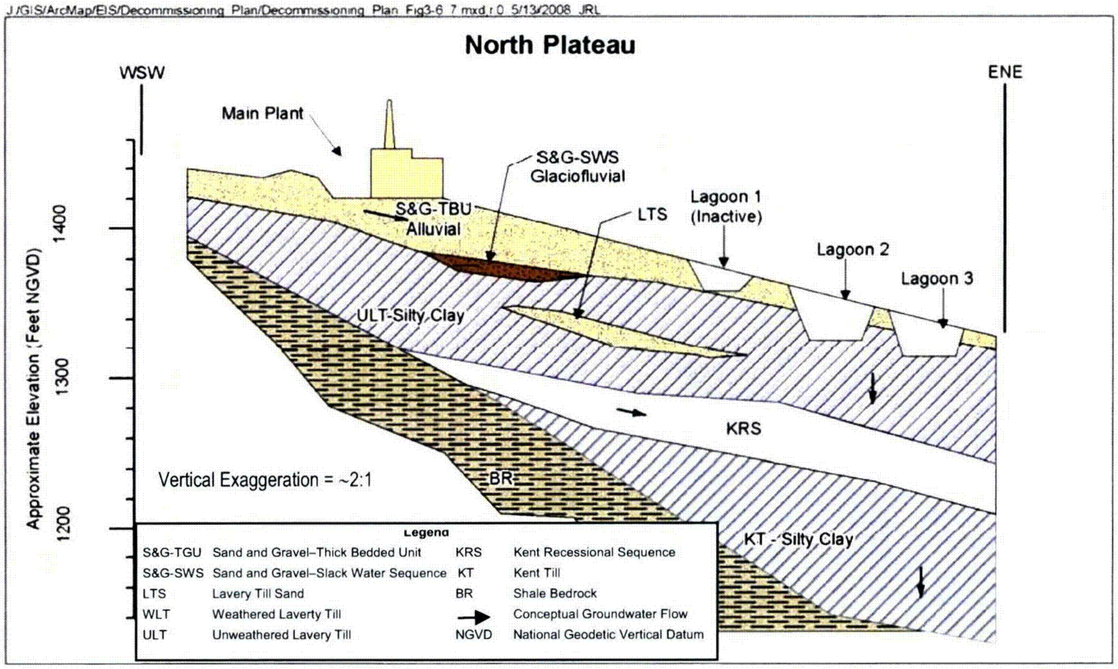


Figure 3-6. North Plateau Geologic Cross Section

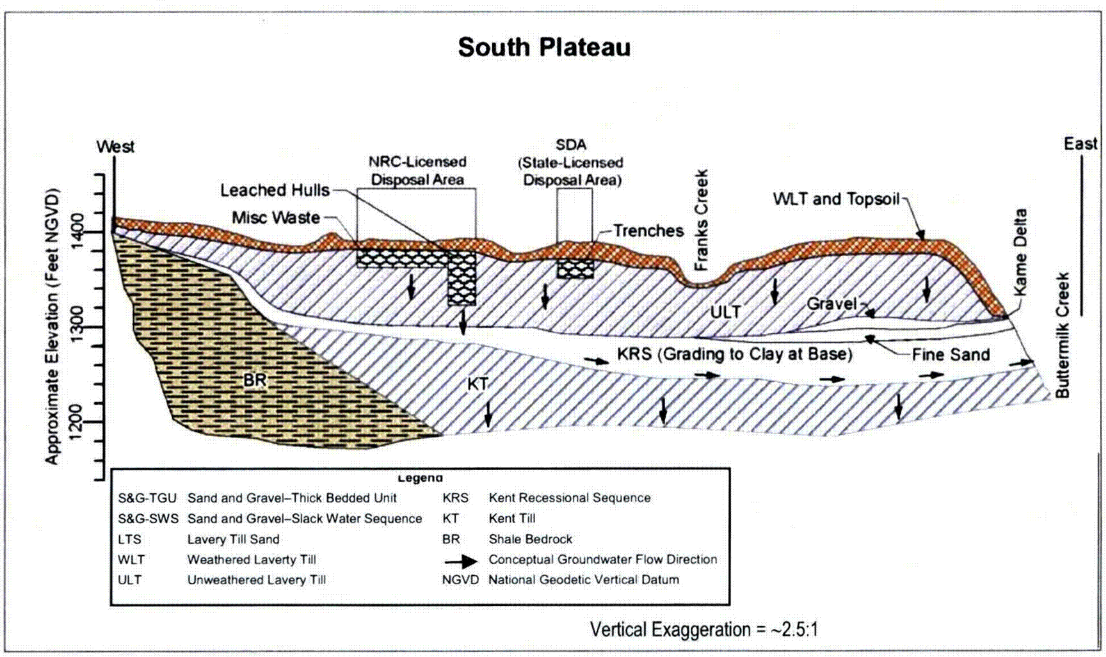


Figure 3-7. South Plateau Geologic Cross Section

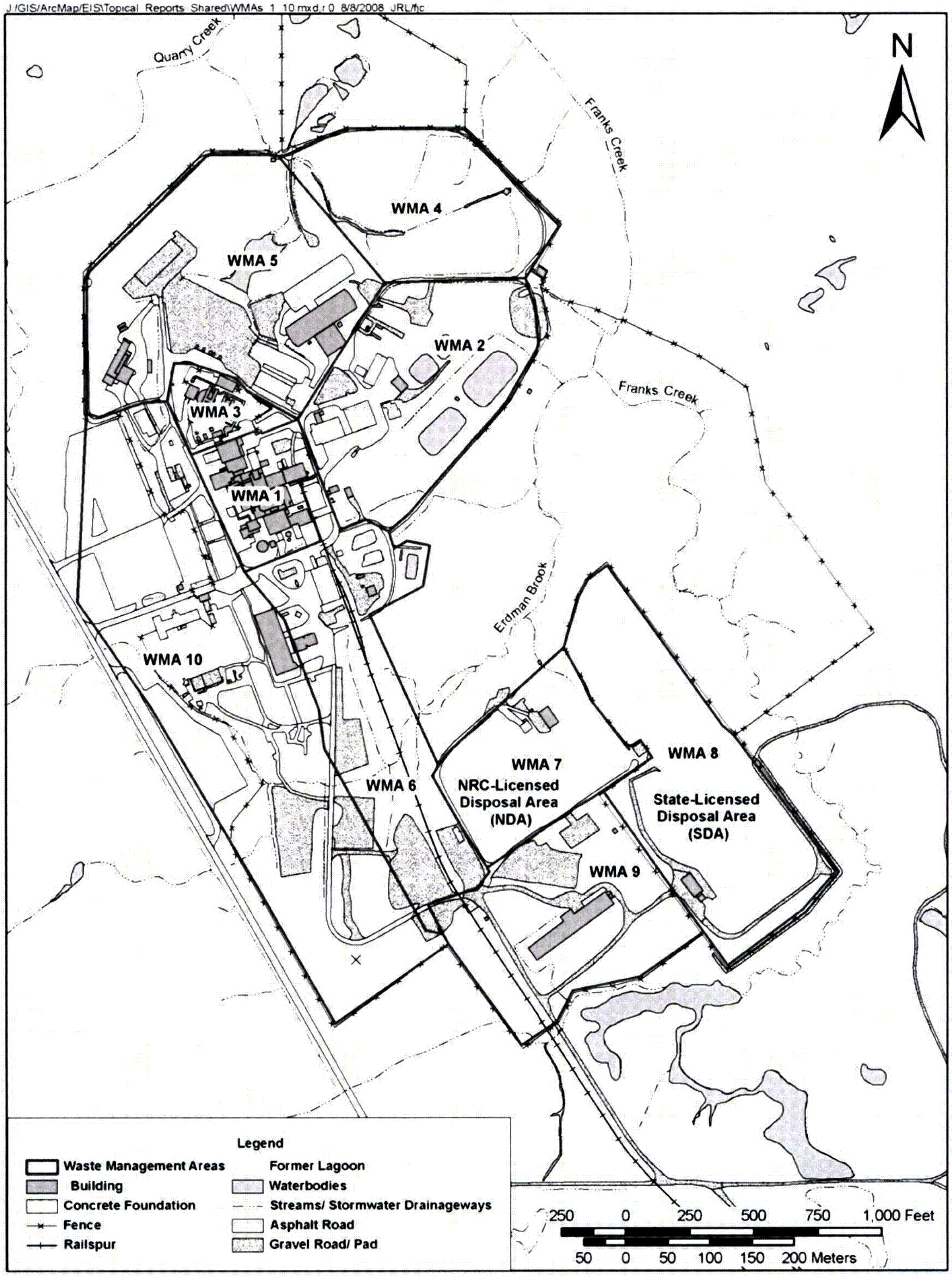


Figure 3-8. WMAs 1 through 10

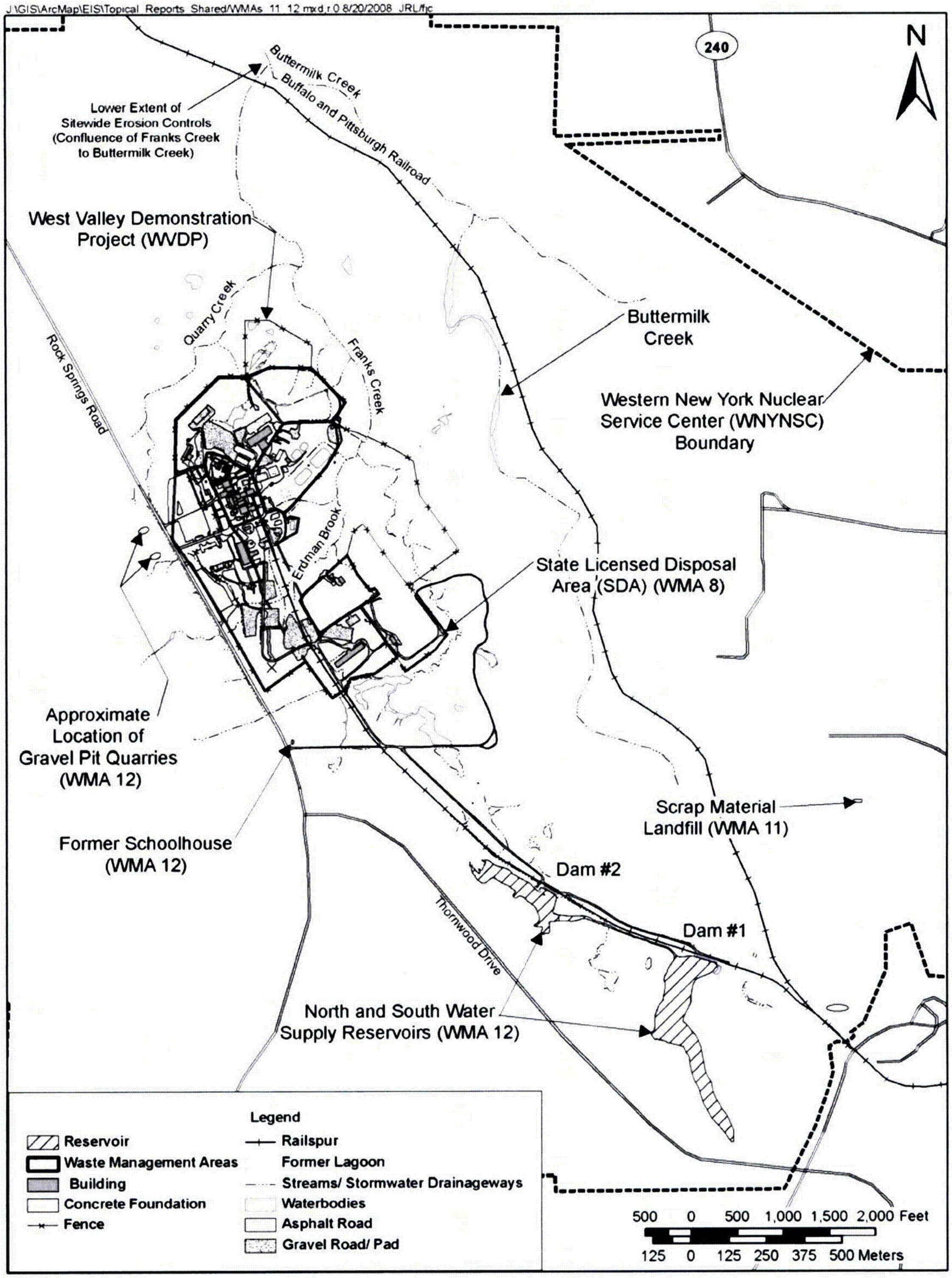


Figure 3-9. WMAs 11 and 12

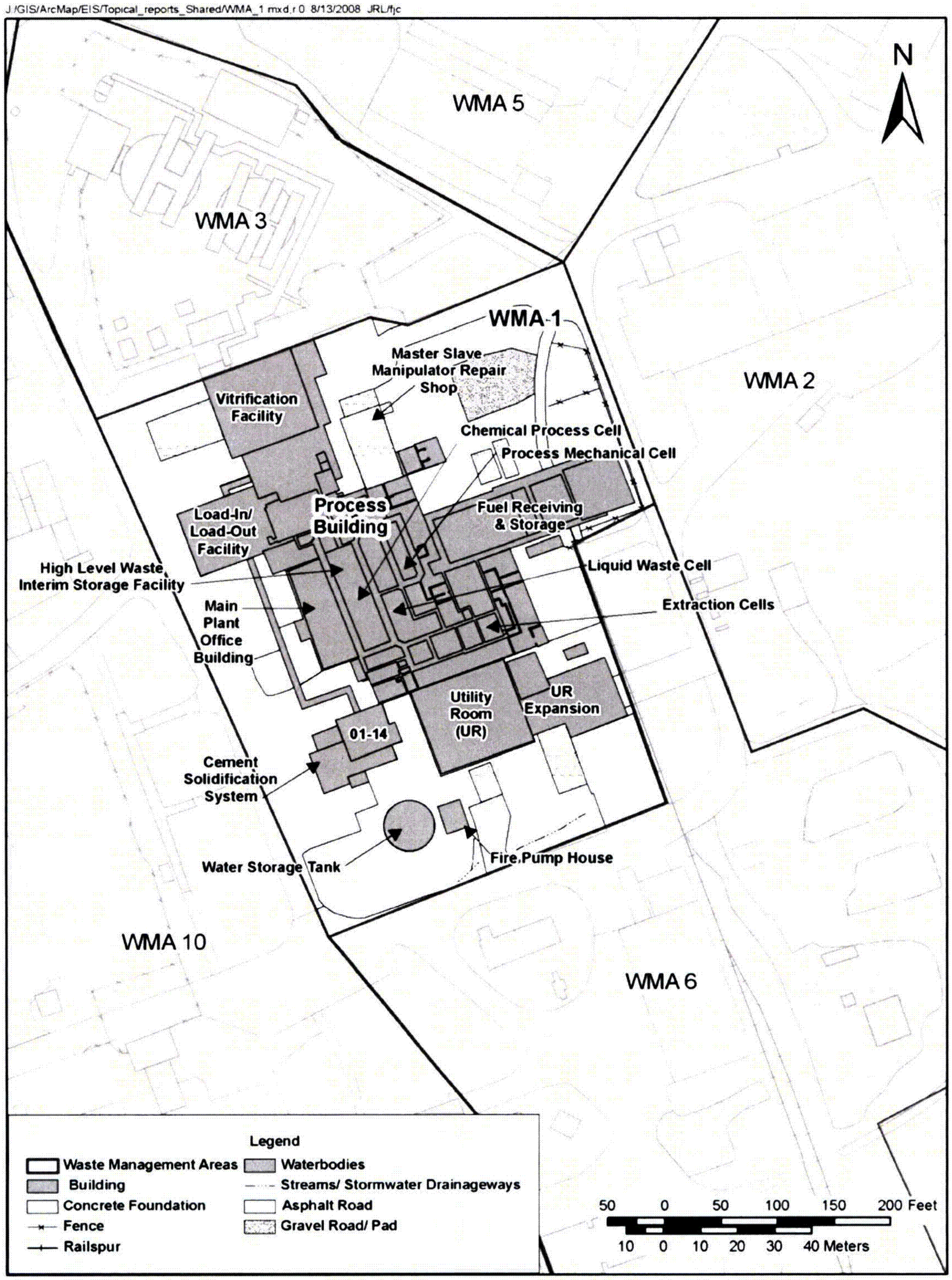


Figure 3-10. WMA 1. (The Phase 1 proposed decommissioning activities would include removal of the facilities and the underlying north plateau groundwater plume source area.)

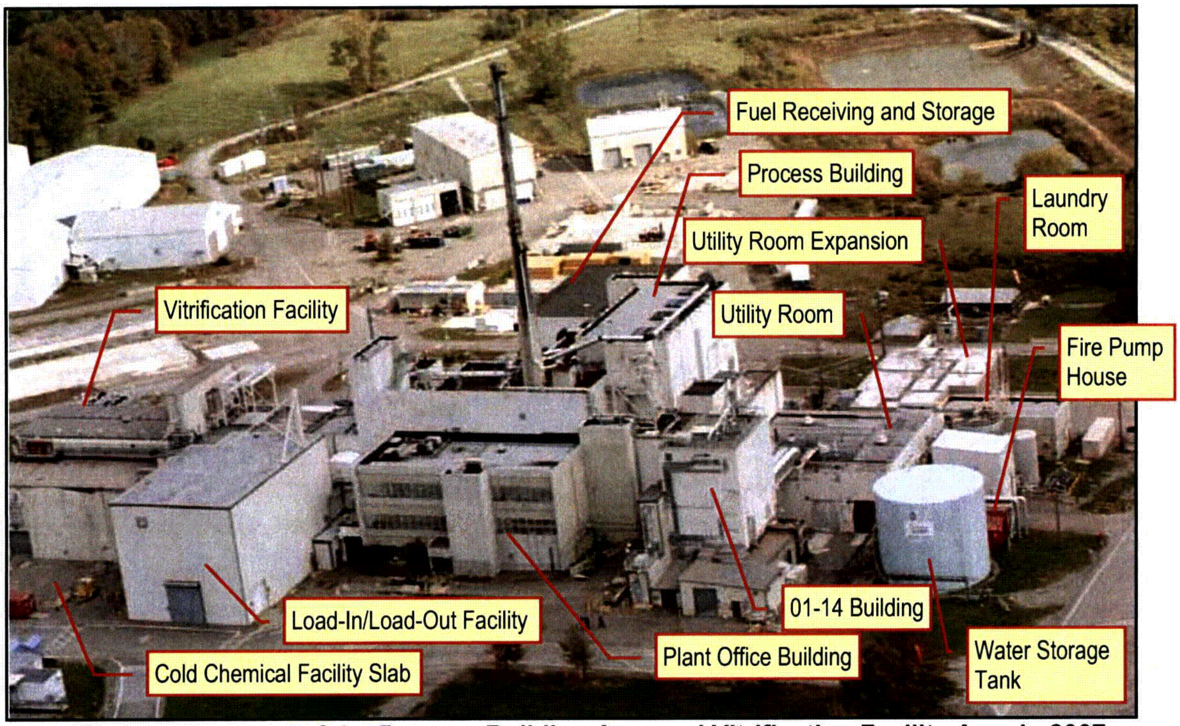


Figure 3-11. Aerial View of the Process Building Area and Vitrification Facility Area in 2007. (The Laundry Room will be removed before the Phase 1 decommissioning begins.)

