Appendix A. Disposal Facility Summaries

This Appendix provides descriptive summaries of the DOE sites and their LLW disposal facilities discussed in the main body of this Report. The Appendix is organized by the seven DOE LLW disposal sites (sections A.1 through A.7), with subsections for each site that discuss facility-specific information. Each summary provides brief information on site background (site location, size, and historical activities); facility characteristics (current status, applicable waste streams, and general design features); and scaling factors used in the radiological capacity analyses. Attachment 1 to the Appendix provides an overview of scaling factor methodology.

A.1 Fernald Environmental Management Project

A.1.1 Background

Location: Located approximately 18 miles northwest of Cincinnati, Ohio, the site covers a 1,050-acre area that includes a 136-acre industrial area.

Historical Activities: The Fernald Environmental Management Project (FEMP) began operation in 1951 as the Feed Materials Production Center. Over 500 million pounds of high-purity uranium metals for use in nuclear weapons were produced there before its closure in 1989.

A.1.2 On-Site Disposal Facility

A.1.2.1 Facility Description

Status: The FEMP on-site disposal facility will be an Environmental Restoration-operated facility operated under the Comprehensive Environmental Response, Compensation, and Liability Act. The Conceptual Design Report for the disposal facility, completed in 1994, lays out assumptions, design criteria, data gaps, etc., for remediating the site (as well as the proposed land disposal facility for treated wastes). Construction of the first of eight cells that will comprise the disposal facility began in July 1997. For the purposes of this Report, the disposal facility is considered current.

Waste Materials: Almost 40 years of site activity produced over 2.3 million m^3 of waste. These wastes exist throughout FEMP's five operable units: the former production area, waste pits, silos, inactive flash pile, and contaminated soils and groundwater. Radioactive wastes consist primarily of uranium, but thorium, radium, and radon are also present as radioactive decay products. Remediation of the uranium should also capture most other radioactive contaminants.

In addition to the radioactive component of waste, there are numerous other hazardous materials present. These include solvents, asbestos, PCBs, and heavy metals. The storage silos located to the west of the formal production area are the source of the highest level of radioactivity at the site. Two of the silos, which contain K-65 material generated from the processing of high grade uranium ores, are sources of high concentrations of radium. Another silo contains "cold" metal oxide waste residues that are left over from uranium extraction operations. In addition to contaminated structures and equipment, the former production area also includes thousands of drums of waste to be disposed at an off-site location. Only materials with low levels of contamination originating at FEMP will be disposed in this on-site facility.

General Design Features: The 8-cell facility footprint is approximately 72 acres. The objective of the facility is to limit migration of contaminants and remain stable for at least 1,000 years. Features to meet this objective include:

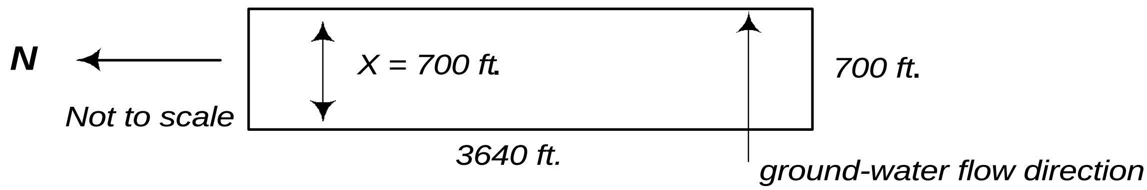
- a 40-foot-thick barrier of glacial overburden (silty clay) maintained between the cell and the Great Miami Aquifer;
- a basal liner approximately 6.5 feet thick composed of multiple layers of clay, gravel, and geosynthetic liner that direct any liquids into the leachate collection system;
- a leachate collection system (not integral to success of cell);
- compaction of the material placed in the cell to inhibit settling; and
- a multicomponent cover approximately 10 feet thick with components to limit radon emissions (compacted clay), water infiltration (geomembrane), and biointrusion (cobblestones). The cell is sloped to deter long-term erosion and inhibit water infiltration.

A.1.2.2 Scaling Factor

Assumptions for determining scaling factor:

1. Ground-water flow direction is from west to east (to Great Miami River) (Parsons, 1993).
2. Orientation of facility with ground-water flow as shown (based on map provided by site).
3. Use PE trench values.

Figure A-1. FEMP Onsite Disposal Facility Analysis Configuration



- Length parallel to ground-water flow = 700 ft (based on map provided by site)
- Effective length parallel to ground-water flow = 700 ft × 0.3048 m/ft = 213 m
- SF = 50 m/213 m = 0.235

A.2 Hanford Site

A.2.1 Background

Location: Managed by DOE, the Hanford Site covers approximately 1,500 km^2 (500 mi^2) of Government-owned land and is located northwest of the City of Richland, Washington, on the Columbia Plateau. It is bounded on the north by the Saddle Mountains, on the east by the Columbia River, and on the south and west by the Yakima River and the Rattlesnake Hills, respectively.

Historical Activities: In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related facilities and activities involving the production and purification of plutonium. Both the Waste Management program and the Environmental Restoration program operate disposal facilities at the Hanford Site. The Environmental Restoration Disposal Facility is discussed in section A.2.2, and the 200 Area Low-Level Burial Ground is discussed in section A.2.3.

A.2.2 Environmental Restoration Disposal Facility

A.2.2.1 Facility Description

Status: The Environmental Restoration Disposal Facility (ERDF) is regulated by the Comprehensive Environmental Response, Compensation, and Liability Act; its Record of Decision was signed in January 1995. This document discusses site and risk assessments, remedial alternatives, the selected remedy, and statutory determinations for the Hanford Site disposal facility. Construction of the first two cells concluded in 1996. The first load of contaminated material was disposed at the ERDF on July 1, 1996.

Waste Materials: Hanford Site waste accounts for nearly 2/3 by volume of the nuclear waste in the Department of Energy complex. The site contains vast amounts of both radioactive and hazardous wastes. Currently, 10 percent of Hanford Site's waste is radioactive, and 75 percent of the site's waste is contaminated with both radioactive and hazardous components. The most abundant contaminants are tritium, carbon tetrachloride, chromium, nitrates, cobalt, strontium, cesium, technetium, iodine, plutonium, and uranium.

The vast majority of waste anticipated to be disposed at the ERDF is LLW. A relatively small percentage would be classified as mixed waste based on the regulatory definition of hazardous waste. Though non-radioactive waste constituents frequently exceed negotiated site-specific cleanup criteria, they are well below levels that qualify them as hazardous, and therefore mixed waste.

Contaminated soil makes up the largest portion of the volume estimated to be disposed at this facility. Other waste forms expected include construction debris, glass, paper, metal pipe/shapes, and plastics. Only Hanford Site waste resulting from remediation of the 100, 200, and 300 Areas will be disposed in the ERDF.

General Design Features: As currently constructed, the ERDF is a single, 70-foot-deep trench consisting of two adjoining side-by-side cells (in the initial phase) located in the south and east of the 200 West Area on the central plateau. The trench dimensions are 1,420 feet by 720 feet at the top of the trench and 1,000 feet by 500 feet at the bottom of the trench, with the long axis oriented north-to-south. The cells are open to the east for future expansion. Based on currently estimated waste volume, the maximum dimension of ERDF would be approximately 1,420 feet by 1,940 feet (six cells, with the long axis oriented east-to-west). The objective of the facility is to limit migration of contaminants and prevent intrusion for at least 500 years. To meet these objectives, the following features are included:

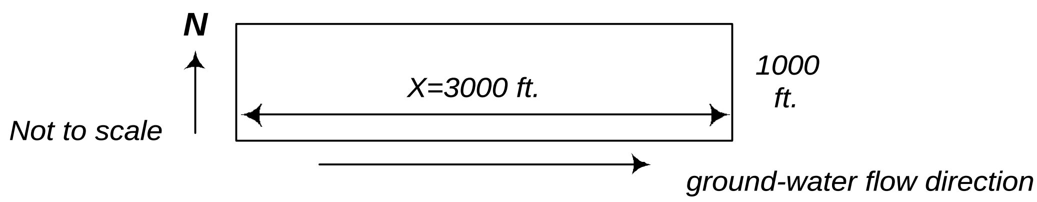
- a double-lined basal liner composed of multiple layers of clay and geosynthetic liner that direct any liquids into the leachate collection system;
- a leachate collection system; and
- a multicomponent cover with components to limit radon emissions (clay), infiltration (geomembrane and an extra 15 feet of soil), and biointrusion (sand and gravel). The cell is sloped to deter long-term erosion and inhibit water infiltration.

A.2.2.2 Scaling Factor

Assumptions for determining scaling factors:

1. Orientation as shown (based on dimensions provided by site).
2. Ground-water flow is generally from west to east (to the river) but varies across the site.
3. Use PE trench values for all.

Figure A-2. Hanford ERDF Analysis Configuration



- Length parallel to ground-water flow is 3000 ft
- Effective length parallel to ground-water flow = 3000 ft × 0.3048 m/ft = 914.4 m
- SF = 50 m/914.4 m = 0.055

A.2.3 200 Area Low-Level Burial Ground

A.2.3.1 Facility Description

Status: The 200 Area Low-Level Burial Ground is classified as a shallow landfill disposal facility, which covers an area of about 660 ha (1,500 acres). Shallow land disposal of solid waste has occurred at the Hanford Site since the late 1940s.

Waste Materials: Until 1970, when the Atomic Energy Commission required that transuranic waste be retrievably stored, no distinction was made between transuranic waste and LLW. In the early 1980s, low-level liquid organic waste was segregated from LLW and stored (retrievably) underground. LLW currently being disposed at the Hanford Site consists of many waste streams derived from numerous sources, both onsite and offsite.

General Design Features: The landfill is divided into eight burial grounds, two of which are located in the 200 East Area and five of which are located in the 200 West Area. The burial grounds considered in the analysis of the Hanford Reservation are listed below. Each burial ground is numbered according to a standard Hanford facility numbering system. The system generally uses a three-part code for the type of facility. For example, the three-part code designation for burial ground 218-E-10 means that the facility is a 200 area burial ground (218), is in the east area (E), and is burial ground number 10 (10).

The current method of disposing LLW is in unlined, sloped (about 45 degrees) trenches that are about 6 to 7 m deep and vary in length up to about 500 m. Trenches are typically wide-bottomed (about 8 m wide) or V-shaped (about 3 m wide).

In 1987, MLLW was distinguished from LLW and its disposal was largely discontinued, except on a case-by-case basis. Two types of MLLW typically considered for disposal in the pre-1987 trenches are remote-handled MLLW (with exposures greater than 200 mrem/hr at the container surface) and special waste. Special waste includes unique waste requiring special handling or unusual waste such as decommissioned reactor vessels. Non-remote-handled MLLW is currently stored in aboveground buildings. Ultimately, MLLW will be disposed in a new, Resource Conservation and Recovery Act-compliant disposal facility located within the Low-Level Burial Ground 218-W-5 in the 200 West Area.

Burial ground 218-W-5 is located generally west of the Central Waste Complex within the fenced area of 200 West. This burial ground began disposing of waste in trenches in 1986. The trenches contain low-level mixed waste that includes lead bricks and shielding. Low-level waste also is placed in this landfill. Burial ground 218-W-5 has two distinct site characteristics. The south portion is a deep depression with elevations varying up to 24.4 meters (80 feet) from a mean elevation at the Waste Receiving and Processing (WRAP) facilities. The north portion is a ridge or plateau area that varies up to 22.9 meters (75 feet) higher than the mean elevation of the WRAP facilities.

Future planning by Decontamination and Decommissioning utilizes a portion of the 218-W-5 development area for disposal of the 100 area production reactors. Currently, an action is proposed to widen and operate the existing and unused disposal trench 33 within the 218-W-5

Burial Ground in the 200 West Area. The trench would be used for large packages of Category 1 LLW. Category 1 waste has low to medium radioactivity, while Category 3 LLW has higher radioactive concentrations. The proposed sloped trench would be approximately 354 m long with a base width of 20.4 m. Packaged waste in carbon-steel, 55-gallon drums, wooden boxes, or other approved containers is stacked to within about 2.5 m of the surface.

Burial ground 218-W-3A began disposing waste in trenches in 1970 and covers 20.4 hectares (50.3 acres). Waste stored or disposed includes mixed, transuranic, low-level, and retrievable waste. Examples of waste placed in this burial ground include ion-exchange resins, industrial waste, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, and accessories. The burial ground also stores remote-handled (RH) TRU.

Burial ground 218-W-3AE began disposing waste in trenches in 1981 and covers 20 hectares (49.4 acres). Waste in this burial ground includes low-level and mixed waste. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and industrial waste.

Burial ground 218-W-6 has not received any waste to date. When developed, this burial ground is expected to cover approximately 18 hectares (44.5 acres).

Burial ground 218-W-4C began disposing waste in trenches in 1978 and covers 21 hectares (51.7 acres). Waste in this facility includes transuranic, mixed, and LLW. Examples of waste placed in trenches include contaminated soil, decommissioned pumps, pressure vessels and hardware, and stored RH TRU. Some of the trenches are designed to be retrievable storage.

Burial ground 218-E-10 began disposing waste in trenches in 1960 and covers 23 hectares (56.7 acres). Waste at this site was received from the Plutonium/Uranium Extraction Plant, B Plant, and N Reactor and includes low-level and low-level mixed waste, such as failed equipment and industrial waste.

Burial ground 218-E-12B began disposing wastes in trenches in 1967 and covers 70.1 hectares (173.1 acres). Waste contained in this burial ground includes mixed waste, low-level, and transuranic (TRU) waste.