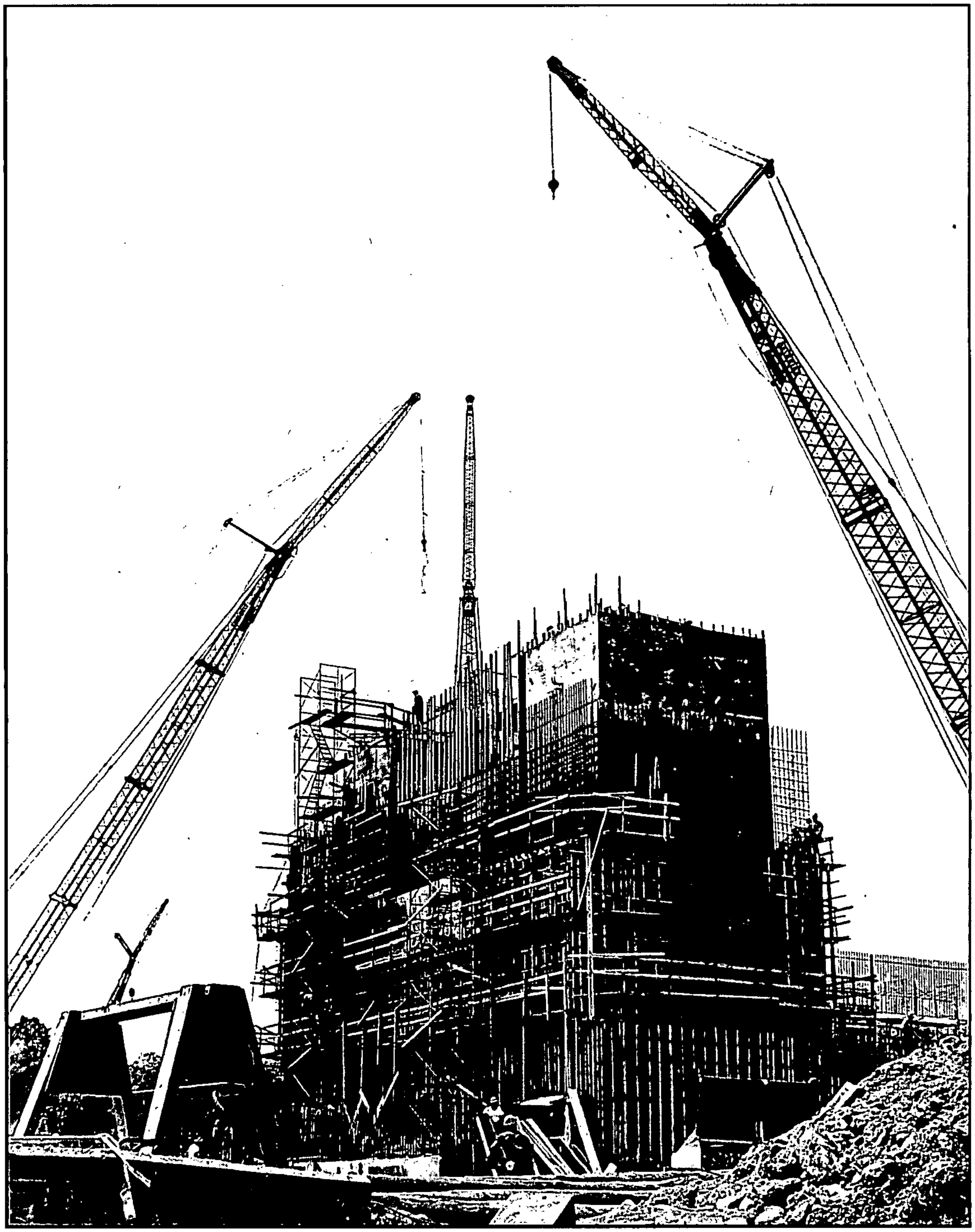
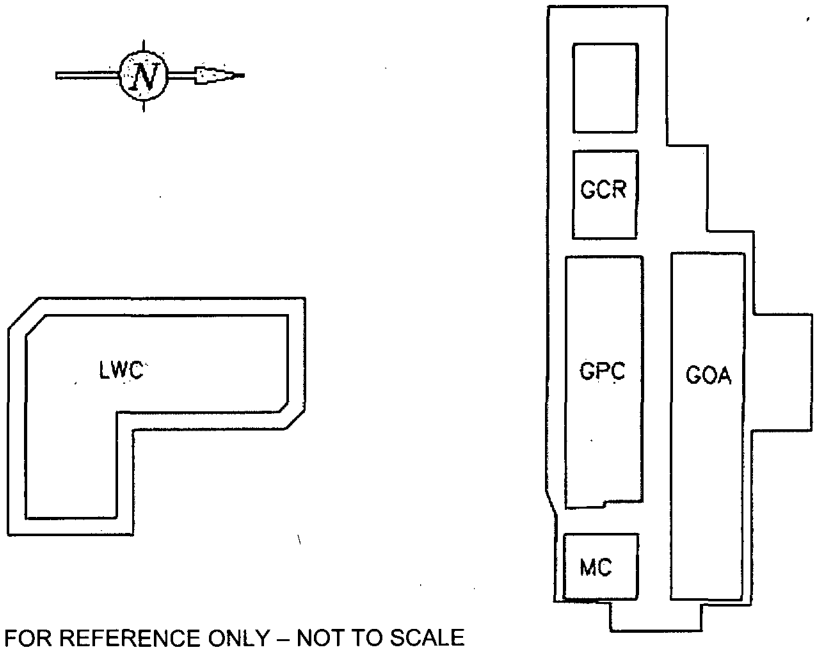


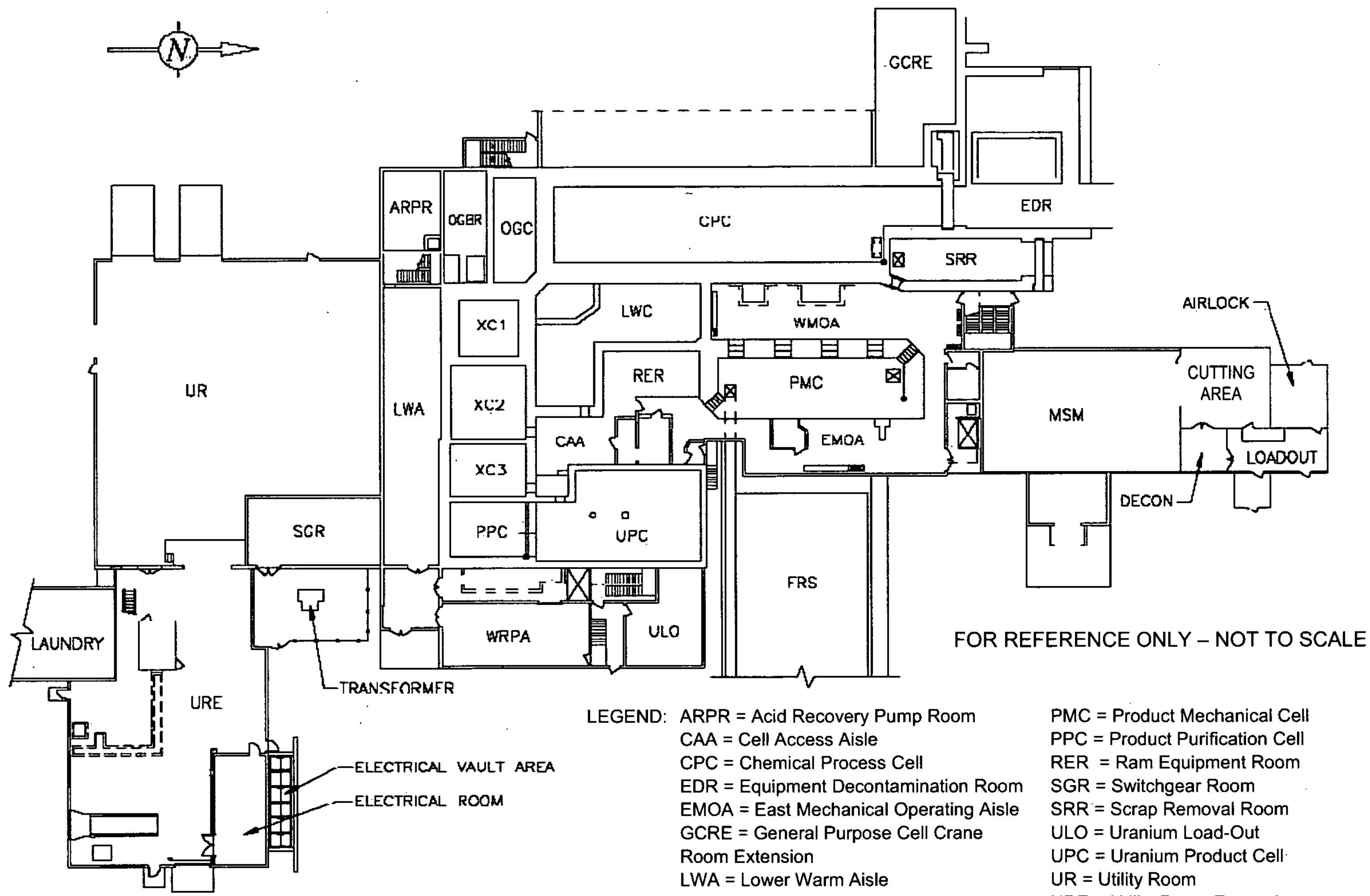
Figure 3-12. Construction of the Process Building.



FOR REFERENCE ONLY – NOT TO SCALE

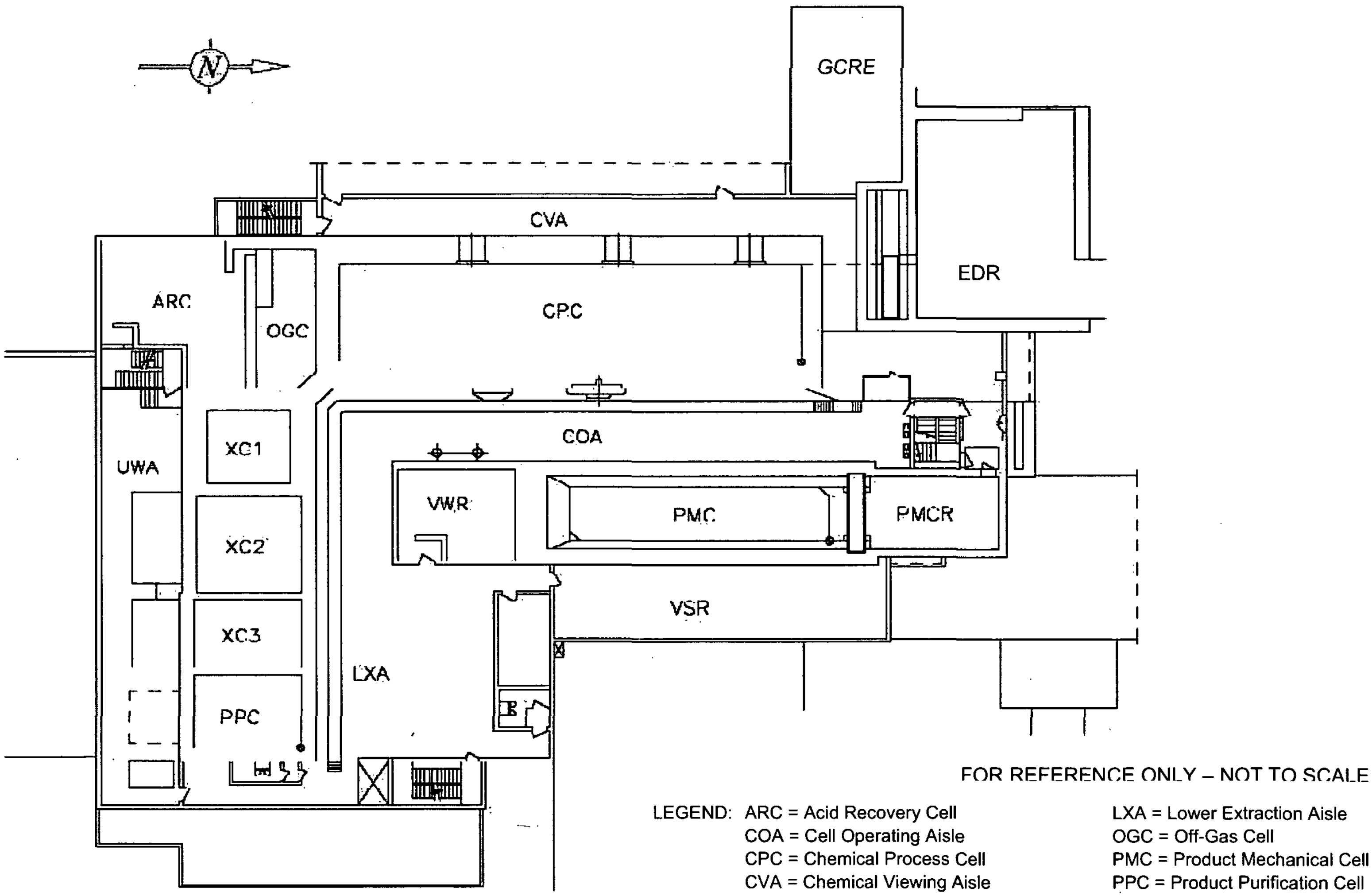
LEGEND: GCR = General Purpose Cell Crane Room
GOA = General Purpose Cell Operating Aisle
GPC = General Purpose Cell
LWC = Liquid Waste Cell
MC = Miniature Cell

Figure 3-13A. Process Building Layout – Below Grade



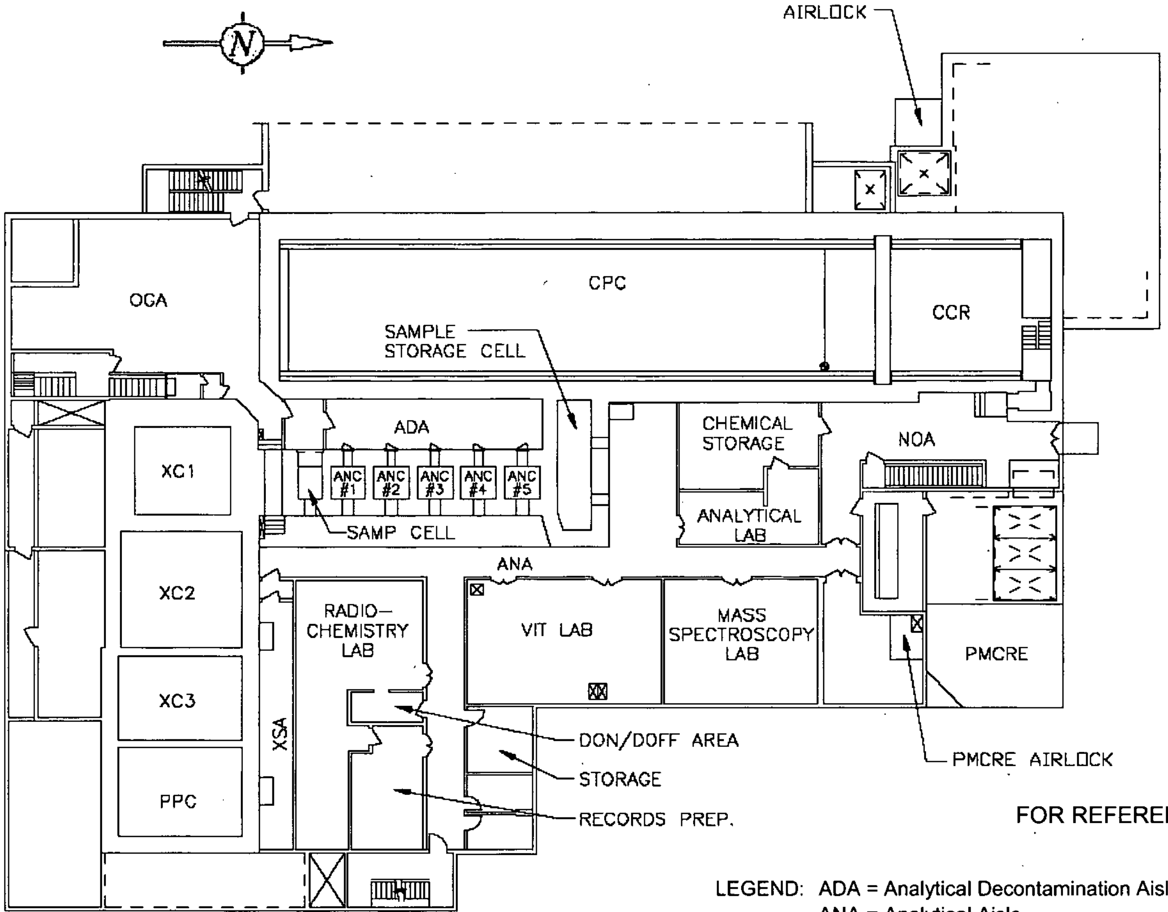
LEGEND:
ARPR = Acid Recovery Pump Room
CAA = Cell Access Aisle
CPC = Chemical Process Cell
EDR = Equipment Decontamination Room
EMOA = East Mechanical Operating Aisle
GCRE = General Purpose Cell Crane Room Extension
LWA = Lower Warm Aisle
LWC = Liquid Waste Cell
MSM = Manipulator Repair Shop
OGBR = Off-Gas Blower Room
OGC = Off-Gas Cell
PMC = Product Mechanical Cell
PPC = Product Purification Cell
RER = Ram Equipment Room
SGR = Switchgear Room
SRR = Scrap Removal Room
ULO = Uranium Load-Out
UPC = Uranium Product Cell
UR = Utility Room
URE = Utility Room Expansion
WMOA = West Mechanical Operating Aisle
WRPA = Waste Reduction & Packaging Area
XC = Extraction Cell

Figure 3-13B. Process Building Layout at 100-Foot Elevation



LEGEND:
ARC = Acid Recovery Cell
COA = Cell Operating Aisle
CPC = Chemical Process Cell
CVA = Chemical Viewing Aisle
EDR = Equipment Decontamination Room
GCRE = General Purpose Cell Crane Room Extension
LXA = Lower Extraction Aisle
OGC = Off-Gas Cell
PMC = Product Mechanical Cell
PPC = Product Purification Cell
PMCR = PMC Crane Room
VWR = Ventilation Wash Room
XC = Extraction Cell

Figure 3-13C. Process Building Layout at 114.5-Foot Elevation



FOR REFERENCE ONLY – NOT TO SCALE

Figure 3-13D. Process Building Layout at 131-Foot Elevation

LEGEND:
ADA = Analytical Decontamination Aisle
ANA = Analytical Aisle
ANC = Analytical Sample Cell
CCR = CPC Crane Room
CPC = Chemical Process Cell
NOA = North Operating Aisle
OGA = Off-Gas-Acid Recovery Aisle
PMCRE = Process Mechanical Cell Crane Room Enclosure
PPC = Product Purification Cell
XC = Extraction Cell