A.2.3.2 Scaling Factor

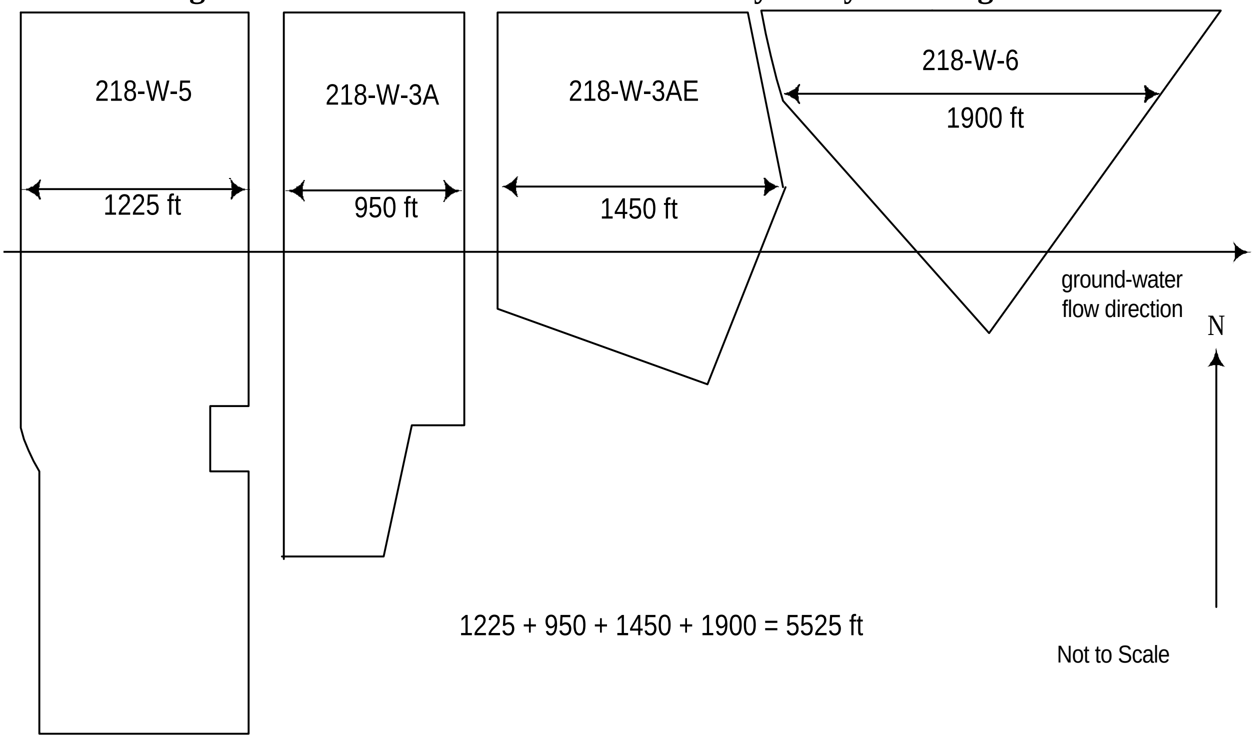
Assumptions for determining scaling factors:

1. Treat the 200 Area and the ERDF as two separate disposal facilities.
2. Orientation as shown in Figures A-3 and A-4.
3. Ground-water flow is generally from west to east (to the river) but varies across the site.
4. For 200-W, assume the length parallel to ground-water flow is comprised of 218-W-5, 218-W-3A, 218-W-3AE, and 218-W-6 (Wood et al., 1994, page 2-26, Section 2.5.2 and information provided by site).
5. For 200-E, assume length of facility parallel to ground-water flow is comprised of 218-E-12B (DOE, 1994).

6. Add the 200-W and 200-E lengths to determine length parallel to ground-water flow.
7. Southern part of 218-W-5 is for mixed waste, but as in the 200-W performance assessment, mixed waste is not considered separately from LLW for radiological purposes.
8. Use PE trench values for all.

Hanford 200 West

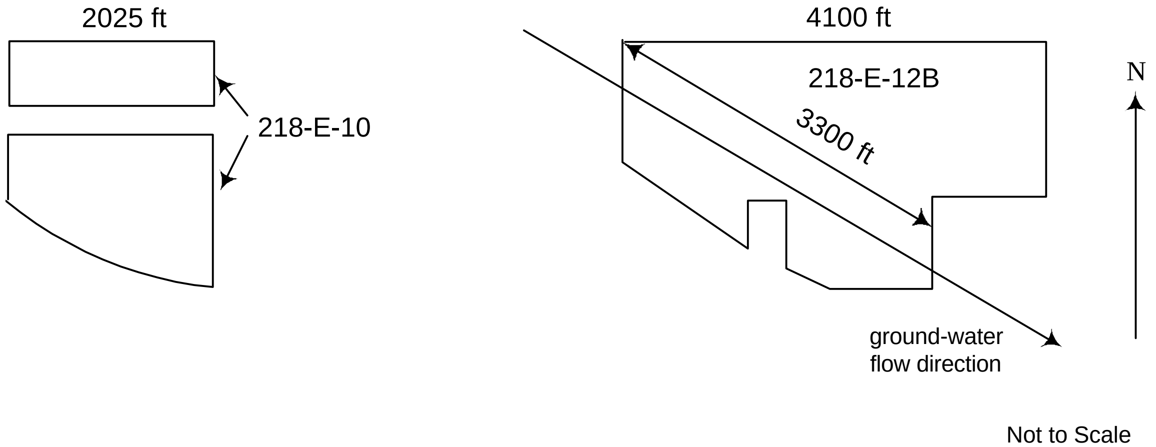
Figure A-3. Hanford 200 West Area Facility Analysis Configuration



- Length parallel to ground-water flow (i.e., east-west dimensions of 218-W-5, 218-W-3A, 218-W-3AE, and 218-W-6) is ~5525 feet (based on DOE, 1994, page A-14, Fig. A-8) (The dimensions of 218-W-4C, which is south of 218-W-5, 218-W-3A, 218-W-3AE, and 218-W-6, are not shown on the diagram because this facility contributes to the width of the west disposal area rather than to its length parallel to ground-water flow and therefore does not influence the scaling factor).
- Effective length parallel to ground-water flow = 5525 ft × 0.3048 m/ft = 1684 m
- Incorporate above effective length into SF determination shown in Figure A-4.

Hanford 200 East

Figure A-4. Hanford 200 East Area Facility Analysis Configuration



- Length parallel to ground-water flow is ~ 3300 ft (based on DOE, 1994, page A-13, Fig. A-7)
- Effective length parallel to ground-water flow = 3300 ft × 0.3048 m/ft = 1006 m
- 200 Area SF = 50 m/(1684 m + 1006 m) = 0.019

A.3 Idaho National Engineering and Environmental Laboratory

A.3.1 Background

Location: The Idaho National Engineering and Environmental Laboratory (INEEL) covers nearly 2,300 km^2 (~890 mi^2) in southern Idaho. The INEEL is within the Medicine Lodge and Big Butte Resource Areas, which are administered by the Bureau of Land Management.

Historical Activities: In 1949, the site was established as the National Reactor Testing Station, where the Atomic Energy Commission built, tested, and operated various types of nuclear reactors. As of April 1991, 52 reactors had been built at the site, and 13 were still operating or operable. INEEL is now a multiprogram laboratory with numerous research and site cleanup activities. One LLW disposal facility, the Radioactive Waste Management Complex (RWMC), is presently operating at INEEL. The RWMC is located in the southwest portion of the site. The INEEL does not plan to build another disposal facility, and is currently evaluating disposal options at Envirocare, the Hanford Site, and the Nevada Test Site.

A.3.2 Radioactive Waste Management Complex

A.3.2.1 Facility Description

Status: The RWMC was established in 1952 for disposal of defense wastes (mostly transuranic), solid LLW, and MLLW generated at INEEL. Since 1970, transuranic waste has been stored aboveground in specially designed storage facilities, and no mixed waste has been disposed at the complex since April 1984. Today, the facility provides waste management, interim storage of transuranic waste, and disposal of INEEL-generated LLW, but provides no means for disposing of MLLW. The facility also retrieves, examines, and certifies stored transuranic waste for ultimate shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico.

Waste Materials: Buried waste and retrievably-stored waste include solid, beta-gamma contaminated LLW from INEEL operations, transuranic waste, and contaminated soil. Buried waste is subdivided into contact-handled and remote-handled waste. The beta-gamma contaminated LLW and contaminated soil contain transuranic contaminants less than 100 nCi/g. The buried waste, beta-gamma LLW, and soil are classified as LLW. A 1989 study of a representative section of the RWMC containing the transuranic waste determined that 46 percent of all past disposed transuranic waste (64,755 m^3) is to be reclassified as LLW. This study also concluded that 95 percent of the disposed transuranic waste inventory contains hazardous constituents and will be reclassified and managed as MLLW.

General Design Features: The 58-ha (144-acre) complex consists of two main disposal and storage areas: the Transuranic Storage Area, Pad A, for storage and examination of transuranic waste, and the Subsurface Disposal Area for disposal of LLW. The Subsurface Disposal Area is a fenced, 97-acre area in the western part of the RWMC surrounded by a flood control dike and drainage channel. Waste has been buried in the SDA since 1952 in trenches, pits, soil vault rows, and concrete vaults. Beginning in 1977, areas not suited for pits were set aside for drilling of soil vaults. Use of soil vaults was discontinued in September 1995. The major burial areas presently open are Pits 17, 18, 19, and 20, which includes disposal in concrete vaults.

Pits are normally used for routine, solid, contact-handled, beta-gamma-contaminated LLW with radiation levels below 500 mR/h at 0.9 m. The pits are 30 x 4 to 6 m (98 x 12- to 20-ft) and vary from 60 to 360 m (200 to 1,200 ft) long. Pits are generally excavated to bedrock depth, about 9 m, and then backfilled with 0.6 m of soil over rock. After the waste is placed on the soil by high-density stacking, the pits are backfilled with at least 0.9 m of soil. Remote-handled waste in concrete vaults is also disposed in the pits area. There are currently 100 concrete vaults installed, with a disposal volume of 5.32 m^3 per vault.

Soil vaults are unlined, augured boreholes between 0.41 and 1.8 m (16 to 72 in.) in diameter used to dispose of remote-handled LLW. The waste is usually placed in bottom discharge shielded casks into the vaults.

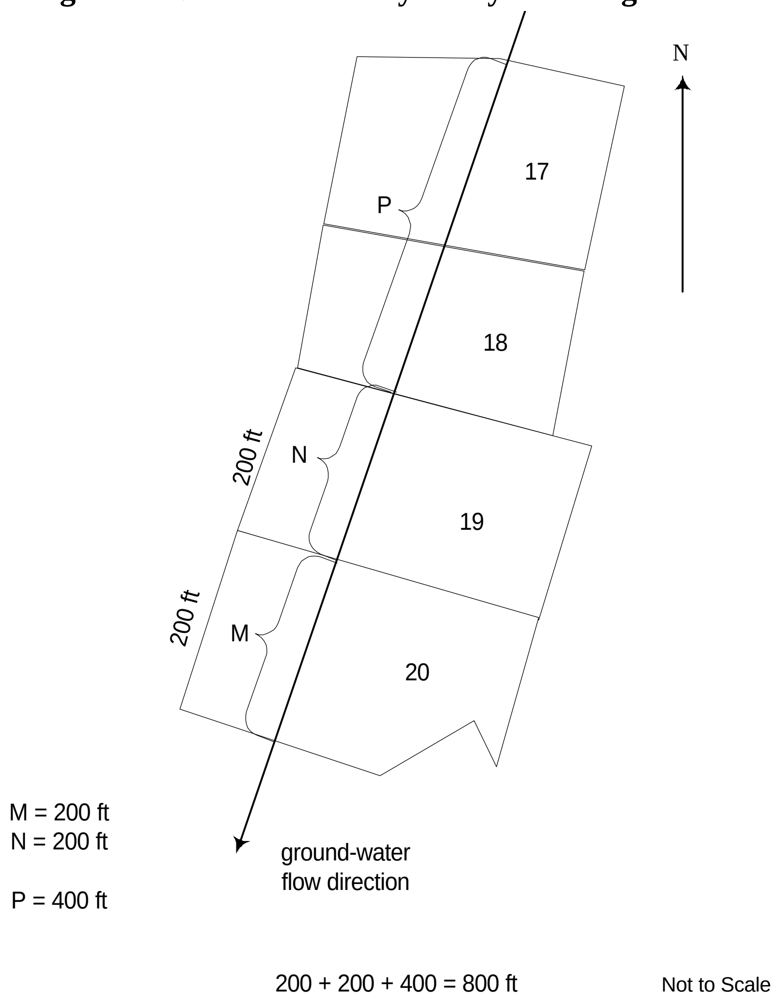
Although there are no plans to expand the existing RWMC Subsurface Disposal Area, new disposal concepts are being evaluated to establish environmental compliance plans and functional and operational requirements for new disposal facilities.

A.3.2.2 Scaling Factor

Assumptions for determining scaling factor:

1. Active disposal of LLW is in Pits 17, 18, 19, and 20, which also includes disposal in concrete vaults (Maheras et al., 1994, page 2-79, Section 2.2.4, and Table 2-6, page 2-75).
2. Ground-water flow is from north-northeast to south-southwest (Maheras et al., 1994, page 2-49, Section 2.1.3.2.2).
3. Orientation as shown.
4. Use PE trench values.

Figure A-5. INEEL Facility Analysis Configuration



- Length parallel to ground-water flow is ~800 feet (based on Maheras et al., 1994, Fig. 2-24, p. 2-74, confirmed by DOE, 1993, page B-4, Figure B-2)
- Effective length parallel to ground-water flow = 800 ft × 0.3048 m/ft = 244 m
- SF = 50 m/244 m = 0.204

A.4 Los Alamos National Laboratory

A.4.1 Background

Location: Los Alamos National Laboratory (LANL) is located on the Pajarito Plateau in Los Alamos County in north-central New Mexico, approximately 97 km (60 mi) north-northeast of Albuquerque and 40 km (25 mi) northwest of Santa Fe. LANL occupies an area of 112 km^2 (43 mi^2), bounded on the southeast by the Rio Grande.

Historical Activities: The University of California has managed LANL since 1943, and the Department has been the designated Federal landlord since 1978. LANL's mission involves the application of science and technology to weapons development, energy supply, and conservation programs. LANL has one operating LLW disposal facility, Technical Area-54 Area G.

A.4.2 Technical Area-54 Area G

A.4.2.1 Facility Description

Status: Beginning in 1957, Area G within Technical Area-54 was used to dispose of waste generated from operations involving radioactive materials and waste that would now be classified as mixed waste.

Waste Materials: In 1970, the Atomic Energy Commission directed its facilities to begin storing transuranic waste so that it could eventually be retrieved. LANL then began segregating LLW from transuranic waste and dedicating specific areas within Area G for management of these wastes. Since 1986, transuranic waste has been segregated for storage at Technical Area-54 Area G.

General Design Features: Area G occupies 64 acres and currently consists of 39 landfill cells (pits and trenches) and 237 land disposal shafts. An additional 24 acres, immediately adjacent to Area G, is dedicated for future expansion of the LLW disposal area. Thirty-five pits and almost 200 shafts were used for disposal of LLW at Technical Area-54 Material Disposal Area (MDA) G through December 31, 1995. Four disposal units within Area G are active for disposal of LLW and asbestos LLW. Closed units include 36 landfill cells (pits and trenches) and 208 land disposal shafts. Four of the 35 disposal pits were still open at the end of 1995. A fifth pit, Pit 15, was recently opened for disposal activities. Pit 31 is dedicated to the disposal of asbestos waste and will continue to receive moderate amounts of waste in the future. Pits 37, 38, and 39 are used for the disposal of routine, ER, and D&D waste generated at LANL. Most pits are excavated, filled, and covered within 2 to 4 years. Fewer than 20 of the disposal shafts active between April 1966 and December 1995 were active at the end of 1995.