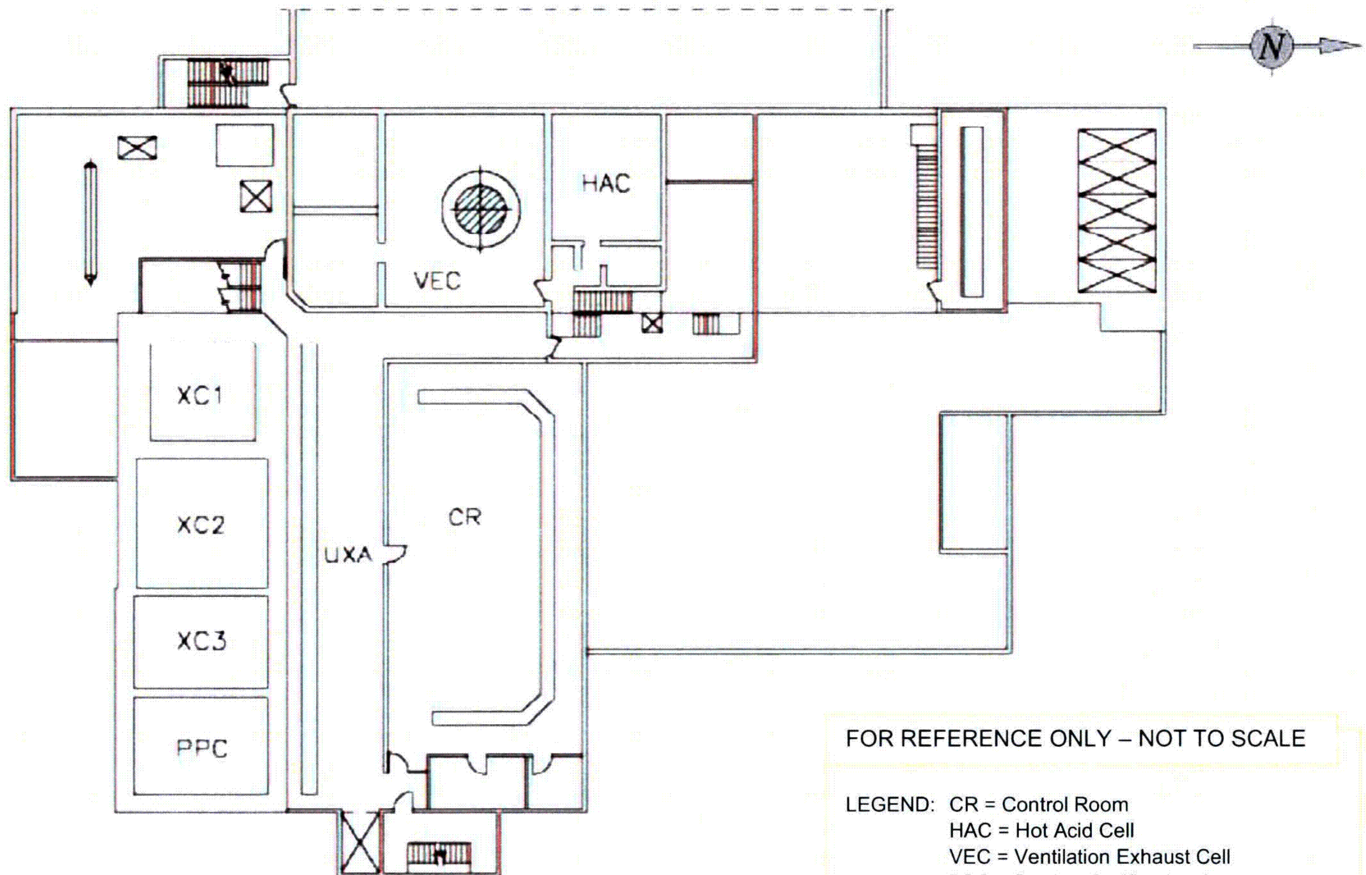
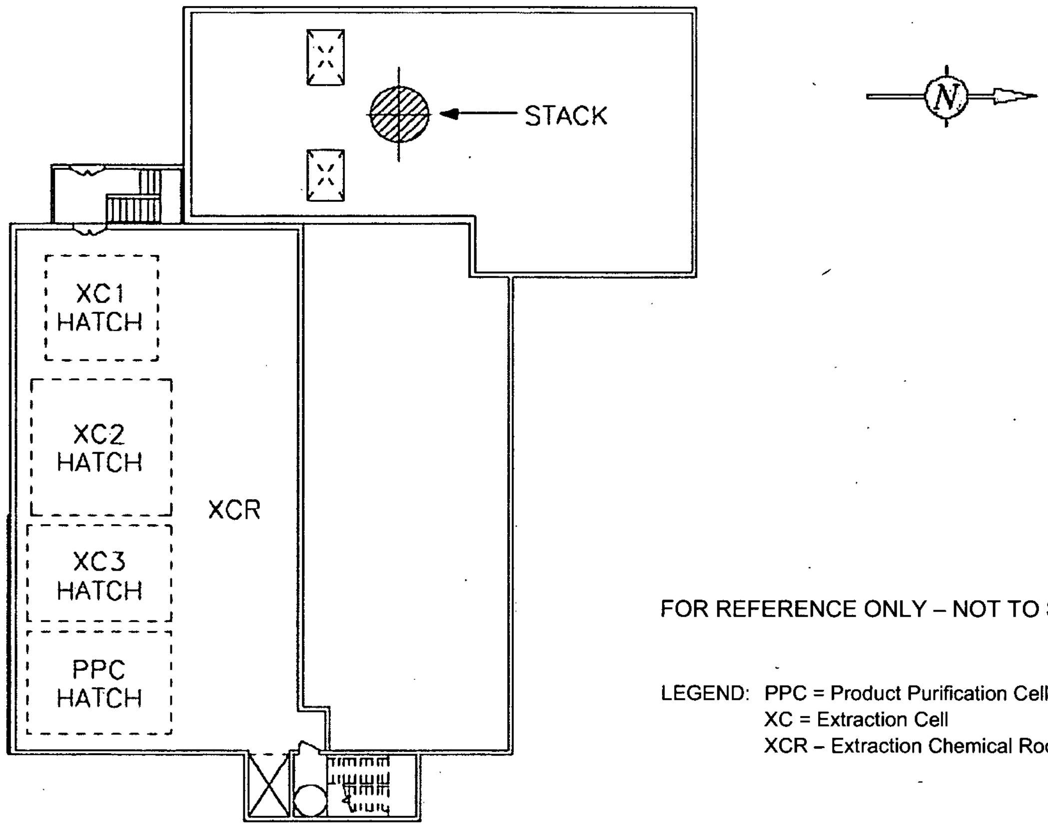


Figure 3-13E. Process Building Layout at 144-Foot Elevation

FOR REFERENCE ONLY – NOT TO SCALE

LEGEND:
CR = Control Room
HAC = Hot Acid Cell
VEC = Ventilation Exhaust Cell
PPC = Product Purification Cell
UXA = Upper Extraction Aisle
VEC = Ventilation Exhaust Cell
XC = Extraction Cell



FOR REFERENCE ONLY – NOT TO SCALE

LEGEND: PPC = Product Purification Cell
XC = Extraction Cell
XCR – Extraction Chemical Room

Figure 3-13F. Process Building Layout at 160-Foot Elevation

Figure 3-14. West Side of the Process Building. (The building with windows is actually the Plant Office Building. The plant part of the Process Building is behind the Office Building

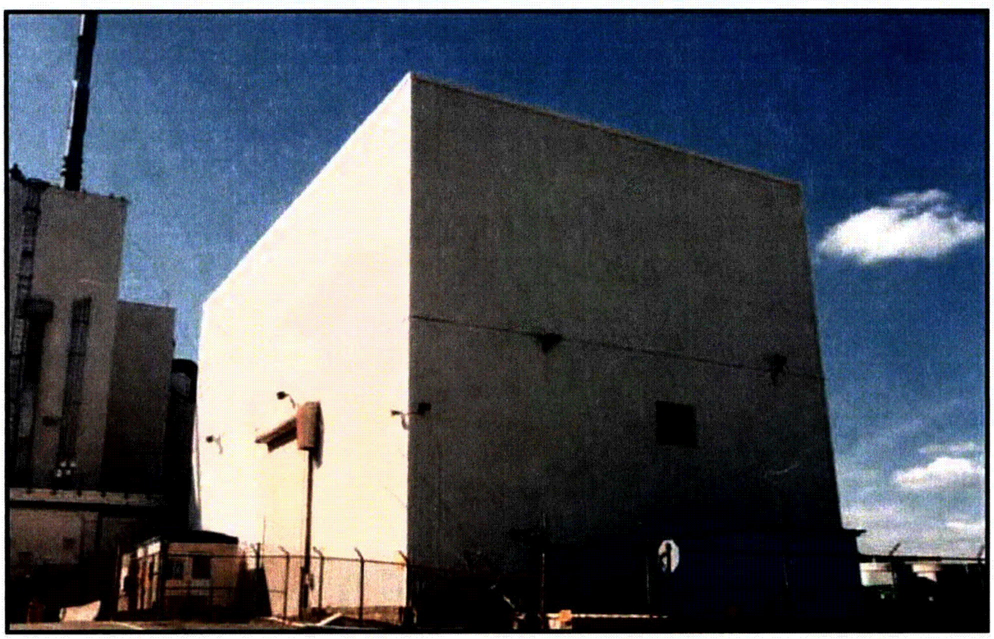


Figure 3-15. Fuel Receiving and Storage Area. (This facility is located on the east side of the Process Building.)

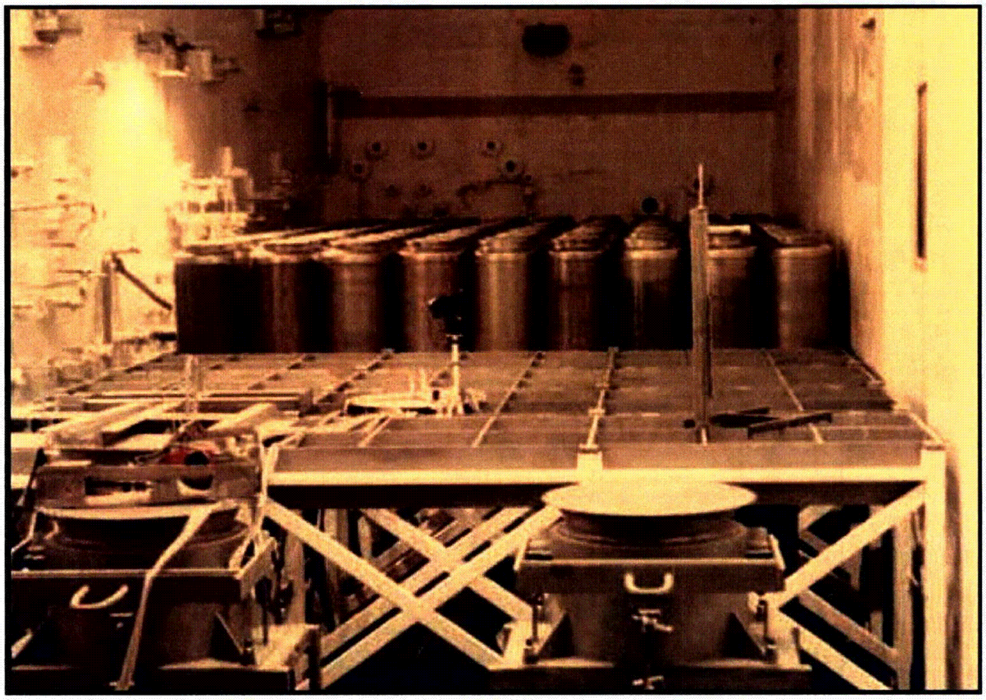


Figure 3-16. HLW Canisters Stored in the HLW Interim Storage Area

Figure 3-17. Conditions in the General Purpose Cell in 1999. (These were the conditions before the beginning of cleanup in connection with deactivation.)

Figure 3-18. Process Mechanical Cell During Activation

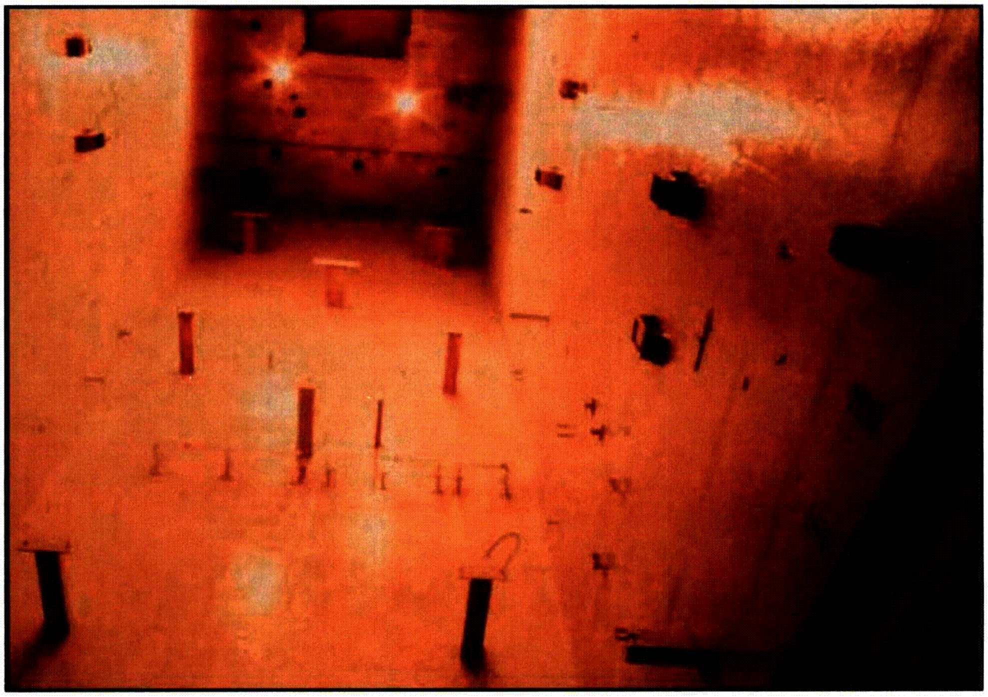


Figure 3-19. Extraction Cell 3 (After removal of processing equipment and before installation of the WVDP Liquid Waste Treatment System Equipment)