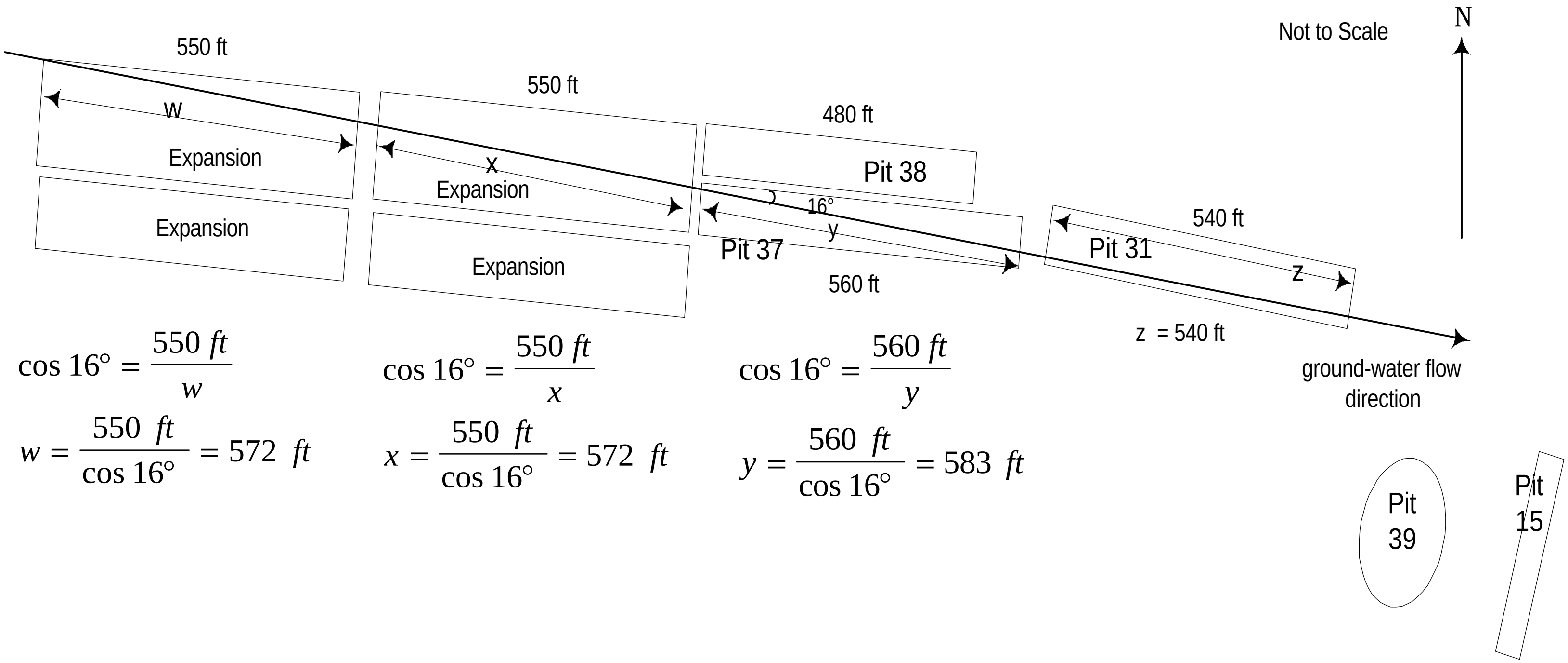
Typically, pits are rectangular, about 20 m wide × 150 m long × 21 m deep (~65 ft × 500 ft × 65 ft); a notable exception is Pit 39, which is approximately hemispherical, about 20 m (65 ft) in diameter, and 20 m (65 ft) deep. Shafts are typically cylindrical, about 20 m (~65 ft) deep and range in diameter from 0.5 to 1 m (~1.5 to 3 ft).

A.4.2.2 Scaling Factor

Assumptions for determining scaling factor:

1. Pits 15, 31, 37, 38, and 39 and several shafts are the only active disposal areas in MDA G (LANL, 1997, p. 1-13, Section 1.2.3; p. 2-22, Section 2.1; Appendix 2e, p. 2-2; and information provided by the site).
2. Treat Pits 31, 37, 38, and the expansion area as single unit. However, an expansion area is proposed west of the current disposal area (ANL, 1997, Appendix 3g, p. 26).
3. Shafts are out of ground-water flow line for pits
4. Ground-water flow is from N 80° W (LANL, 1997, page 2-36, Figure 2-12).
5. Orientation as shown (based on LANL, 1997, page 2-22, Figure 2-7; Appendix 3g, p. 26).
6. Use PE trench values.

Figure A-6. LANL Facility Analysis Configuration



$$\cos 16° = \frac{550\ ft}{w} \qquad \cos 16° = \frac{550\ ft}{x} \qquad \cos 16° = \frac{560\ ft}{y}$$

$$w = \frac{550\ ft}{\cos 16°} = 572\ ft \qquad x = \frac{550\ ft}{\cos 16°} = 572\ ft \qquad y = \frac{560\ ft}{\cos 16°} = 583\ ft$$

572 ft + 572 ft + 583 ft + 540 ft = 2267 ft

- Effective length parallel to ground-water flow = 2267 ft × 0.3048 m/ft = 691 m
- SF = 50 m/691 m = 0.072

A.5 Nevada Test Site

A.5.1 Background

Location: The Nevada Test Site (NTS) occupies 3,500 km^2 (1,400 mi^2) of Federally owned land in southeastern Nevada. Located about 105 km (65 mi) northwest of Las Vegas, the site is bordered to the west, north, and east by the Nellis Air Force Base Bombing and Gunnery Range and the Tonopah Test Range.

Historical Activities: The NTS has been the primary location for testing the Nation's nuclear weapons and devices since 1951. Other functions include environmental restoration efforts throughout the NTS, technology development projects, and operation of the Liquefied Gaseous Fuels Spill Test Facility. Waste disposal facilities for LLW and MLLW are located in Areas 3 and 5.

A.5.2 Area 3 Radioactive Waste Management Site

A.5.2.1 Facility Description

Status: The Area 3 Radioactive Waste Management Site (RWMS) is located on Yucca Flat and covers an area of approximately 20 ha (50 acres).

Waste Materials: Contaminated bulk debris from DOE and DOE-approved on- and off-site generators are disposed in subsidence craters produced from underground nuclear testing.

Description: U3ahat is an active disposal cell that currently receives LLW from approved offsite generators. Crater U3bh is also open, and it has received bulk soil from cleanup of contaminated areas at NTS. U3axbl is an inactive, covered disposal cell discontinued in January 1988. Because waste received in the past contained lead, U3axbl may contain mixed waste; formal closure will commence when the Resource Conservation and Recovery Act closure cap plan is approved. Two other sites in Area 3 are in reserve, U3az and U3bg.

A.5.2.2 Scaling Factor - Not applicable.

A.5.3 Area 5 Radioactive Waste Management Site

A.5.3.1 Facility Description

Status: Beginning in 1961, the Area 5 RWMS was used to dispose of LLW and classified LLW generated by NTS operations.

Waste Materials: In 1978, NTS began accepting LLW generated by offsite Department of Energy facilities. Pit 3 has received mixed waste in the past, but under agreement with the State has suspended receipt pending resolution of waste acceptance criteria. However, mixed waste generated on the NTS may be disposed in Pit 3 if Land Disoposal Restrictions requirements are met. This landfill unit has accepted pondcrete, a mixture of MLLW sludge and cement, from the DOE Rocky Flats Environmental Technology Site. Pit 6, opened in 1990, and Pit 5, opened in 1995, are used for the disposal of LLW. Pit 7 is open for disposal of LLW containing regulated asbestos.