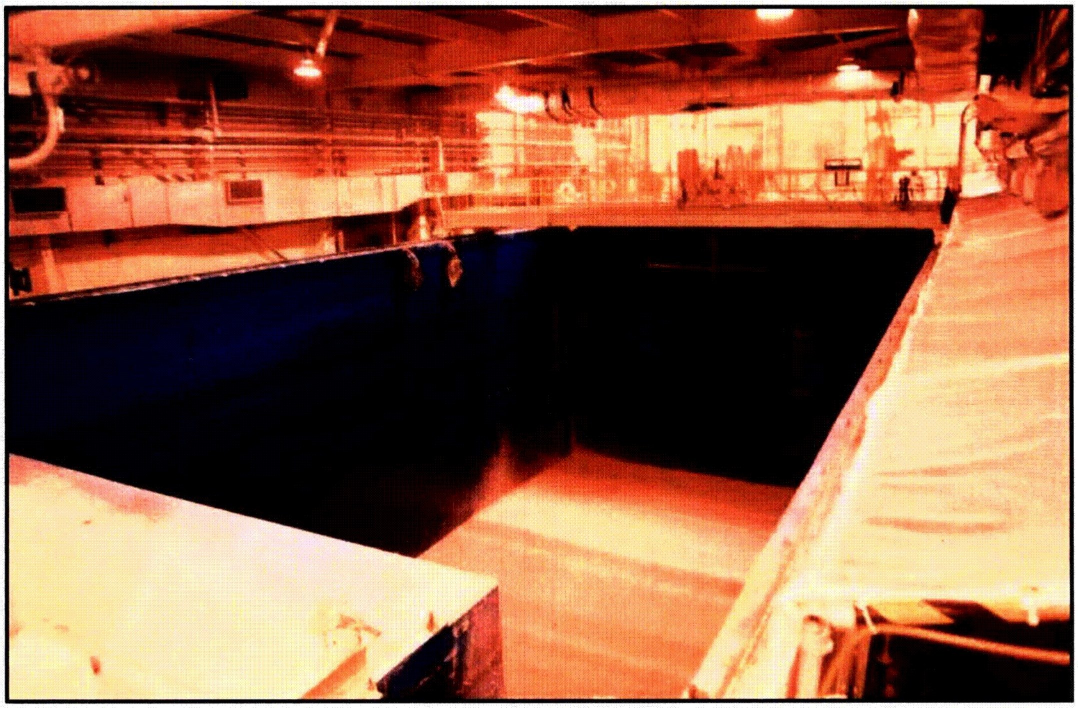


Figure 3-20. The Spent Fuel Pool After Deactivation

Figure 3-21. Equipment Decontamination Room Before Cleanup

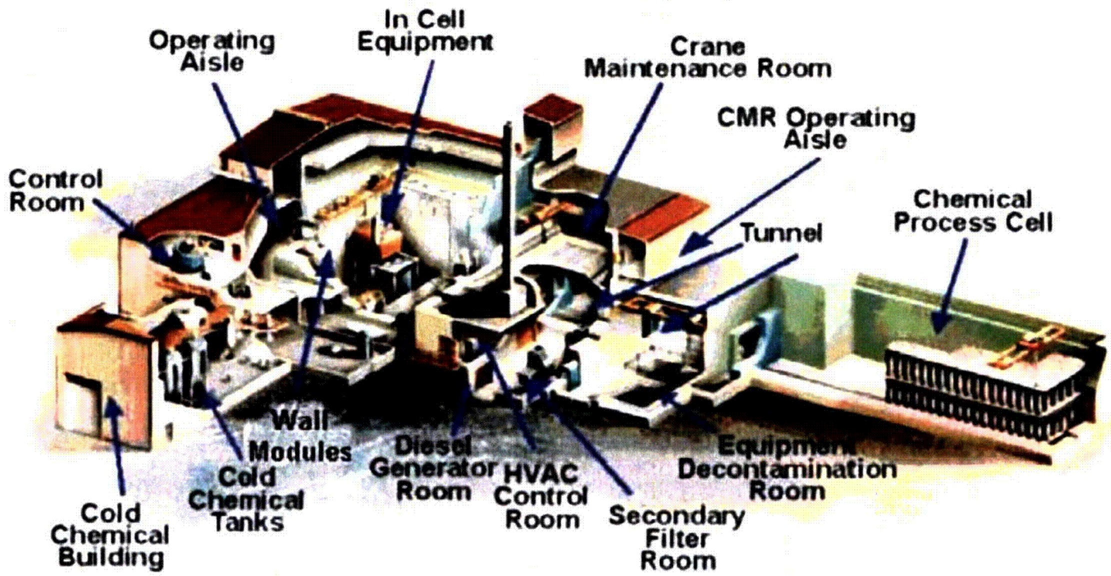


Figure 3-22. Vitrification Facility General Arrangement

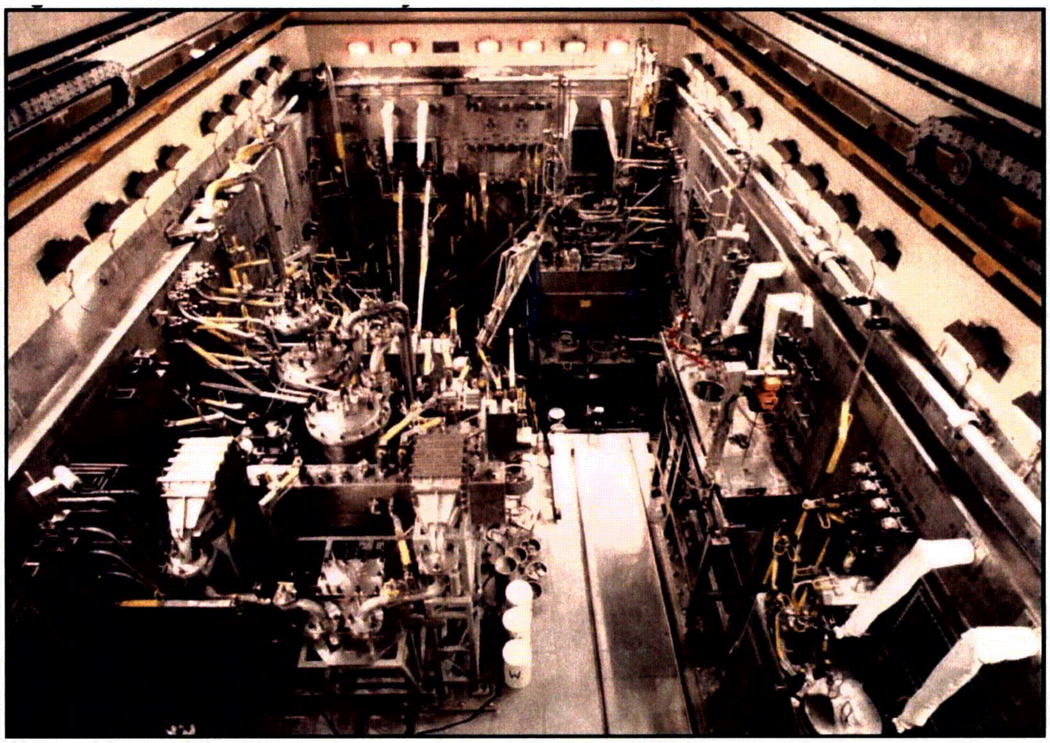


Figure 3-23. Vitrification Cell at Time of Startup

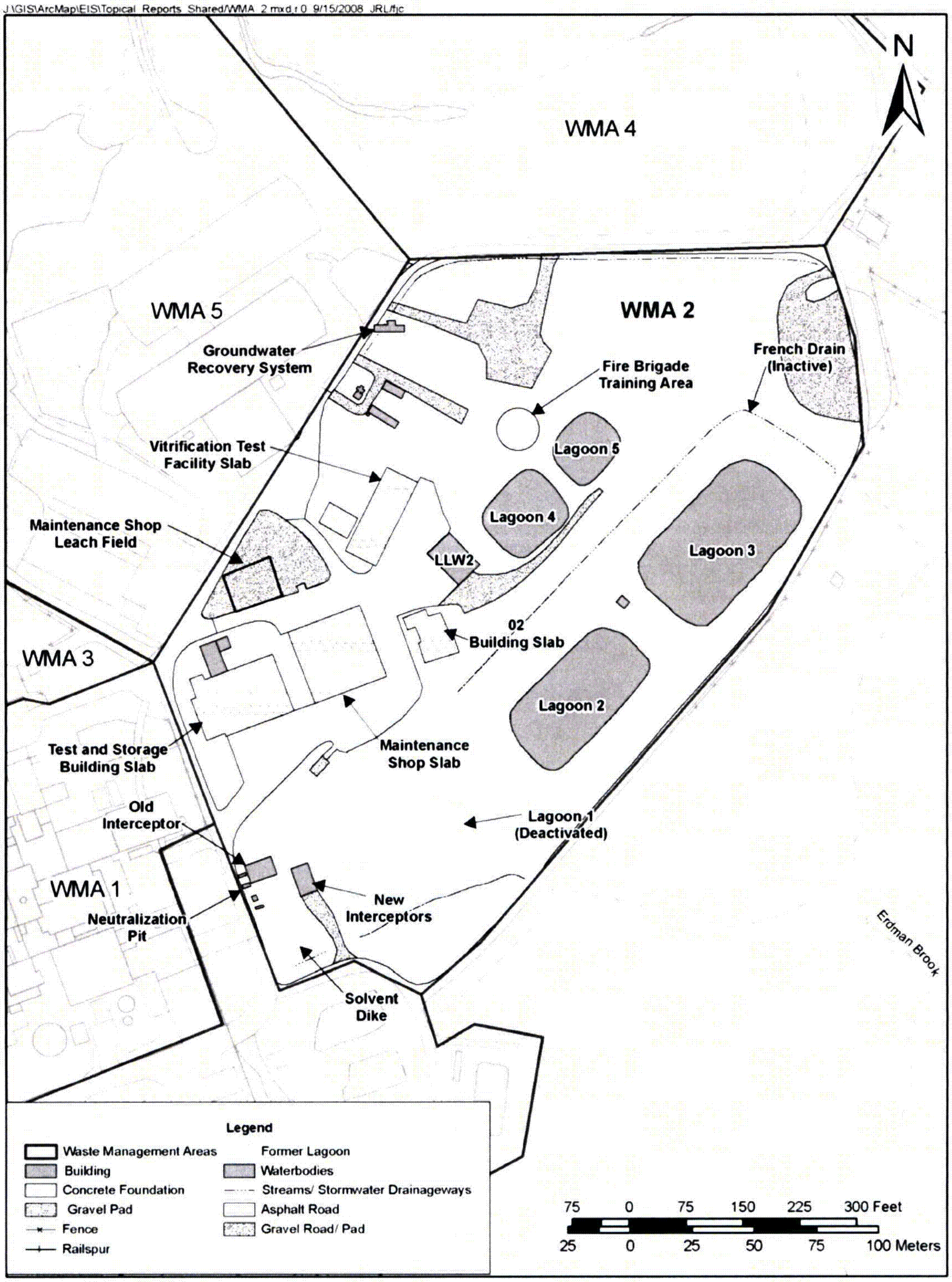


Figure 3-24. WMA 2. (The facilities to be removed during Phase 1 Decommissioning activities include the Neutralization Pit, Interceptors, Lagoons, and remaining slabs.)

Figure 3-25. The Low-Level Waste Treatment Facility. (This photo shows the site in 1982, looking toward the southwest.)

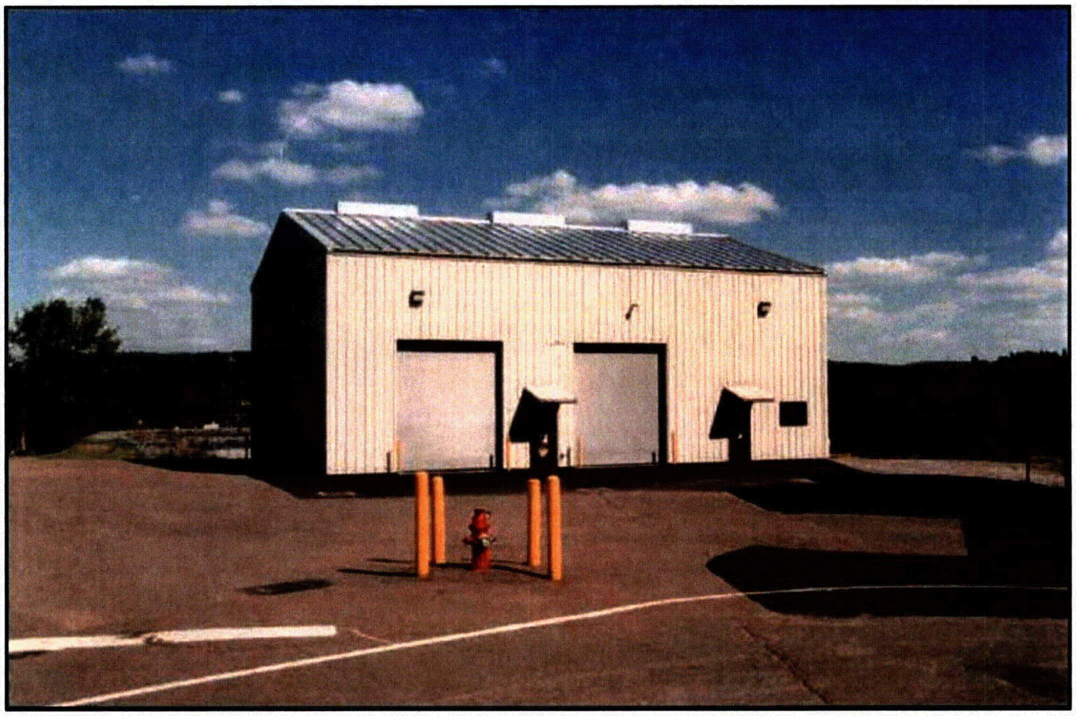


Figure 3-26. The LLW2 Building that Replaced the O2 Building

Figure 3-27. The Lagoon 1 Area. (Radioactive debris was placed in Lagoon 1 when it was closed in 1985.)

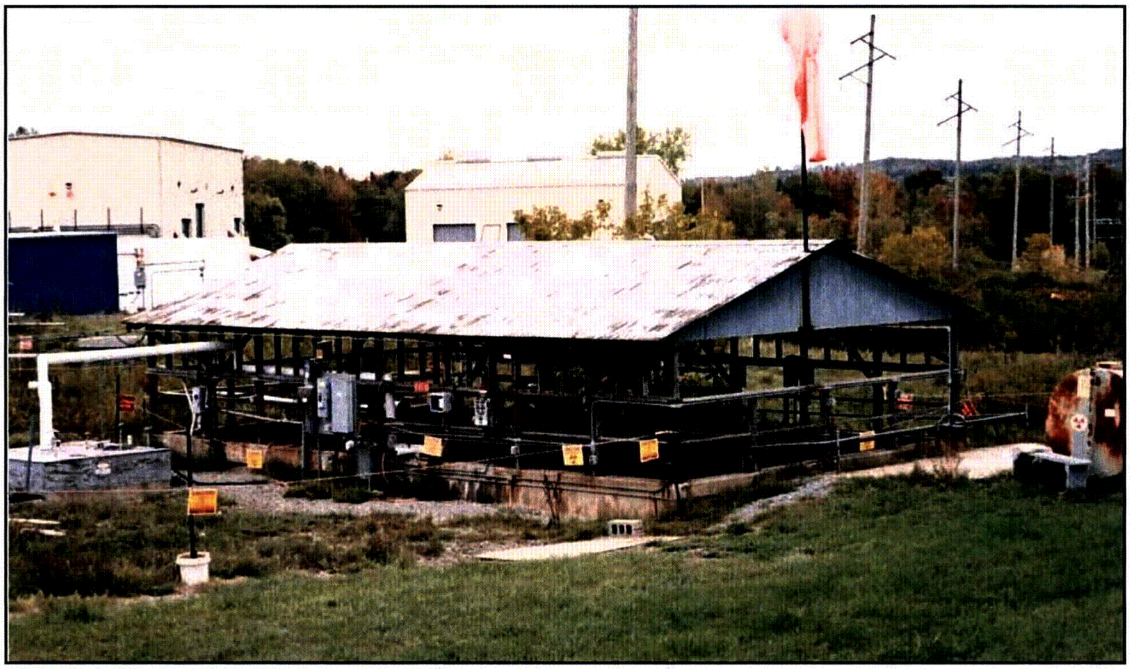


Figure 3-28. The New Interceptors. (These are twin stainless-steel lined concrete holding tanks.)

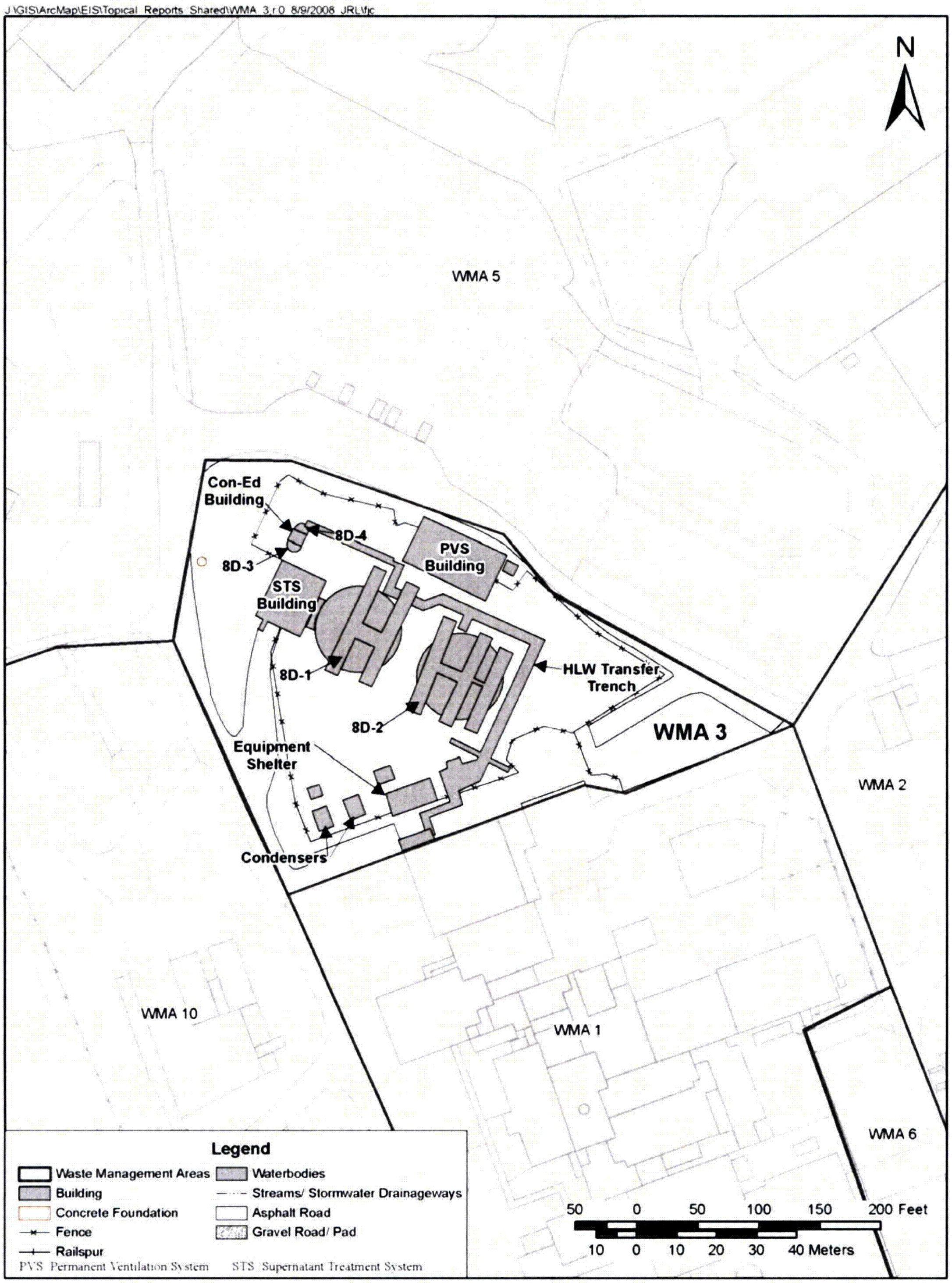


Figure 3-29. WMA 3. (Facilities to be removed during Phase 1 decommissioning activities include the Equipment Shelter, the condensers, the piping in the HLW transfer trench, and the Con-Ed Building.)

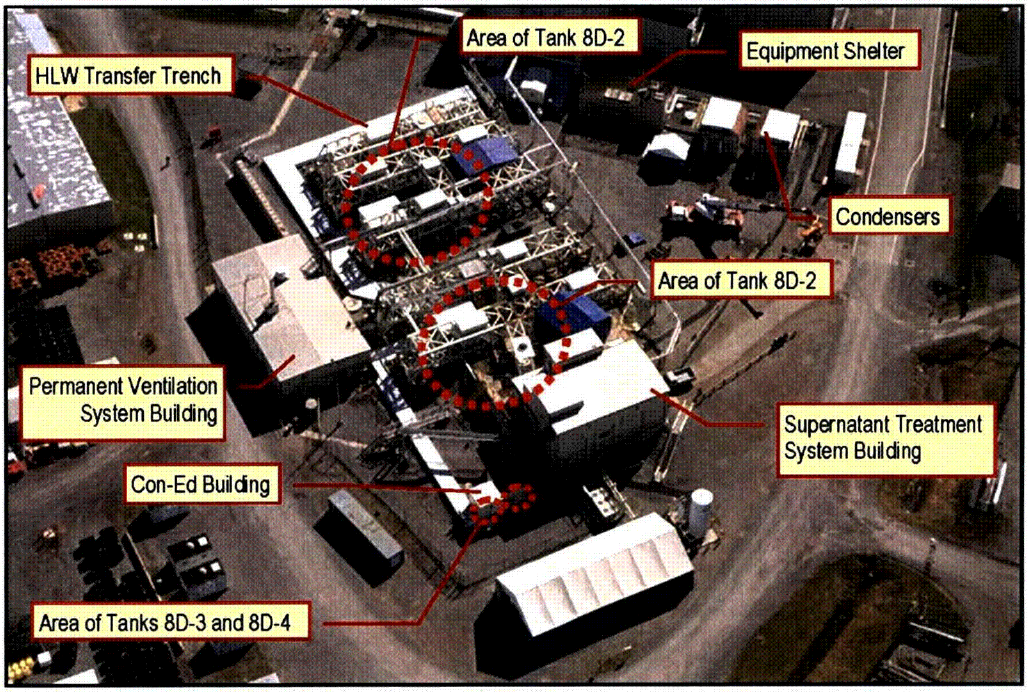


Figure 3-30. Aerial View of WMA 3 Area

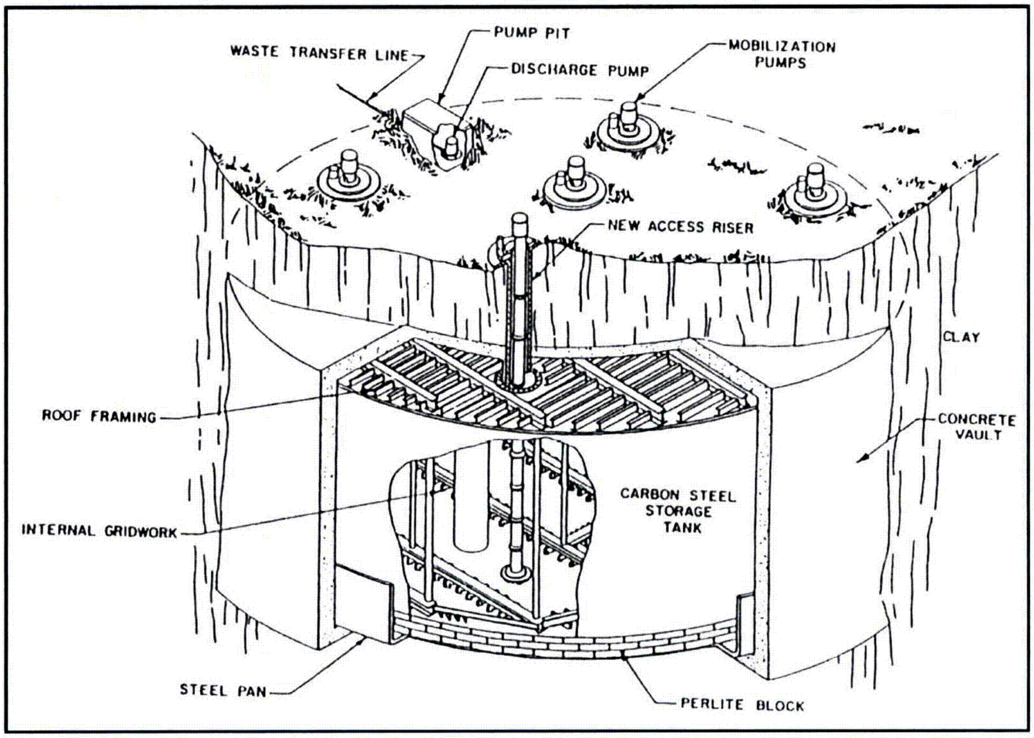
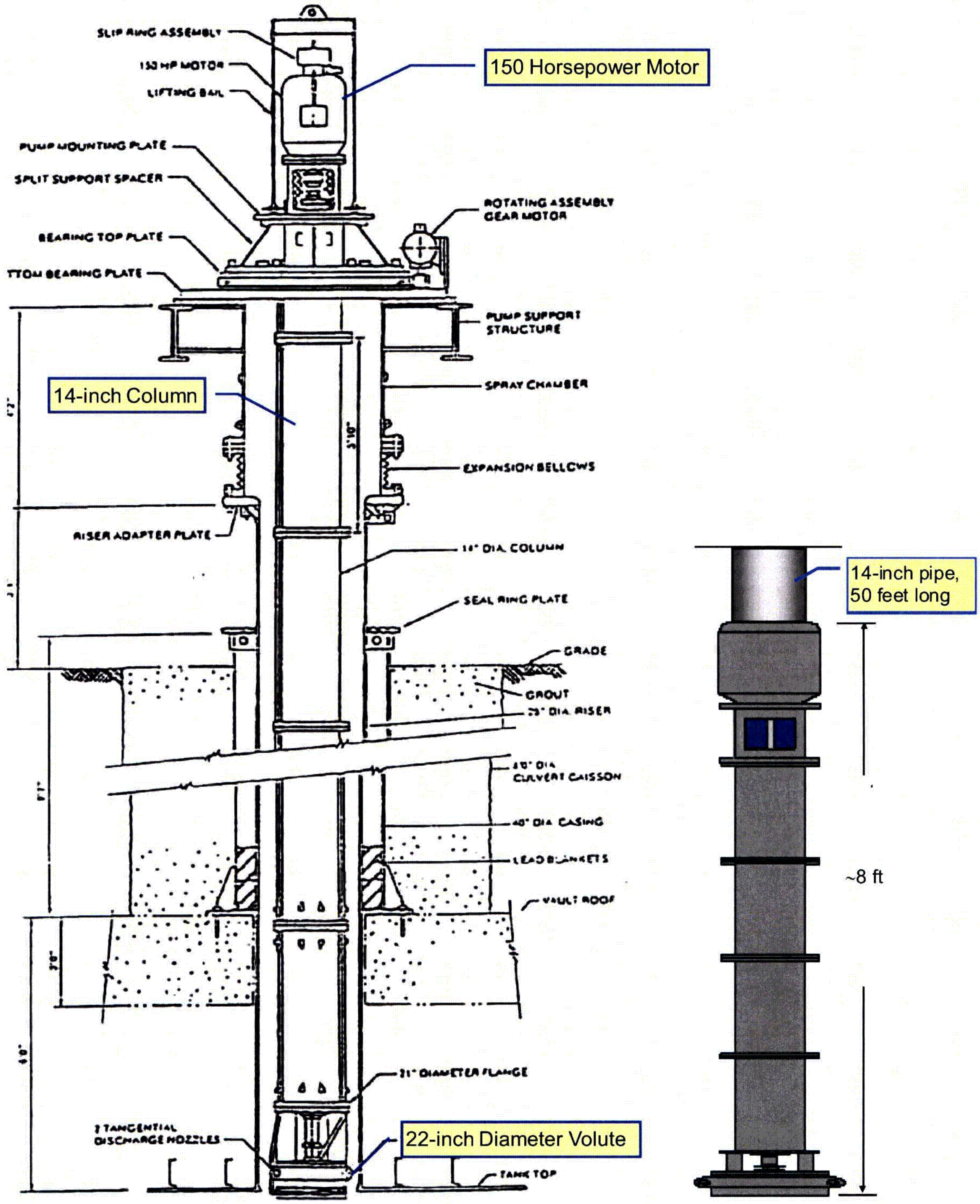


Figure 3-31. Cutaway View of 750-Gallon Underground Waste Tank



Transfer Pump **Mobilization Pump**

Figure 3-32. HLW Transfer and Mobilization Pumps

Figure 3-33. HLW Transfer Trench Under Construction

Figure 3-34. Typical HLW Pump Pit

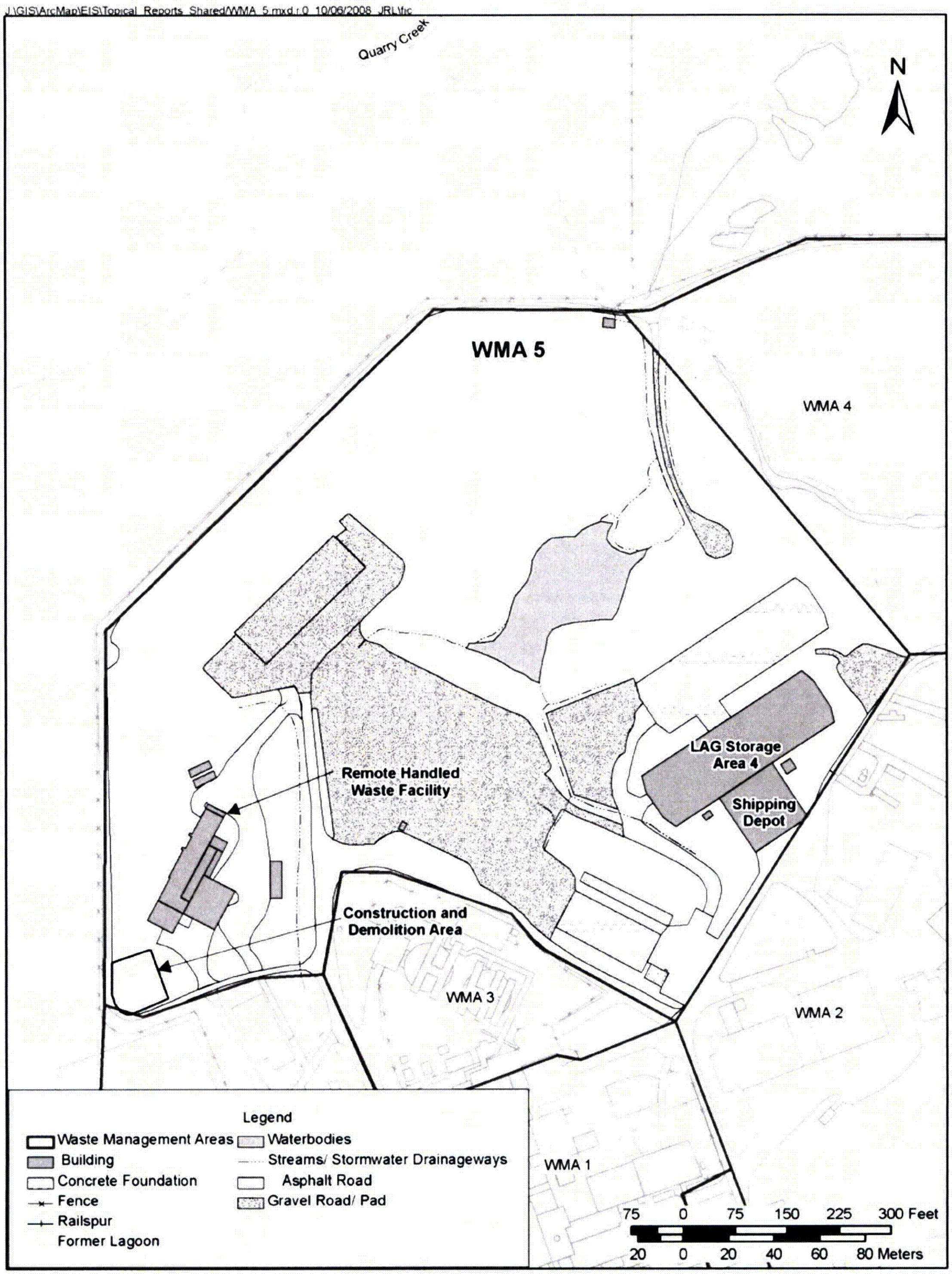


Figure 3-35. WMA 5. (Facilities to be removed during Phase 1 of the decommissioning include the Remote-Handled Waste Facility, Lag Storage Addition 4 and its Shipping Depot.)

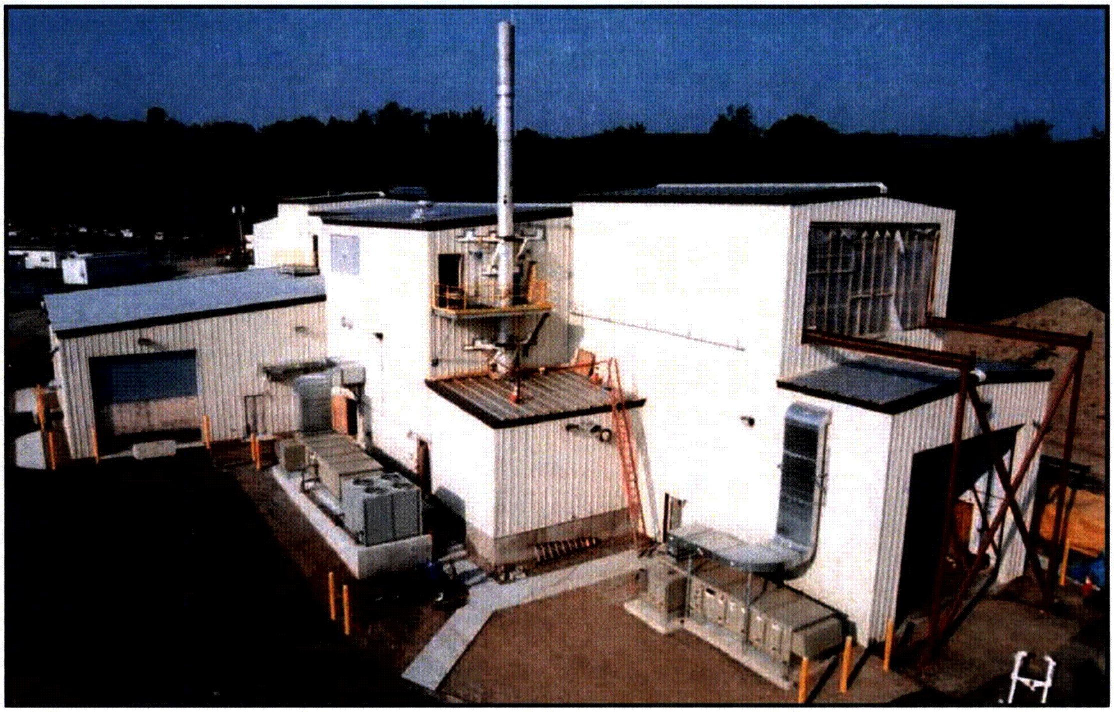


Figure 3-36. The Remote-Handled Waste Facility. (Placed into service in 2004, this new building may contain significant contamination at the time it is removed.)

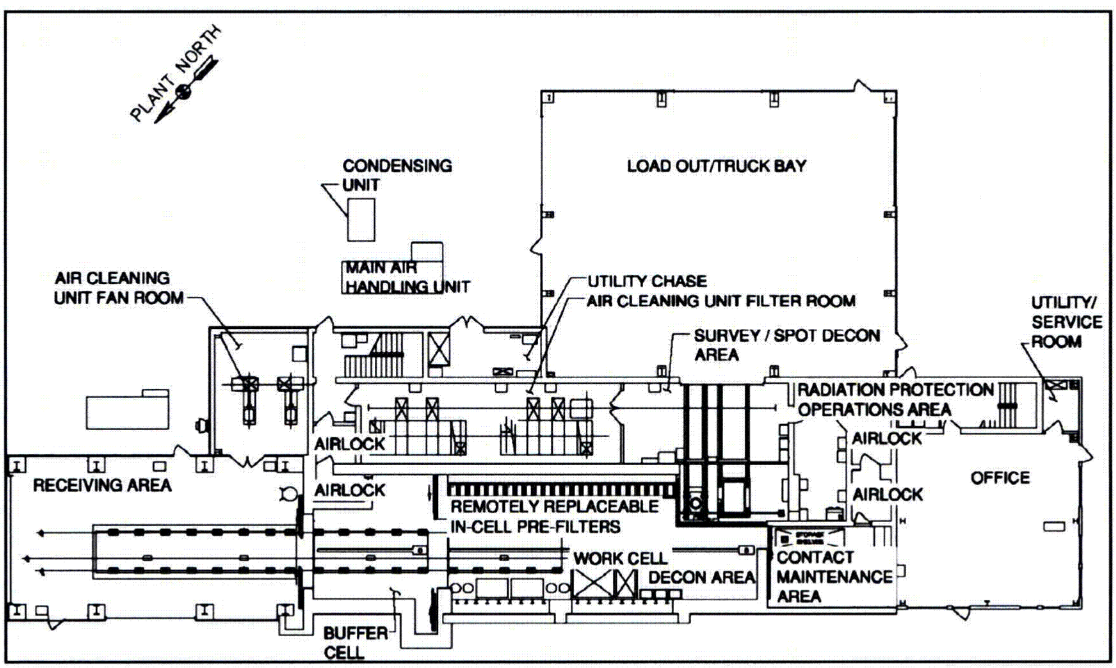


Figure 3-37. The Remote-Handled Waste Facility First Floor Layout.

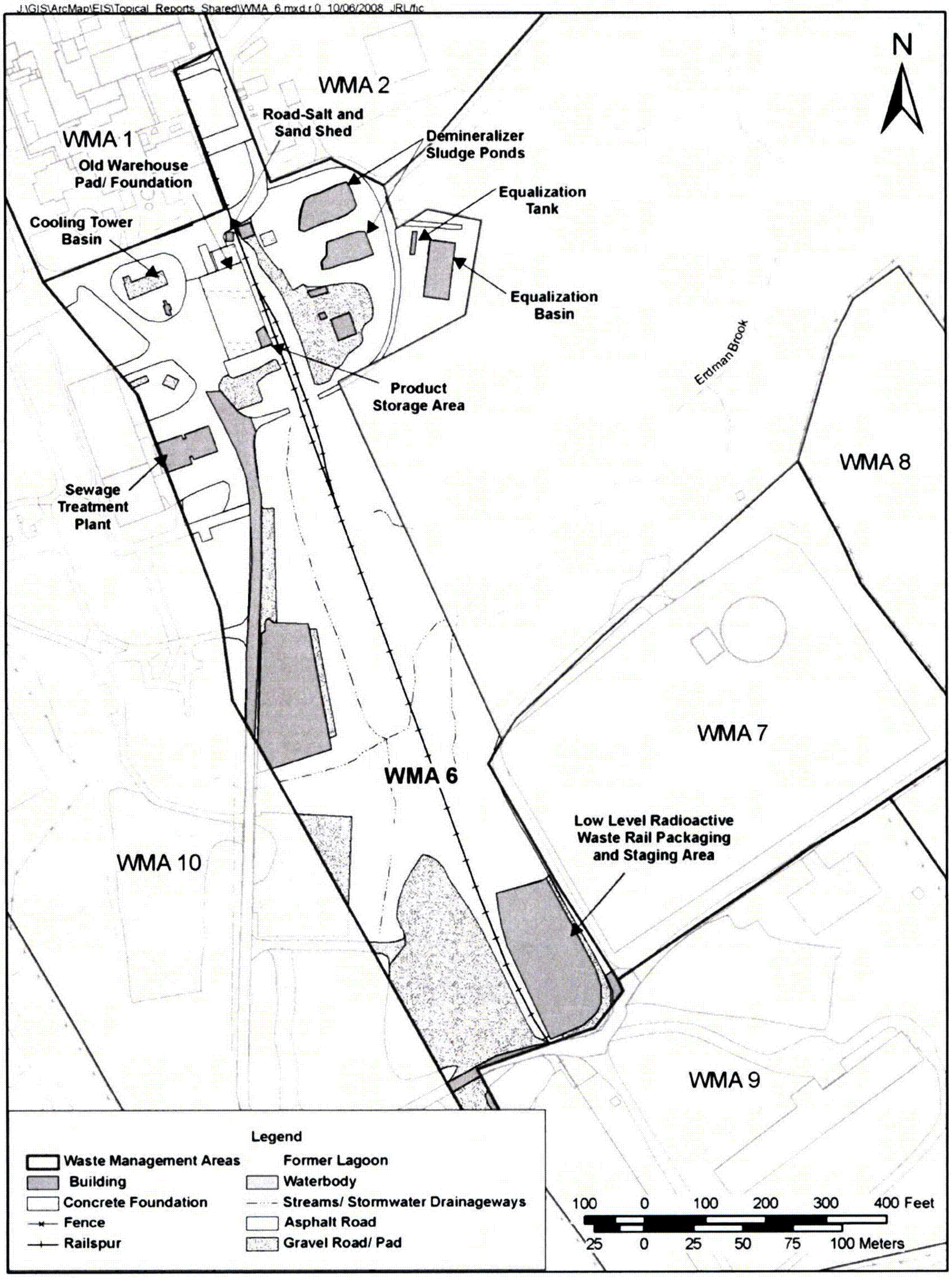


Figure 3-38. WMA 6. (Facilities to be removed during Phase 1 Decommissioning include the Demineralizer Sludge Ponds, the Sewage Treatment Plant, the Equalization Tank and Basin, the south Waste Tank Farm Training Platform, and the remaining slabs.)

Figure 3-39. The Rail Spur. (The rail spur leads to the Fuel Receiving and Storage Facility.)

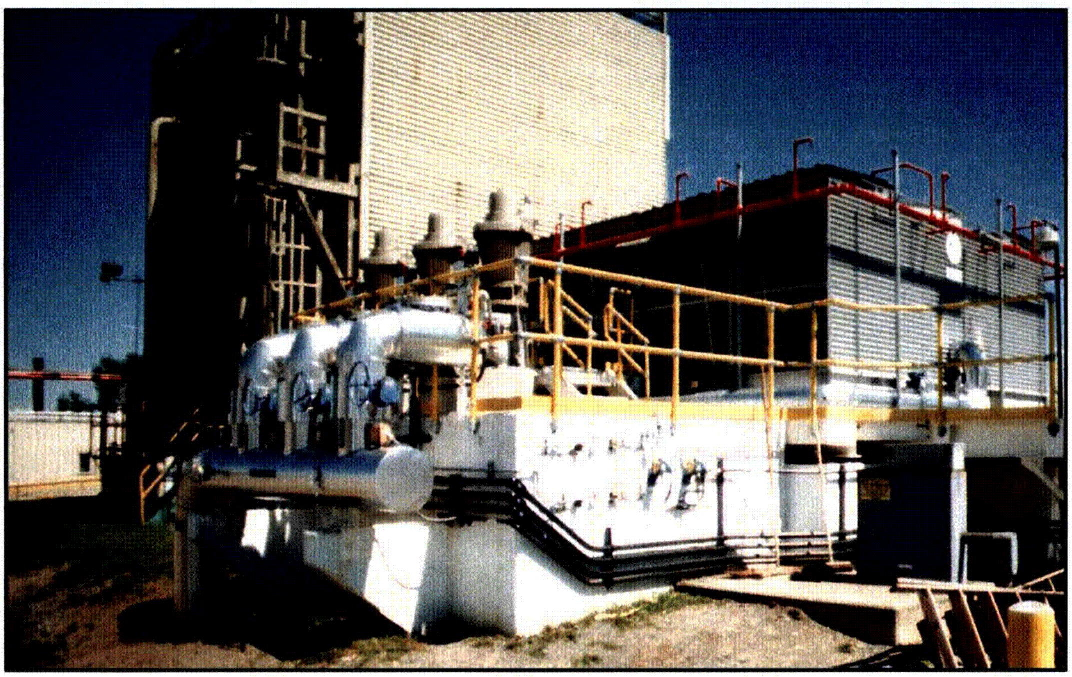


Figure 3-40. The New Cooling Tower. (The cooling tower will be removed, except for its concrete basin, before Phase 1 decommissioning activities begin.)