General Design Features: The total area allocated to the Area 5 RWMS is 296 ha (732 acres). The developed portion of Area 5 occupies 37 ha (92 acres) in the southeast corner and contains 17 landfill cells (pits and trenches), 13 Greater Confinement Disposal Units boreholes, and a Transuranic Waste Storage Pad. Four pits are currently in operation in Area 5, one for disposal of MLLW, two for disposal of LLW, and one for disposal of LLW containing regulated asbestos. Three trenches in Area 5 are operational and designated to receive classified LLW: Trench T07C, Trench T08C, and Trench T09C. Trenches T03U and T04C have been closed.

The Mixed Waste Disposal Unit (currently designed to consist of 10 cells) is a landfill proposed for location on about 18 ha (45 acres) of the Area 5 RWMS, immediately north of the developed RWMS landfill area. The design has been completed, the unit is included in the Resource Conservation and Recovery Act permit application, and the environmental assessment is being updated.

A.5.3.2 Scaling Factor - Not applicable.

A.6 Oak Ridge Reservation

A.6.1 Background

Location: The Oak Ridge Reservation (ORR) is located in a valley between the Cumberland and southern Appalachian Mountain ranges in eastern Tennessee about 25 km west of Knoxville. ORR covers an area of 35,252 acres and contains three major facilities: Oak Ridge National Laboratory (ORNL), the Oak Ridge East Tennessee Technology Park (formerly called the “K-25" site), and the Oak Ridge Y-12 Plant.

Historical Activities: The ORR was originally constructed as a research and development facility to support plutonium production and research. Today, the ORR conducts research on the fission nuclear fuel cycle and nuclear fusion. ORNL is the only facility of the three at ORR that currently operates a disposal site for LLW, the Interim Waste Management Facility (IWMF) at Solid Waste Storage Area (SWSA) 6.

A.6.2 Facility Description

Status: Located about 40 km west of Knoxville, in Melton Valley in the southwest region of ORR, the 28-ha (68-acre) SWSA 6 has been used by the ORNL since 1969 for the disposal of on-site generated LLW. Until 1986, all LLW generated at ORNL (including MLLW) was disposed of by shallow land burial, generally in unlined trenches and auger holes. This practice came under closer scrutiny by Federal and State regulators and DOE officials, and as a result, in 1986 major changes in the operation of SWSA 6 were initiated. Because of the disposal practices conducted before 1986, some areas in SWSA 6 were remediated under a

Resource Conservation and Recovery Act interim status closure agreement with the Tennessee Department of Environment and Conservation. The remediation activities were coordinated with ongoing Greater Confinement Disposal units waste operations. Remediation of SWSA 6 will occur under the Comprehensive Environmental Response, Compensation, and Liability Act.

Waste Materials: SWSA 6 does not accept any mixed waste for disposal. The radioactive solid waste disposal facility, the IWMF, was constructed in 1991 for solid LLW disposal. While SWSA 6 also served as a disposal site for fission-product LLW in Greater Confinement Disposal units and for waste in shallow land burial units, the IWMF is the only currently active disposal unit at SWSA 6.

General Design Features: Below-grade disposal methods used at SWSA 6 include concrete silos, wells in concrete silos, pipe-lined auger hole wells, unlined trenches, and landfills. ORNL began phasing out below-grade disposal operations in December 1992 at a Tennessee Department of Environment and Conservation request because of concerns about shallow land disposal in the trenches and landfill and concerns that the wells would not meet the long-term performance objectives of DOE Order 5820.2A. Below-ground disposals were terminated in 1994. The wells in concrete silos and the pipe-lined auger hole wells are still used for retrievable storage of very high-range, remote-handled LLW. The landfill was also closed in 1992 for disposal of very low activity waste. The unlined trenches were phased out for animal wastes in 1992 and for other biological wastes in early 1993.

The IWMF is the only active above-grade tumulus disposal facility in SWSA 6, occupying an area of approximately 3.8 ha (9.5 acres) in the southwest portion of SWSA 6. The IWMF began operation in December 1991 and will provide interim disposal for contact-handled LLW. The original facility was designed for six tumulus pads. Each tumulus pad is approximately 18.2 m x 27.4 m (60 x 90 ft) and 38.1 cm (15 in.) thick, constructed using high-density concrete and reinforced with epoxy-coated steel. The pad has concrete curbs 0.30 m (1 ft) high on the north, south, and west sides. The east side is used for vehicle access. Each pad provides disposal for approximately 330 vaults (approximately 897 m^3 (31,680 ft^3)) stacked three high.

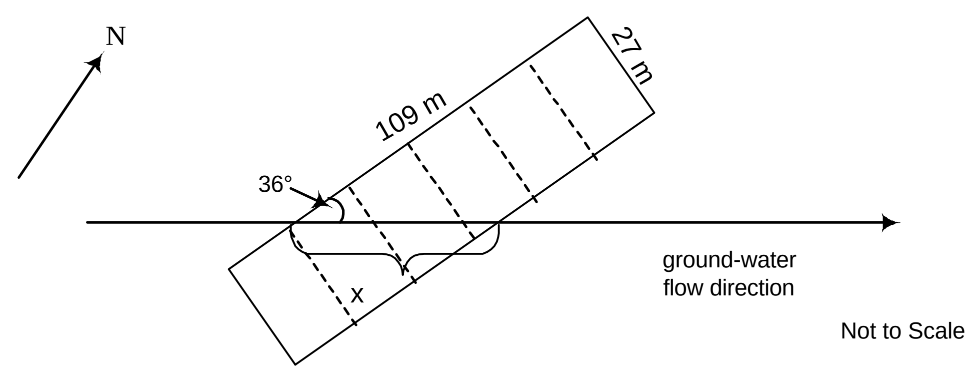
The IWMF is designed to divert water into three sumps, located in a monitoring station adjacent to the tumulus pads. The monitoring station is equipped for receiving, monitoring, and collecting sample from flows received from the storm water, underpad, and infiltration drain systems. The underpad sump is designed to allow monitoring of any ground water that may accumulate under the pads. The storm water sump collects water from the pad that is in operation. The infiltration sump is used to collect water from the pads that have been filled with vaults. A principal feature of tumulus disposal is the inherent capability for monitoring ground water and surface water for contamination. The sealed concrete pad is the primary barrier from the ground water. The pad is sloped 1 percent to one side where a curb and gutter collects all surface pad runoff and drains the water to a monitoring station. A liner below the pad provides a secondary barrier from the ground water and collects any water that may have penetrated the pad, which is then also diverted to the monitoring station.

A.6.3 Scaling Factor

Assumptions for determining scaling factor:

1. IWMF is the only active disposal facility (ORNL, 1997b, pages 3-45 to 3-68).
2. Ground-water flow is roughly west-to-east.
3. IWMF is composed of Pads 1 through 6, each 27 m by 18.2 m (ORNL 1997b, p. 3-65).
4. Orientation of the IWMF with ground-water flow as shown (ORNL 1997b, p. E-28).
5. Use PE tumulus values.

Figure A-7. ORR Facility Analysis Configuration



$$\sin 36° = \frac{27m}{x}$$

$$x = \frac{27m}{\sin 36°} = 46m$$

Effective length parallel to ground-water flow = 46 m
SF = 50 m/46 m = 1.087

A.7 Savannah River Site

A.7.1 Site Description

Location: The Savannah River Site (SRS) is located in south-central South Carolina and occupies an area of approximately 300 mi^2 (192,000 acres). Ranging from 25 m to 130 m above mean sea level, the site's major geophysical feature is the Savannah River, which forms the area’s southwestern boundary.

Historical Activities: The U.S. Government began constructing the SRS in 1950. The Site's current missions are site remediation and safe processing of nuclear materials. In 1987, the Department directed new disposal facilities constructed in humid climates to be "decoupled from the ground-water table." To comply with this directive, a project to build disposal vaults, called the E-Area Vaults, was initiated.

A.7.2 E-Area Vaults and Slit Trenches

A.7.2.1 Facility Description

Status: The E-Area occupies a 78.9-ha (195-acre) area, approximately 10 km (6 miles) from the nearest plant boundary. Radioactive solid waste produced at the SRS as well as off-site DOE shipments are disposed in one centrally located site. The original 31-ha area began to receive waste in 1953 and was filled in 1972, when operations were shifted to a contiguous 48.1-ha site. In 1986, part of the site was closed and designated as a mixed waste facility because it contains hazardous material. Because these older facilities are filled, disposal is now shifted to the 40.5-ha (100-acre) E-Area Vaults and slit trenches to the north.

Waste Materials: LLW handled at the E-Area is segregated for disposal according to three main categories: Low Activity Waste (LAW); Intermediate Activity Waste, which is also referred to as Intermediate Level Waste; and, waste material for disposal in slit trenches.

LAW is waste material that radiates ≤200 mR/hr at 5 cm from an unshielded container. Intermediate Level Waste is waste material that radiates ≥200 mR/hr at 5 cm from an unshielded container. Intermediate Level Waste is further categorized into Intermediate Level Tritiated (ILT) Waste and Intermediate Level Non-Tritiated (ILNT) Waste. Tritiated waste is waste material that contains greater than a trace quantity of tritium (trace quantity is defined as ≤10 Ci of tritium per waste container) regardless of the radiation rate. Any LLW, whether it is Intermedite Level Waste or not, that is tritiated waste is disposed in an ILT Vault.

Waste material to be disposed in slit trenches is generally soil and rubble that has the potential to be contaminated with radionuclides (i.e., "suspect soil") but is neither tritiated waste nor designated as LAW or Intermediate Level Waste.

General Design Features: The E-Area currently has one LAW Vault and one ILT/ILNT Vault. Two more LAW Vaults are considered planned, with one becoming operational by the end of 2005. Vaults are of concrete construction and are divided into cells.

The three LAW vaults are oriented in a general east-west direction and consist of two or three major subdivisions (modules) with each module containing four cells. The combined disposal capacity of the three LAW vaults is approximately 112,000 m^3.

The ILT/ILNT Vault is one structure oriented in a general east-west direction that has segments comprising vaults for ILT Waste and ILNT Waste. The structure, is 189 feet long by 48 feet wide by 29 feet tall with approximately 7300 m^3 of disposal capacity.

The E-Area also currently contains three slit trenches which are shallow land burial trenches. The trenches are oriented in a general northeast-southwest direction. The dimensions of each slit trench are 6 m wide by 200 m long by 6 m deep. Each trench provides approximately

26,000 m^3 of waste disposal capacity. Based on its current configuration, it is estimated that the E-Area could accommodate at least 286,000 m^3 of disposed waste in slit trenches.

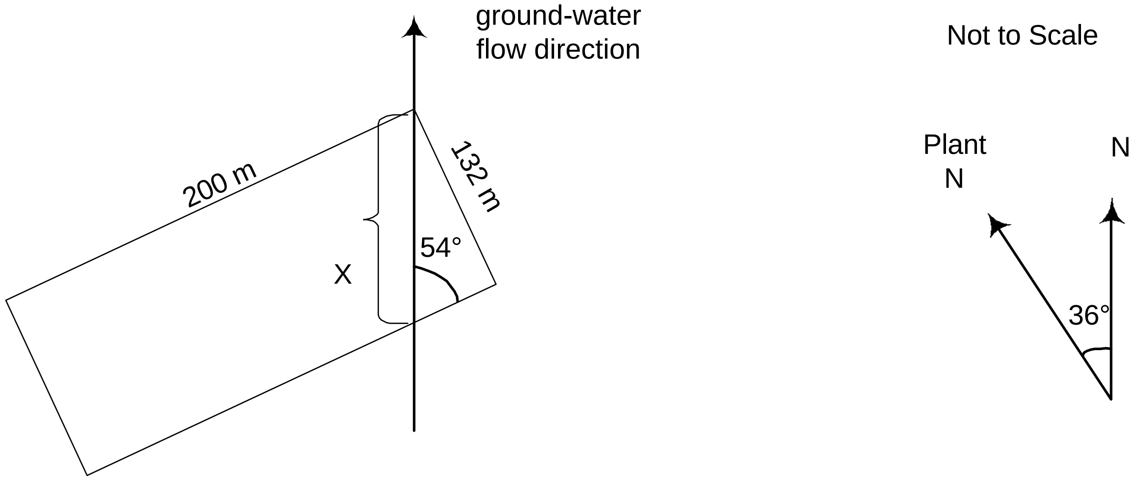
A.7.2.2 Scaling Factor

Assumptions for determining scaling factors:

1. Three separate disposal areas: LAW Vaults, ILT/ILNT Vaults, and slit trenches (based on map provided by site).
2. Ground-water flow is south-to-true north (MMES, 1994, Fig. 3.4-3).
3. Active disposal in three LAW Vaults (1, 2, and 3), one ILT/ILNT Vault, and three slit trenches.
4. An expansion area is available for additional slit trenches.
5. Use PE vault values (Waters and Gruebel, 1996, Table SRS-3) for LAW and ILT/ILNT vaults; scale based on assumed length of vault facility parallel to ground-water flow used in PE vault analysis (250 m) (Waters and Gruebel, 1996, p. A-SRS-6), and use PE trench values for slit trenches.

Savannah River LAW Vaults
Orientation as shown.