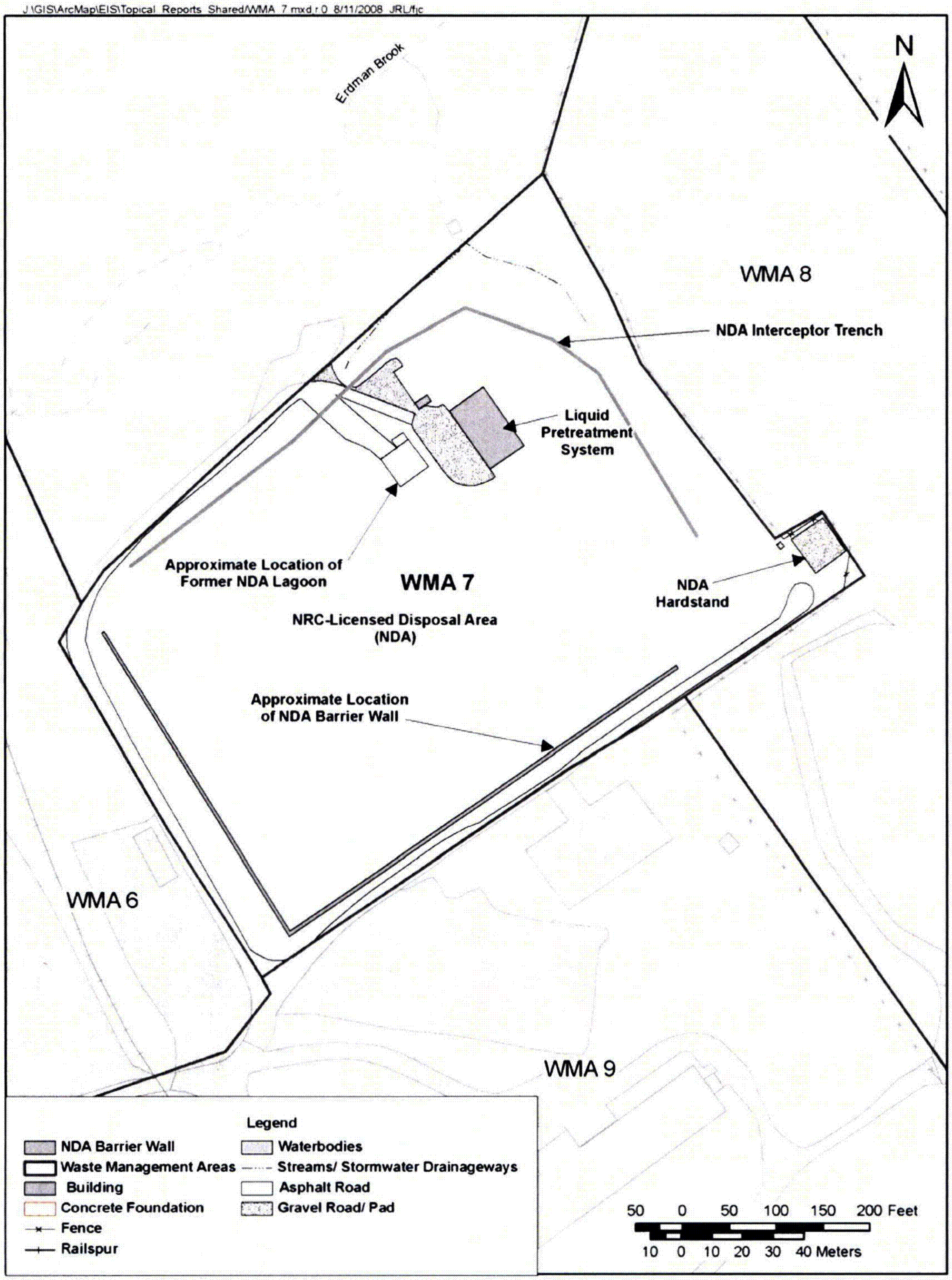


Figure 3-41. WMA 7. (The only facility to be removed during Phase 1 of the decommissioning is the NDA hardstand pad.)

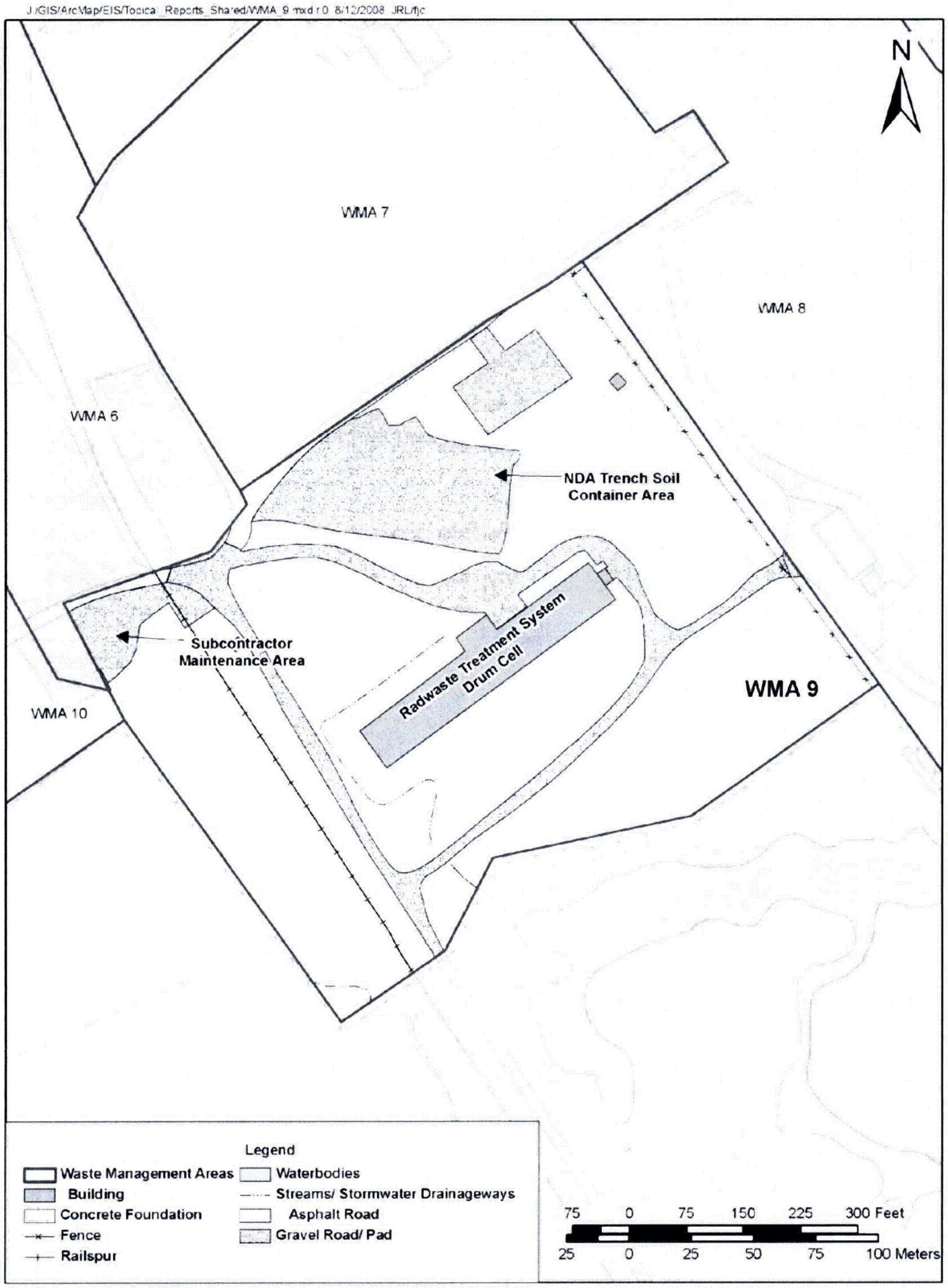


Figure 3-42. WMA 9. (The Drum Cell would be removed during Phase 1 of the proposed decommissioning, along with NDA Trench Soil Container Area and the Subcontractor Maintenance Area.)

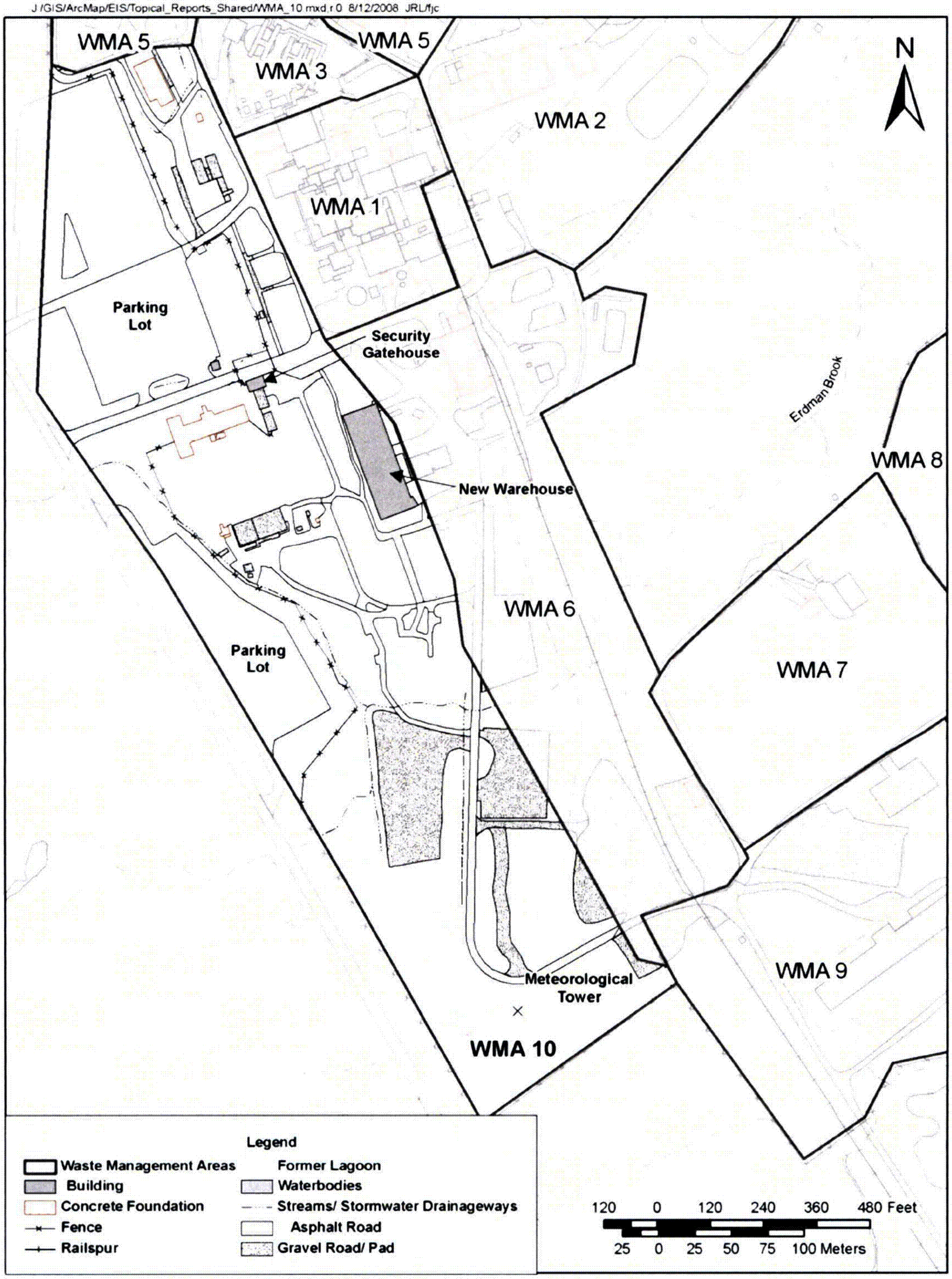


Figure 3-43. WMA 10. (Facilities to be removed during Phase 1 of the decommissioning include the New Warehouse and the remaining slabs and pads.)

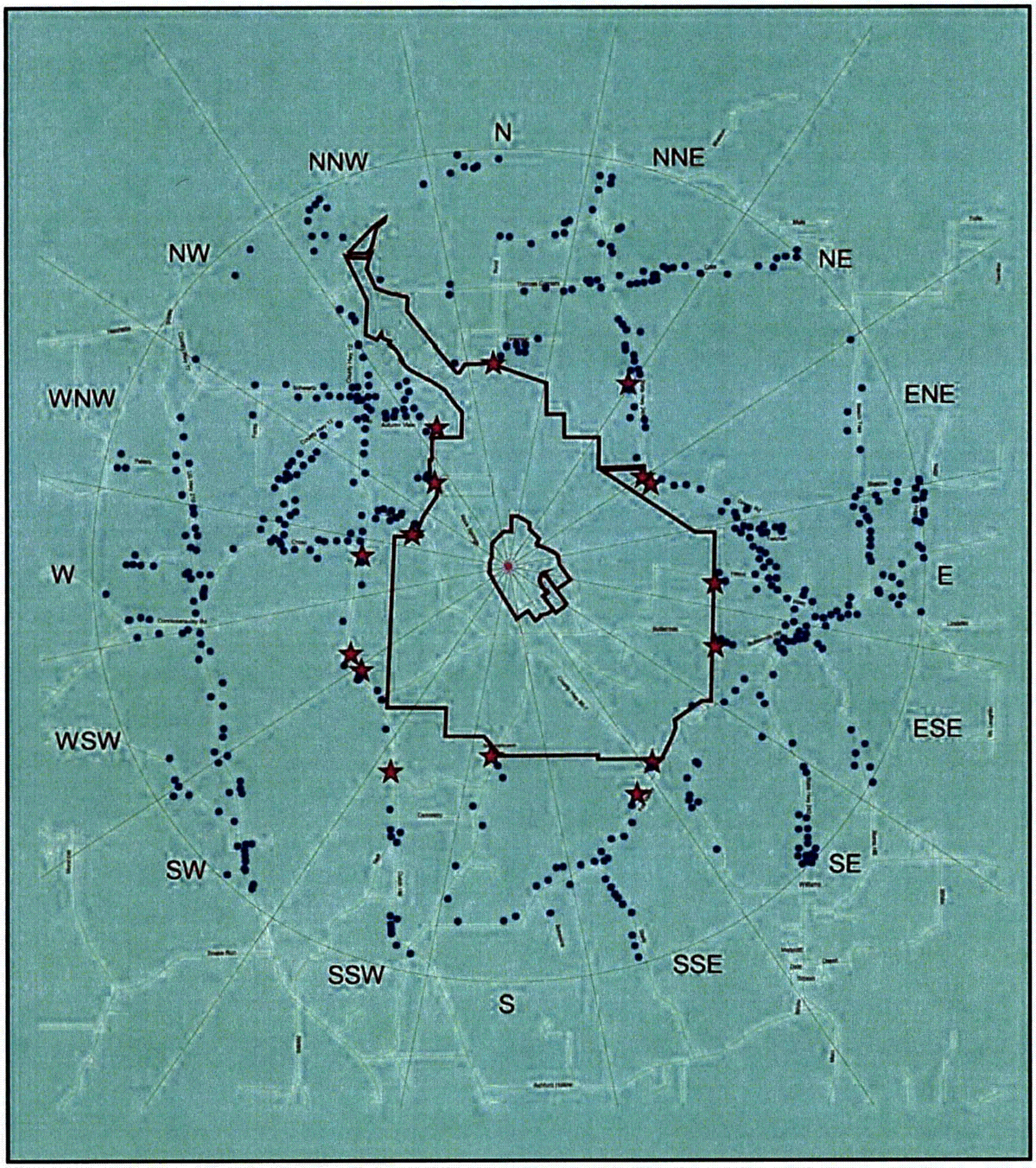


Figure 3-44. Population Around the WVDP by Compass Vector. (The dots represent residences. The stars show the nearest residences by compass vector.)

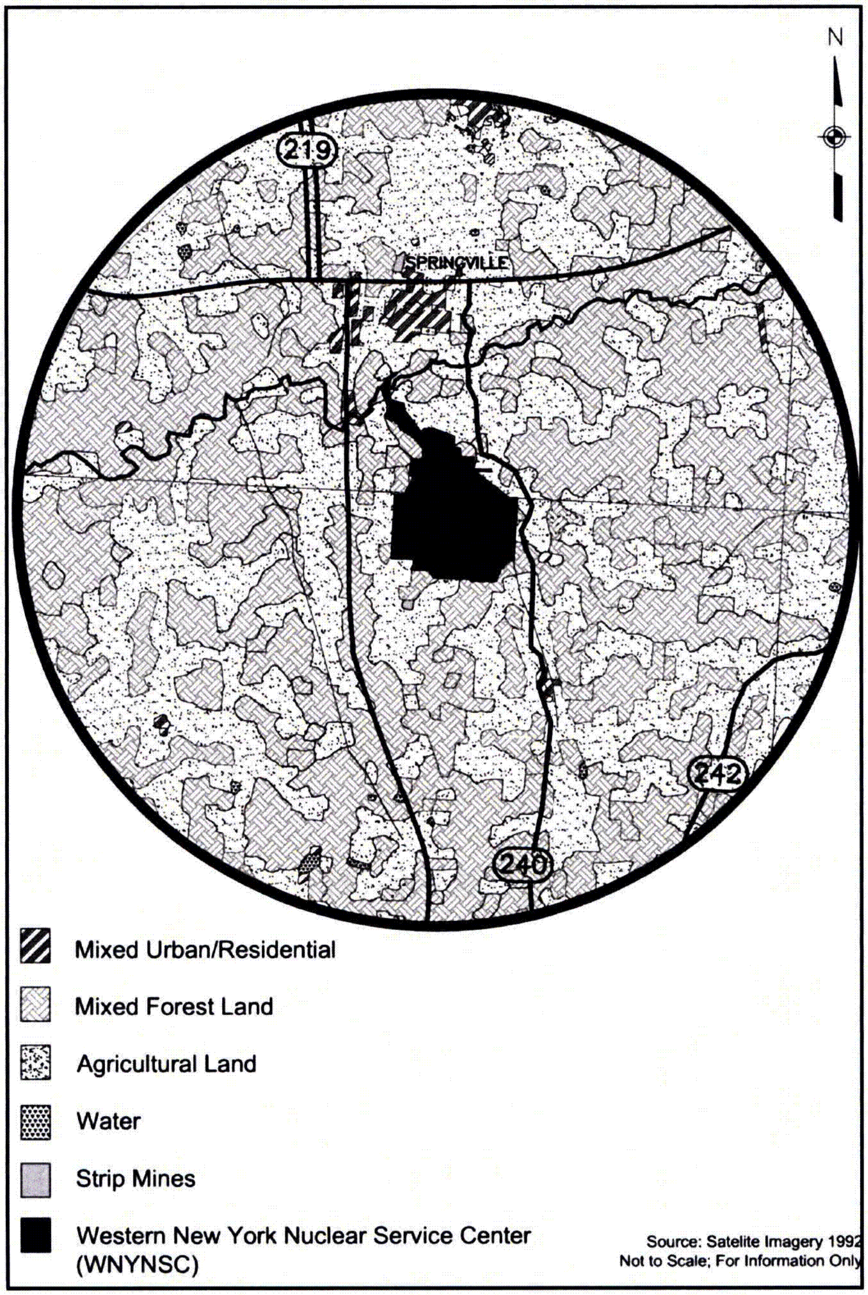


Figure 3-45. Land Use in the Vicinity of the Center

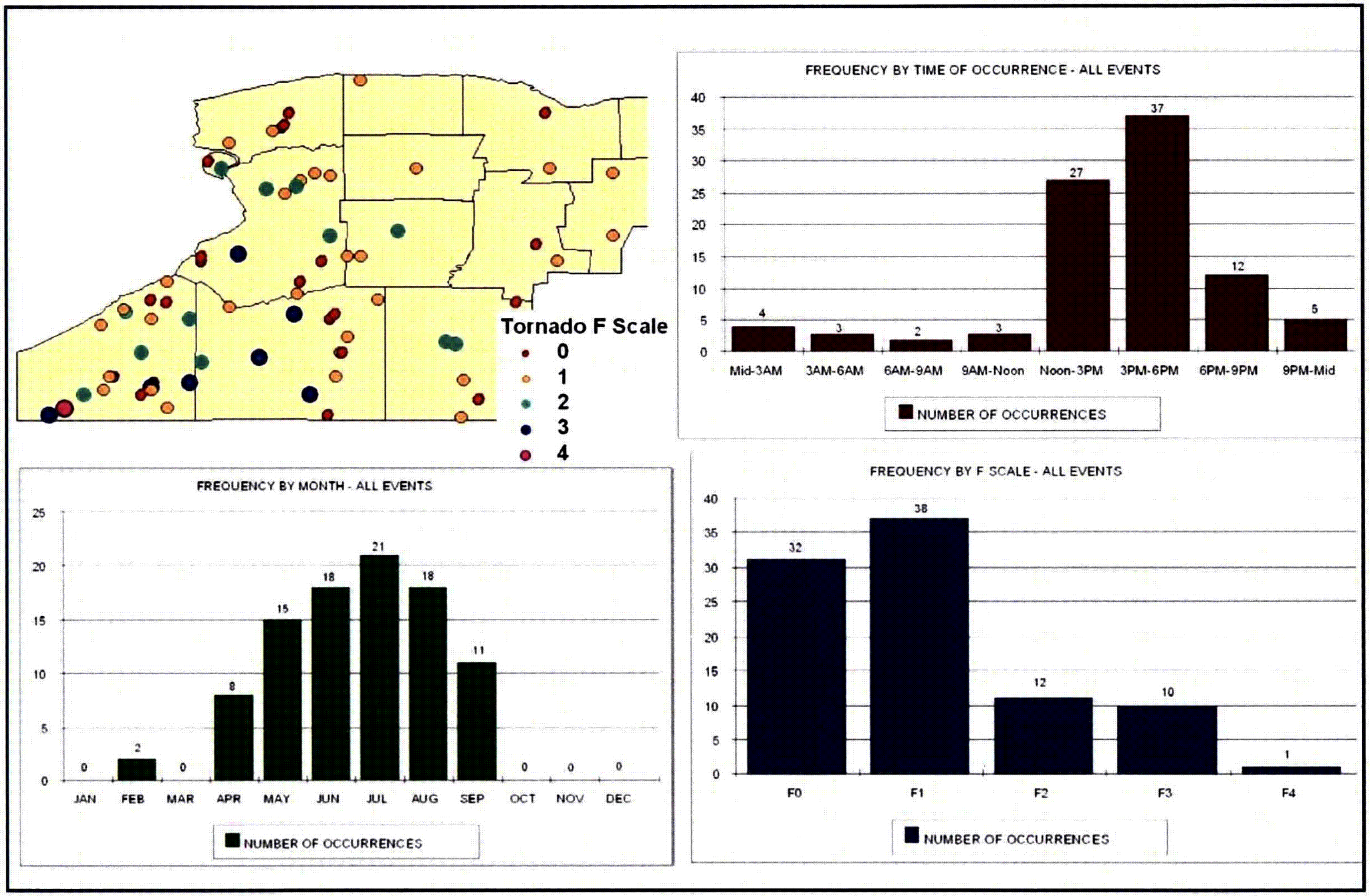


Figure 3-46. Tornado Events in Western New York (1950 – 2002) (From National Weather Service, Buffalo)

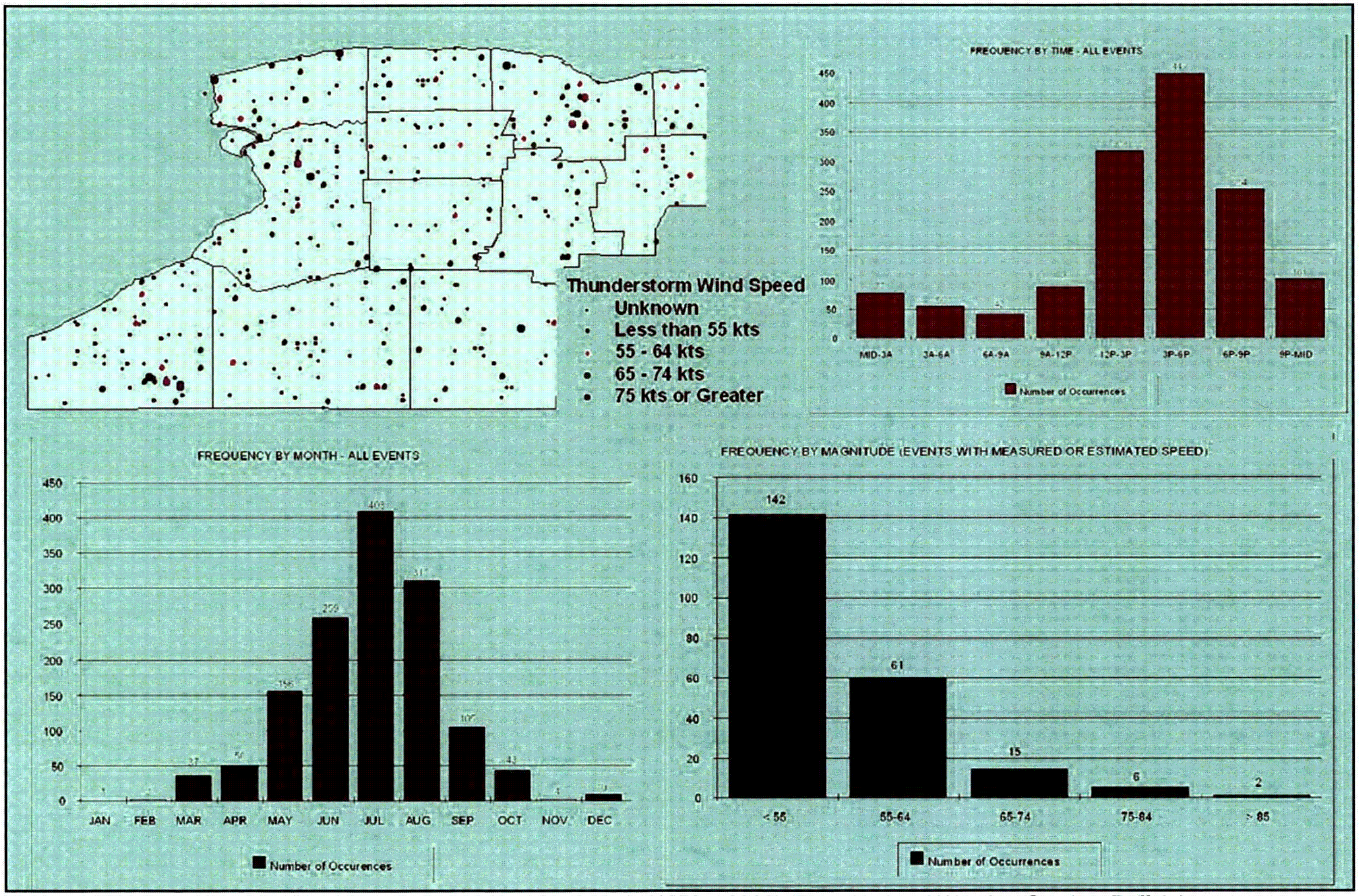


Figure 3-47. Thunderstorm Wind Events in Western New York (1950 – 2002) (From National Weather Service, Buffalo)

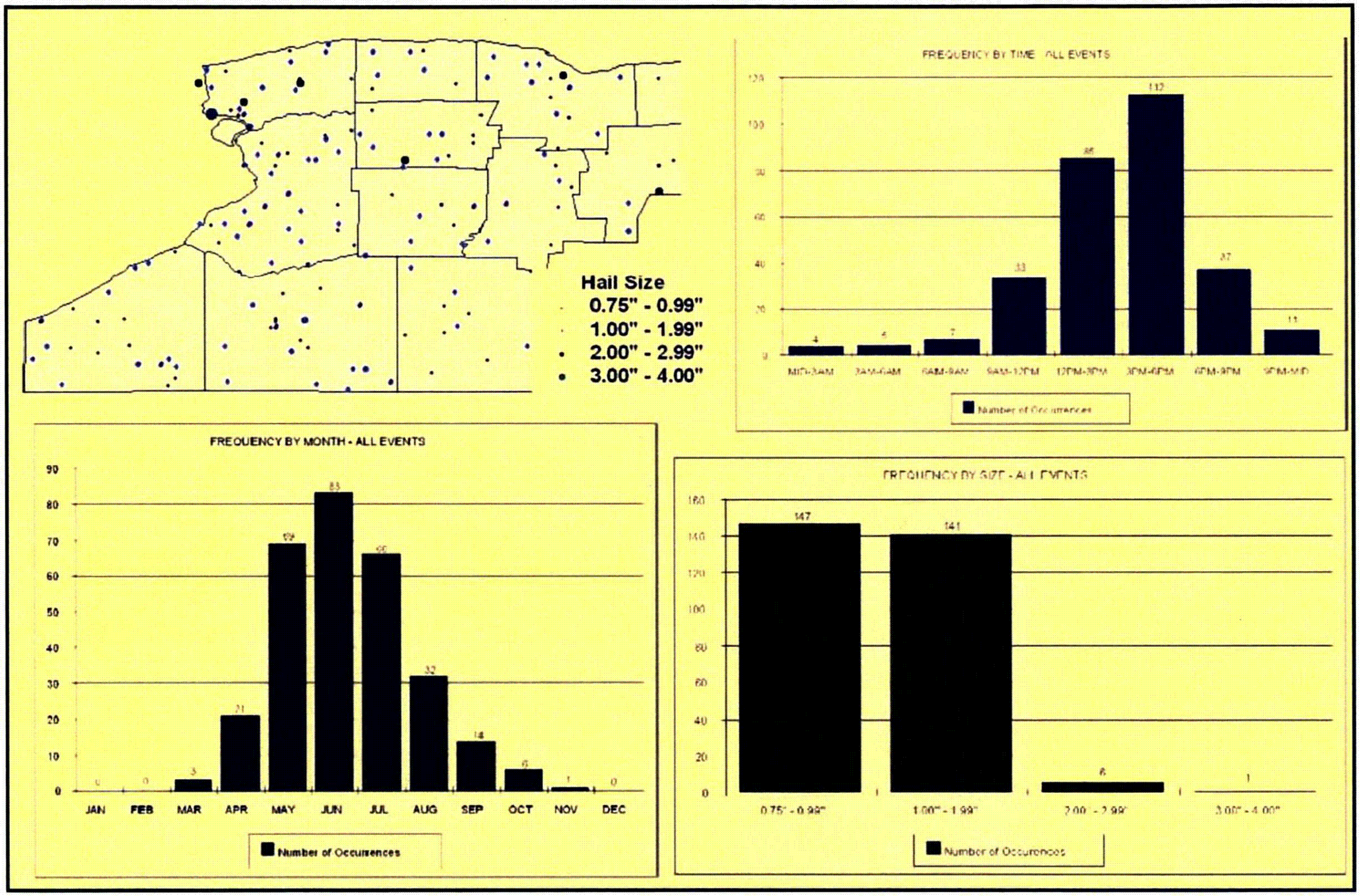


Figure 3-48. Hail Events in Western New York (1950 – 2002) (From National Weather Service, Buffalo)

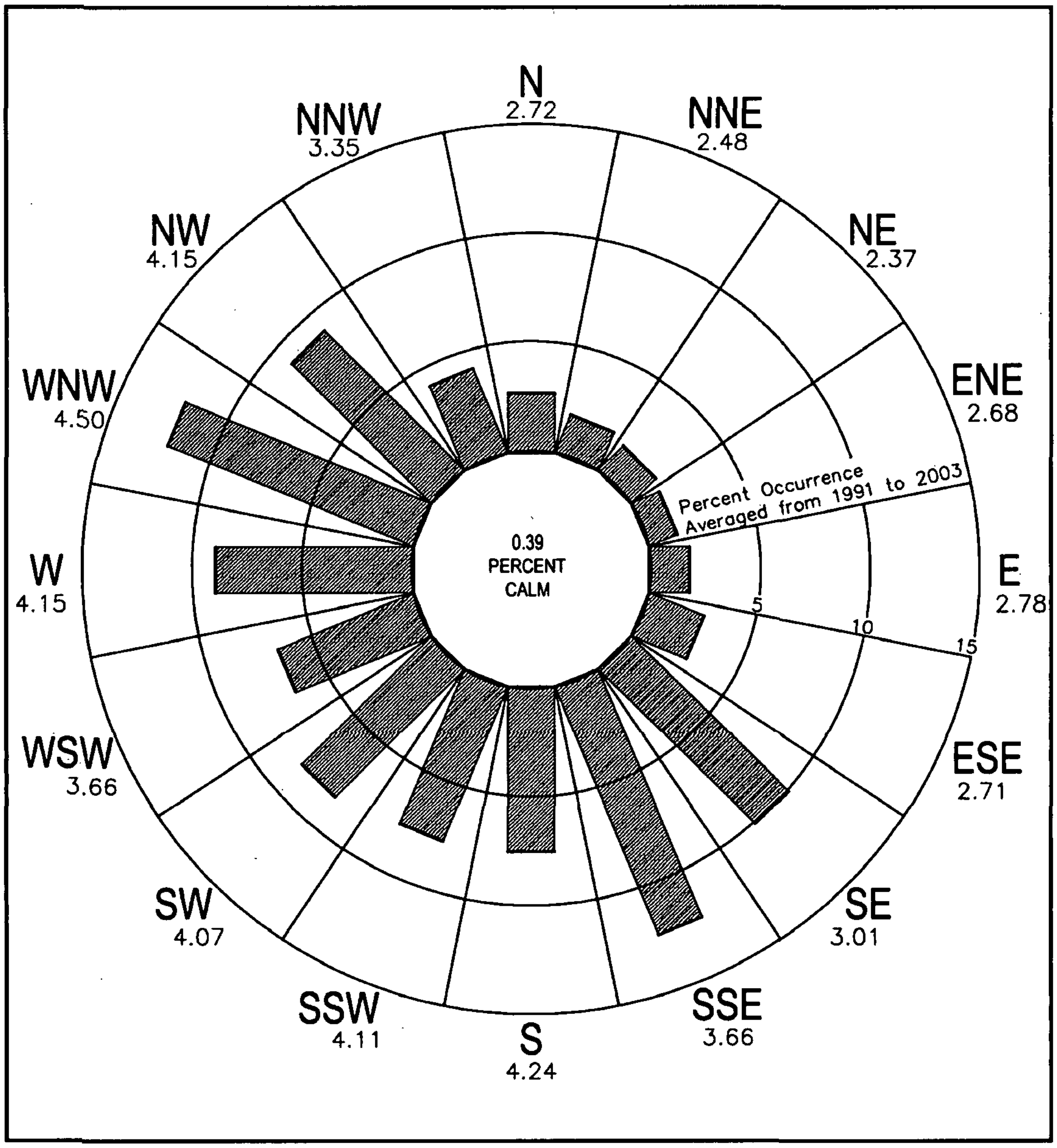


Figure 3-49. Wind Rose Diagram. (1991 – 2003 average head-wind direction and average wind speed in m/s)

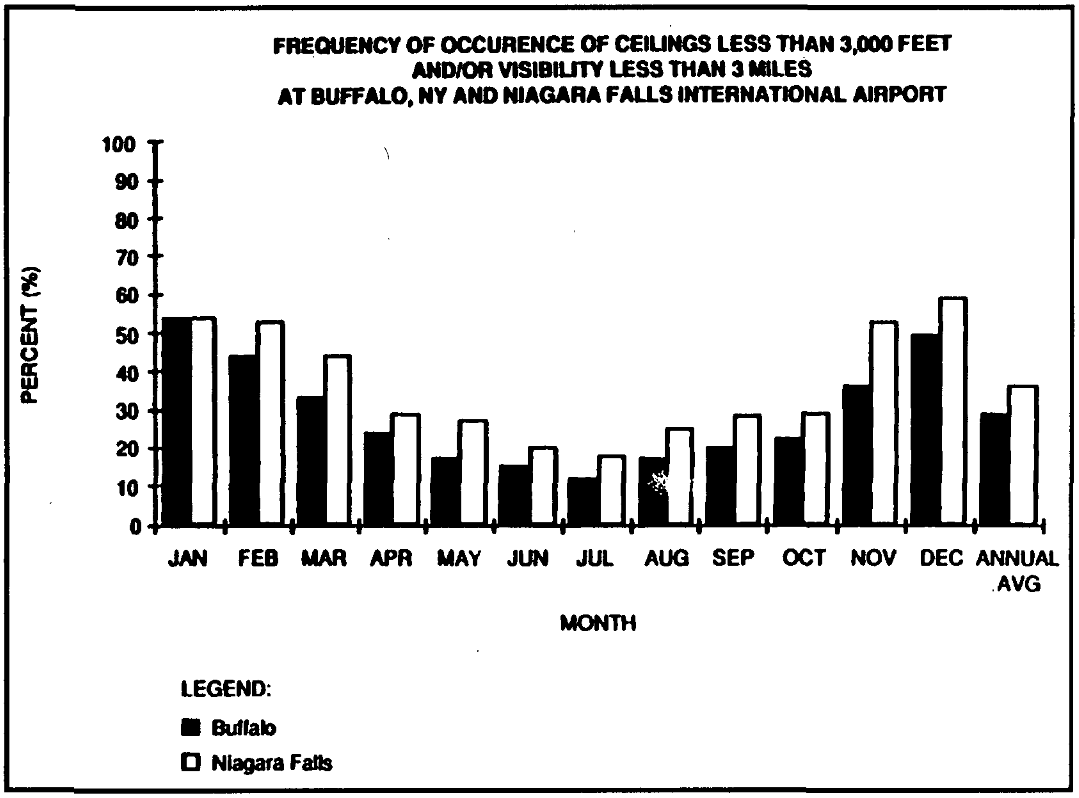


Figure 3-50. Cloud Ceiling Information (From reference 3-11)