Figure A-8. SRS LAW Vault Analysis Configuration



$$\sin 54° = \frac{132m}{x}$$

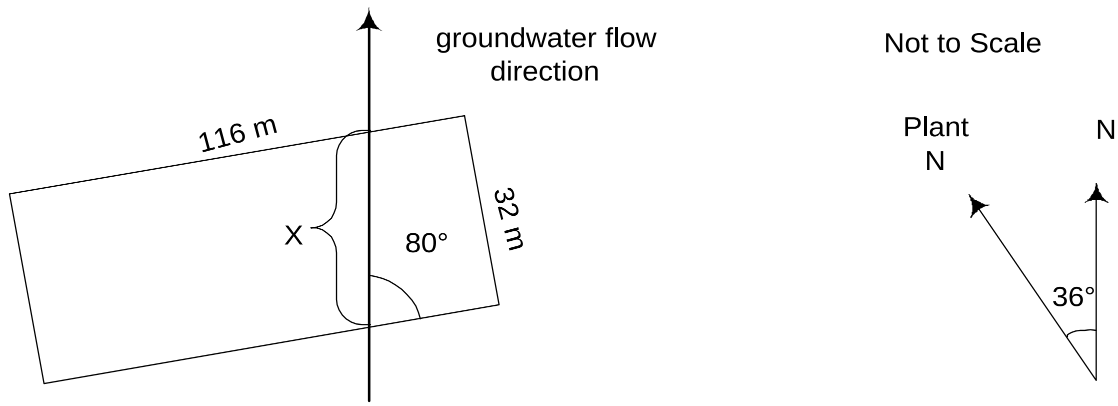
$$x = \frac{132m}{\sin 54°} = 163m$$

Effective length parallel to ground-water flow = 163 m; SF = 250 m/163 m = 1.534

Savannah River ILT/ILNT Vaults
Orientation as shown

$$x = \frac{32\,m}{sin80°} = 32.5$$

Figure A-9. SRS IL Vault Analysis Configuration

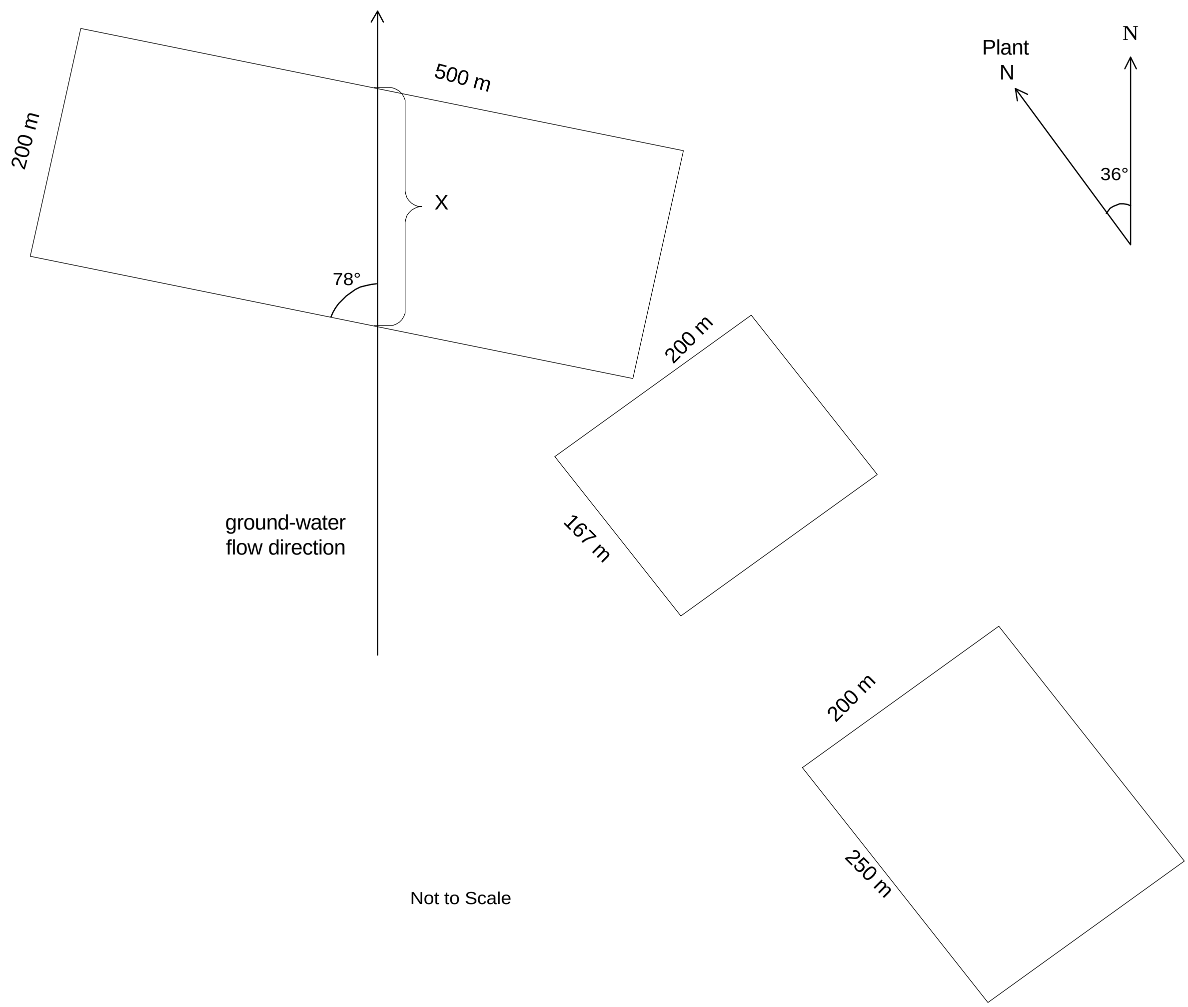


$$sin80° = \frac{32m}{x}$$

Effective length parallel to ground-water flow = 32.5 m
SF = 250 m/32.5 m = 7.69

Savannah River Slit Trenches
Orientation as shown.

Figure A-10: SRS Slit Trench Analysis Configuration



$$sin78° = \frac{200m}{x}$$

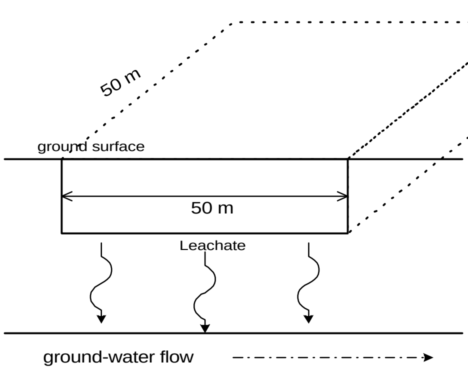
$$x = \frac{200m}{sin78°} = 204m$$

Effective length parallel to ground-water flow = 204 m
SF = 50 m/204 m = 0.245

Attachment 1: Scaling Factors for the Water Pathway at Disposal Sites

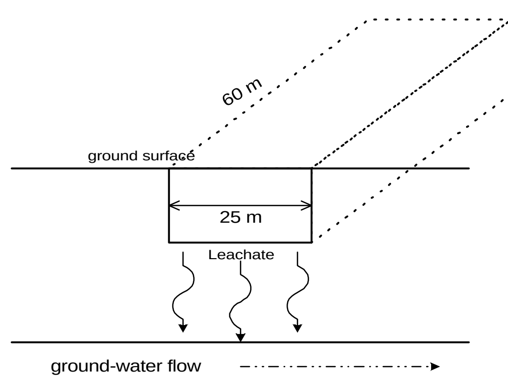
This attachment illustrates how the scaling factor (SF) used in estimating disposal facility radiological capacity was determined for each site. Based on the performance evaluation (PE) methodology (Waters and Gruebel, 1996) for the water pathway, the length of a disposal facility parallel to the flow of ground water is an important parameter in estimating the radiological capacity of the facility. The PE values are based on a generic disposal facility that is 50 m in length by 50 m in width (Figure 1a). Disposal facilities oriented with the long dimensions perpendicular to ground-water flow (Figure 1b) will have higher permissible radionuclide concentrations in waste for the water pathway than facilities oriented with the long dimension parallel to ground-water flow. $C_{W\text{-}Water}$ represents the permissible concentration in waste for the water pathway, and $SC_{W\text{-}Water}$ represents the scaled permissible concentration in waste for the water pathway.

Figure 1. Example of a permissible radionuclide concentration in disposed waste (a) for the generic disposal design in the PE and (b) that is based on scaling of the relative lengths parallel to ground-water flow of the generic PE facility and an actual disposal facility ($SC_{W\text{-}Water}$).



EXAMPLE:
For radionuclide *I*,
$C_{W\text{-}Water} = 1000\ \mu Ci/m^3$

(a) Generic PE design



EXAMPLE:
For radionuclide *I*,
$SC_{W\text{-}Water} = 1000\ \mu Ci/m^3 * (50\ m/25\ m)$
$= 2000\ \mu Ci/m^3$

(b) Example disposal facility

For a disposal facility with a length parallel to ground water that is different from that of the generic facility in the PE, the lengths are scaled accordingly, with the resulting scaling factor (SF) used to determine a new permissible radionuclide concentration in waste for the water pathway. The SF for a disposal facility is determined by

$$SF = \frac{Length_{PE}}{Length_{Site}} \qquad \text{(Eq. 1)}$$

where $Length_{PE}$ is the PE generic disposal design length that is parallel to ground-water flow (50 m), and $Length_{Site}$ is the length of the site-specific disposal facility that is parallel to ground-water flow (m).