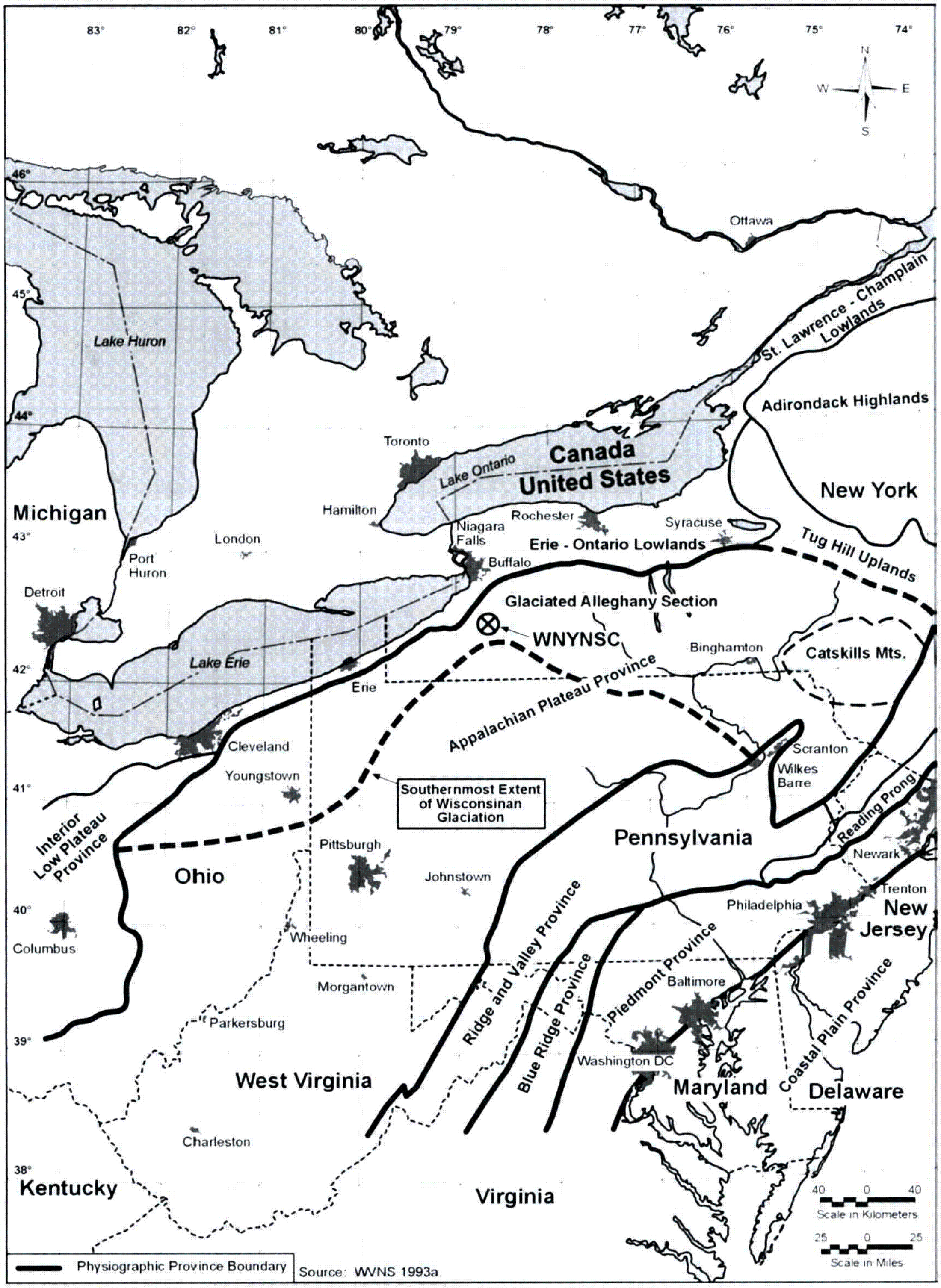


Figure 3-51. Regional Physiographic Map

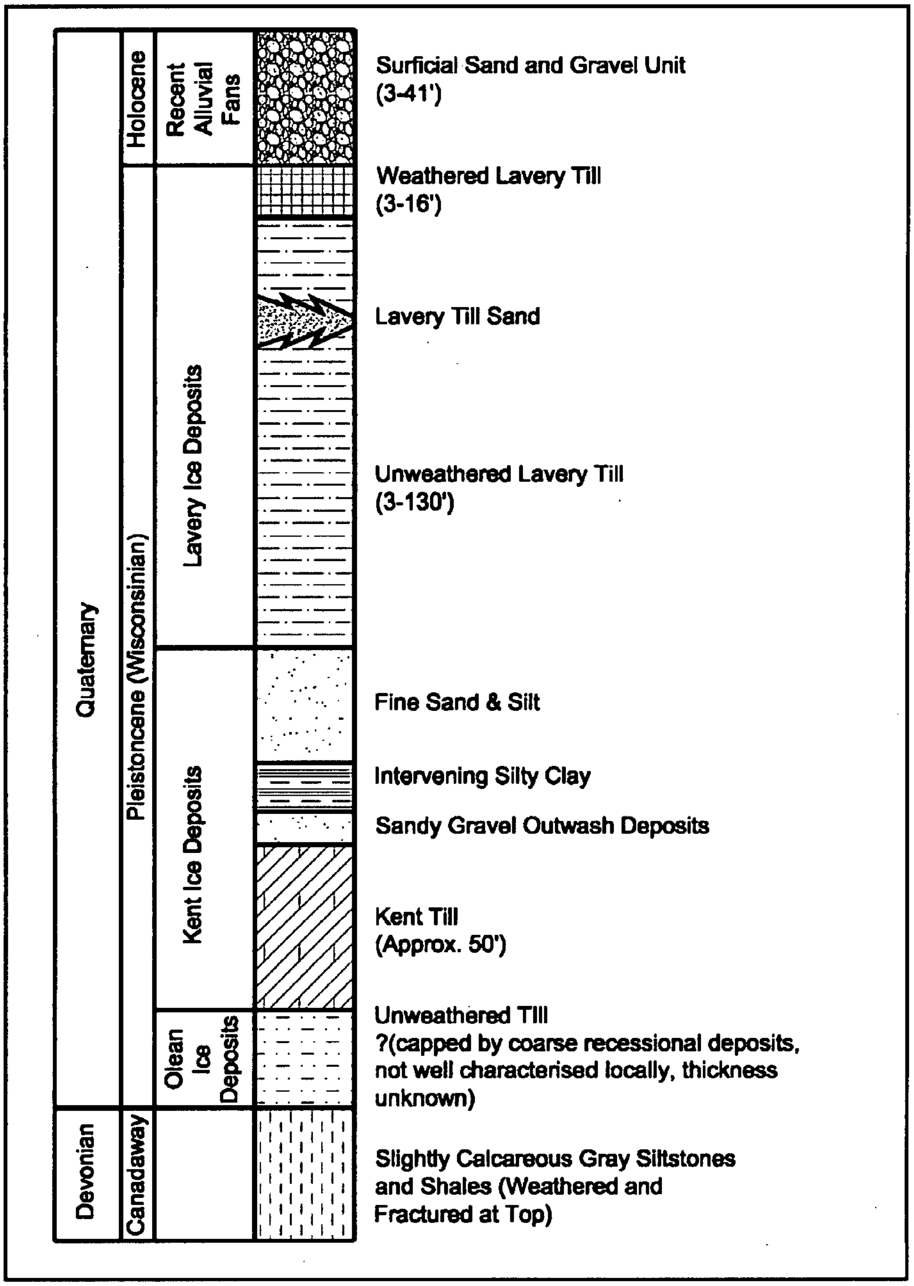


Figure 3-52. Bedrock and Glacial Stratigraphy of the WVDP

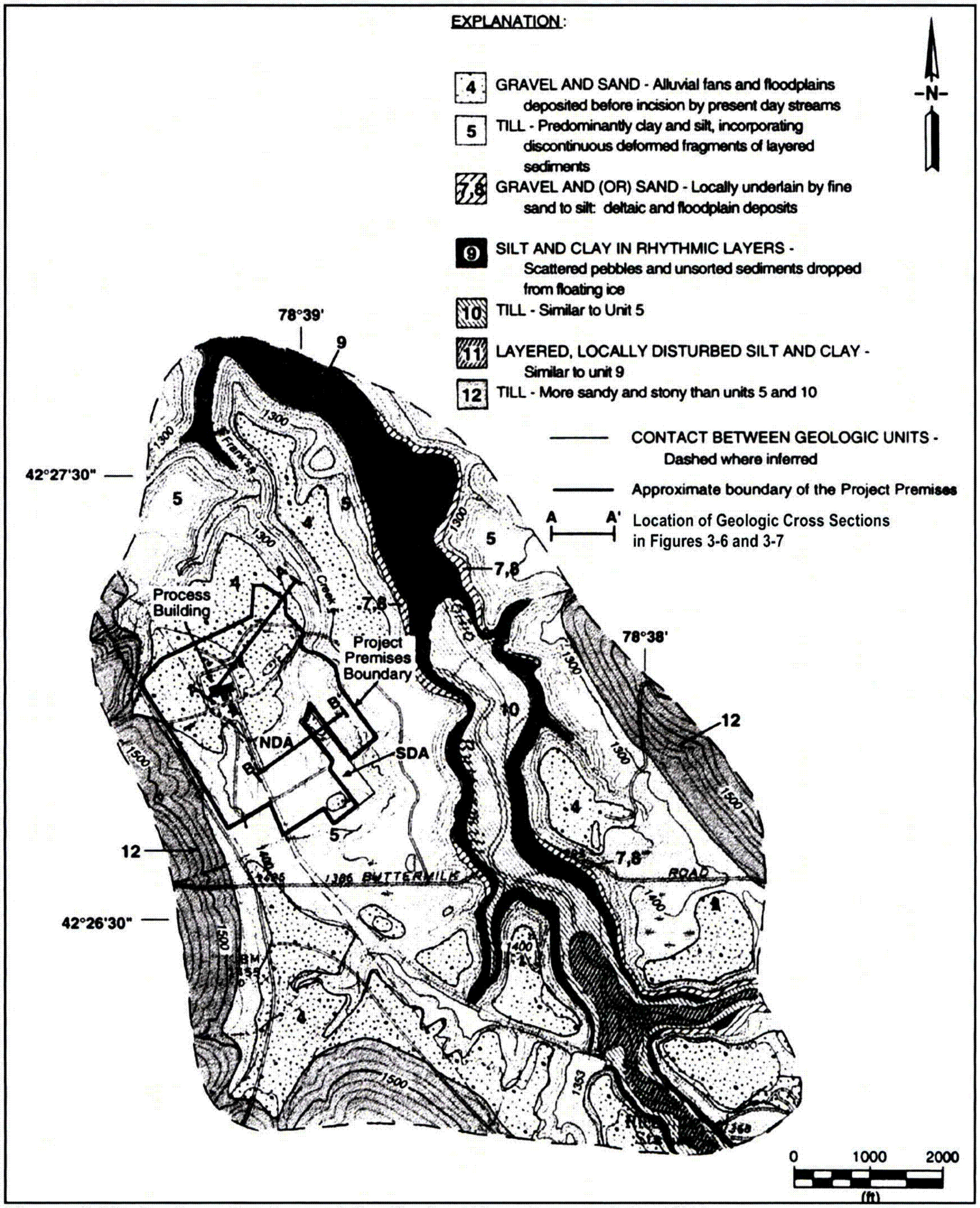


Figure 3-53. Surface Geology of the Project Premises and the SDA

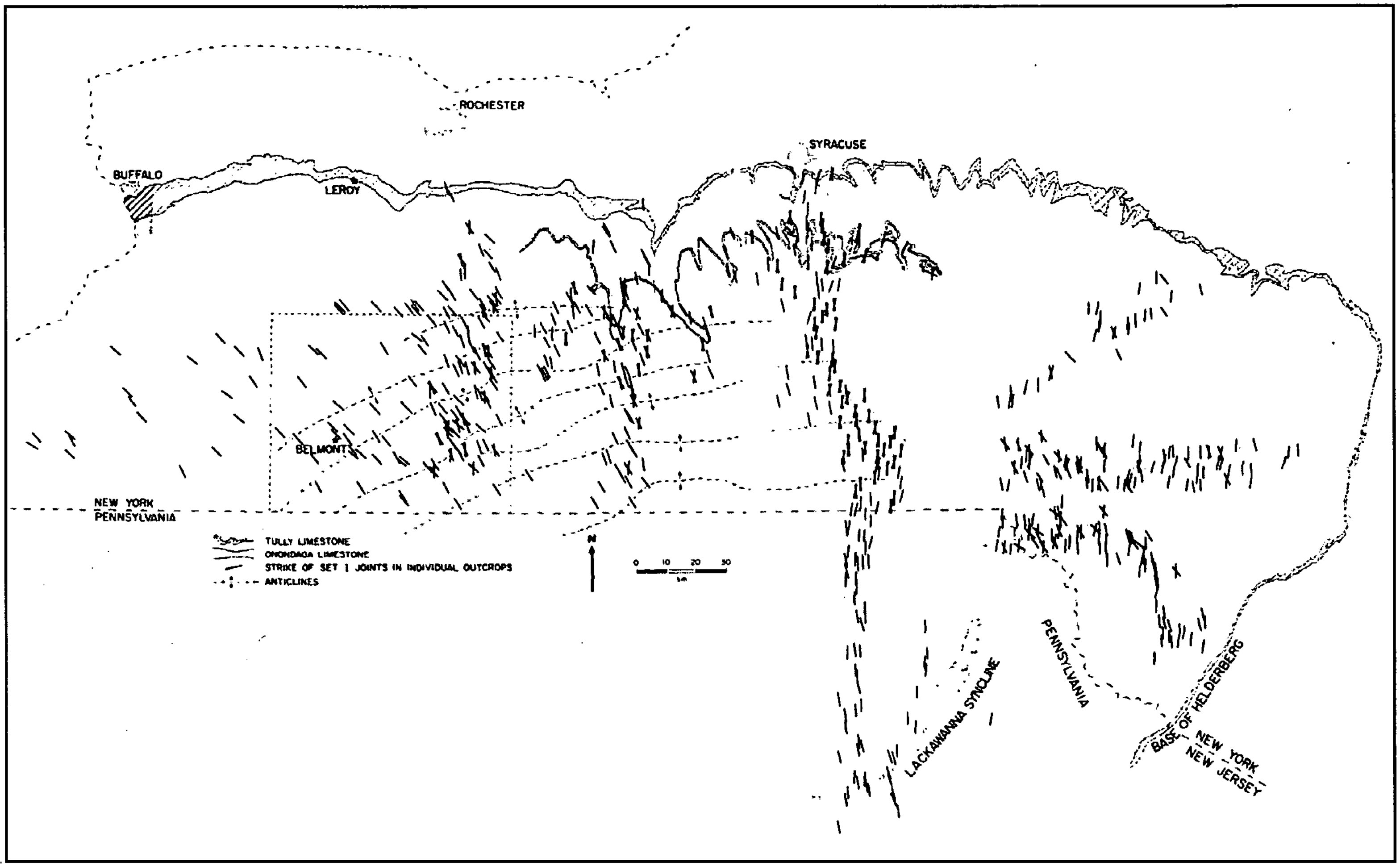


Figure 3-54. Fold and Selected Joint Trends in the Appalachian Plateau of Western and Central New York

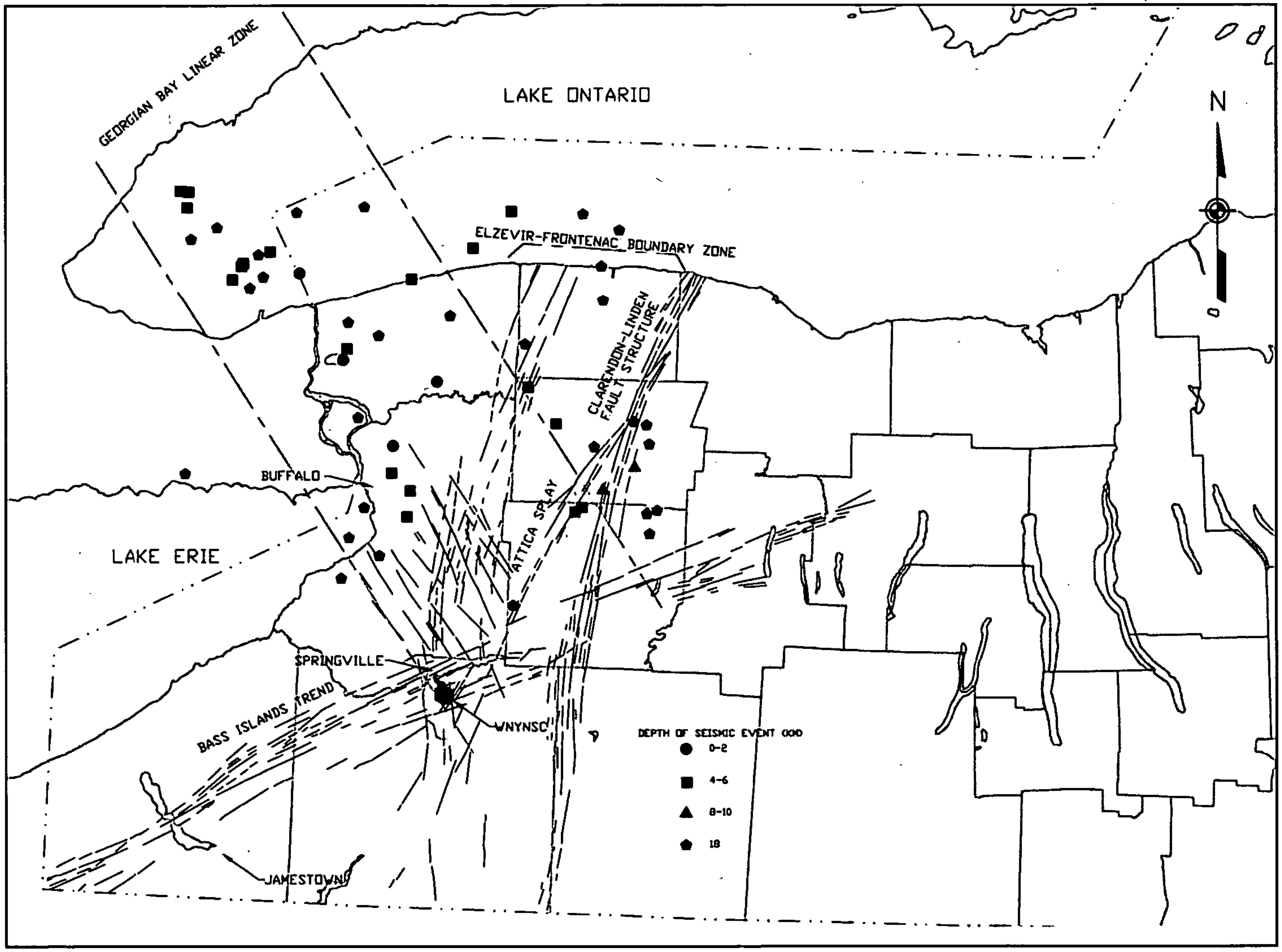


Figure 3-55. Seismo-Tectonic Map of Western New York Showing Selected Regional Geologic Structures

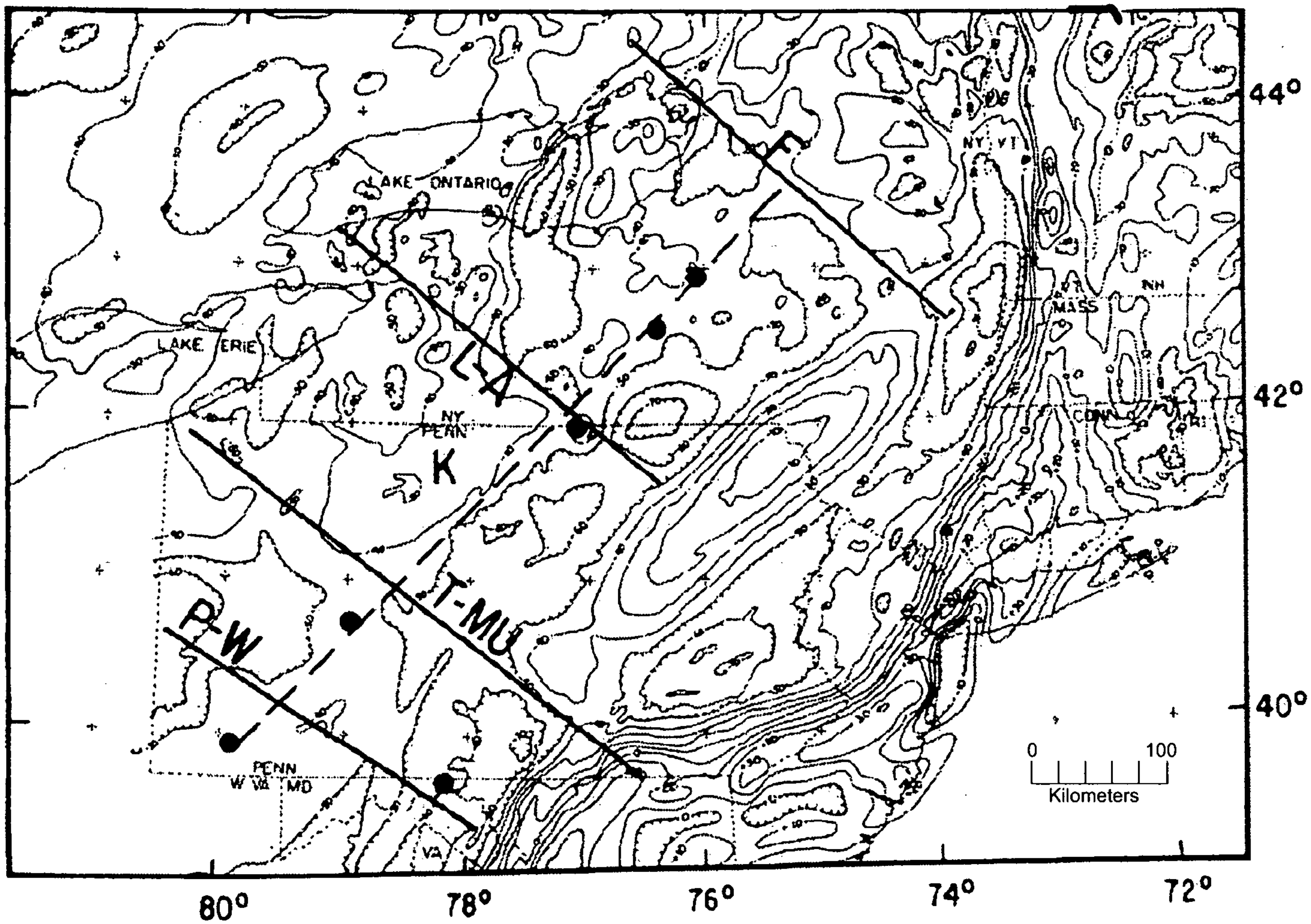


Figure 3-56. Major Northwest Trending Lineaments in New York and Pennsylvania (PW – Pittsburgh-Washington Lineament, T-MU – Tyrone-Mt. Union Lineament, L-A – Lawrenceville-Attica Lineament, F – F Lineament)