APPENDIX E

NEW DISPOSAL FACILITY ALTERNATIVES

Chapter 2 of this environmental impact statement (EIS) defines four alternative waste management strategies (No Action, Dedication, Elimination, and Combination) for the modification of SRP waste management activities. In its Record of Decision, the U.S. Department of Energy (DOE) will select a strategy based on its evaluations of optional technologies that will conform to the objectives of the strategy and will achieve regulatory compliance. Section E.1 describes the various project-specific technologies being considered under each waste management strategy. Section E.2 describes the wastes that will require disposal. Section E.3 discusses the methodology through which candidate sites were identified to provide a basis for certain project-specific environmental analyses (e.g., groundwater modeling). Section E.4 identifies the project-specific technologies associated with each strategy and describes the advantages and disadvantages of implementation, the range of waste volumes currently anticipated, the range of potential costs associated with implementation, and the major analytical assumptions. TC

The objective of this appendix is to describe the technologies that could be used to implement each strategy to provide a basis for defining the range of environmental impacts expected (see Appendix G). This range, rather than specifically defined impacts, is intended to cover the potential project-specific actions that will be decided through planning and feasibility studies during the regulatory permitting process. These project-specific actions are associated with site selection, engineering design details, waste stream characteristics and volumes, closure of existing waste sites, predisposal treatment facilities, cost effectiveness, regulatory requirements, and judicial mandates. For the analysis of environmental impacts, this EIS makes conservative assumptions about project-specific actions to describe impacts that include all known reasonable waste management possibilities. TC

E.1 DESCRIPTION OF TECHNOLOGIES

This section describes the project-specific technologies being considered for the disposal and/or storage of hazardous, mixed, and low-level radioactive wastes. (Note: The term "disposal" refers to the permanent deposition of wastes in an engineered facility; the term "storage" presumes retrieval of the waste at some future time; the term "technology" means a project-specific technology or action; and the term "strategy" implies a means of achieving a specified waste management goal through the implementation of any of several optional project-specific technologies.) TE

E.1.1 HAZARDOUS OR MIXED WASTE

E.1.1.1 Applicable Regulations and Criteria

The management of hazardous waste and mixed (radioactive and hazardous) waste at the Savannah River Plant (SRP) is regulated by the Resource Conservation and Recovery Act (RCRA), the Hazardous and Solid Waste Amendments (HSWA), and

DOE Orders. Chapter 6 discusses these acts and amendments and other applicable regulations.

TE Predisposal treatment of these wastes might be required with all of the disposal technologies. Currently, RCRA prohibits the disposal of bulk or uncontainerized liquid waste or waste containing free liquids until they are treated chemically or physically (e.g., by mixing with a sorbent solid), such that free liquids are no longer present as defined by the regulations (i.e., the paint filter test).

TC Under the 1984 Amendments to RCRA (i.e., HSWA), the U.S. Environmental Protection Agency (EPA) will restrict or ban the land disposal of most untreated hazardous wastes over the next 5 years. These amendments require the treatment of hazardous wastes to remove their most toxic components, allowing only the treatment residue to be disposed of on land.

EPA's first action under this requirement applies to spent solvents and wastes that contain dioxin. Other materials to be affected include liquid hazardous waste containing cyanides, metals, and polychlorinated biphenyls (PCBs); corrosive wastes; and both liquid and solid hazardous wastes containing halogenated organic compounds (HOCs). To implement these requirements, EPA is establishing predisposal treatment standards based on actual performance of the best demonstrated treatment technologies available.

Under RCRA, EPA could consider a request from DOE for an exemption to the land disposal ban. EPA's approval would have to be based on its determination that no migration of hazardous constituents would occur from the waste management unit.

Predisposal treatment of hazardous or mixed waste for volume reduction, detoxification, and chemical or physical stabilization might be desirable and cost effective, regardless of the legal requirements. Appendix D describes the application of predisposal treatment, which will be determined specifically in the context of future advanced planning designed to carry out the selected waste management strategy.

E.1.1.2 Belowground Vault Disposal (RCRA Waste)

TC One technology being considered for shallow-land disposal of hazardous or mixed wastes is the double-lined, reinforced-concrete vault. A typical disposal vault would be a large, water-tight, reinforced-concrete box set below the surface of the ground on an exterior liner of compacted clay. Each vault would be divided into cells for the disposal of the different types of hazardous waste. A membrane liner in each cell would ensure containment of any leakage within that cell. A leachate (or leakage) collection system would be installed in each cell above the concrete liner (floor), and a leachate monitoring and collection system would be installed between the concrete floor and the compacted clay liner. Prior to closure, any rain or run-on would be collected and disposed of properly.

Hazardous or mixed wastes, delivered to the vaults in containers, would be placed in the cells in layers. As each layer in a cell was completed, voids would be filled with grout and the layer would be capped with about 0.3 meter of reinforced concrete. After capping, the cells would be sealed by a sloped, reinforced-concrete roof and covered with approximately 1 meter of soil. The closed facility would appear to be a mound at the ground surface. Space utilization efficiency would be about 66 percent.

Vaults for mixed waste would be nearly identical to those for hazardous waste, because no additional shielding would be required for radiation protection. However, intermediate-activity mixed waste (greater than 300 millirem per hour) would be handled by remote-controlled or shielded equipment and would be immediately grouted in place and covered by approximately 0.6 meter of concrete to provide the required occupational shielding.

This technology relies primarily on the design and integrity of the structure and its backup systems to ensure that hazardous or mixed waste constituents do not migrate from the facility into the surrounding soils or groundwater. The following features facilitate this objective:

- A water-tight concrete structure that prevents the entry of water into the facility and provides long-lasting stability
- Grouting of void spaces to improve stability and minimize channels through which water or liquids could percolate
- An interior synthetic-membrane (primary) liner that prevents the release of contaminated water or liquids from the facility
- A leachate collection system above the primary liner to provide a means of detecting and removing accumulated liquids
- A backup (secondary) liner consisting of at least 1.5 meters of compacted clay or the equivalent
- A secondary leachate collection system to provide a means of detecting and removing contamination outside the primary liner
- Placement below the surface of the ground to protect the structure and provide radiation shielding

E.1.1.3 Aboveground Vault Disposal (RCRA Waste)

The aboveground vault technology is similar to that of belowground vaults. This technology responds to the statement in the Notice of Intent to have the analysis of new disposal facility alternatives include an evaluation of aboveground disposal.

Section E.1.1.2 contains a description of the aboveground vault technology, except the aboveground vault is constructed at or near the natural surface of the ground with its concrete sides and roof protruding above the surface. A mixed waste facility could require allowances for additional radiation shielding or interior locational preferences for the disposal of intermediate-activity waste.

This technology relies on the design and integrity of the structure and its backup systems to ensure that hazardous and mixed waste constituents do not migrate from the facility into soils or groundwater. The features facilitating this objective are the same as those listed in Section E.1.1.2, except the vault is above the ground. A unique feature of this technology is its construction at the surface of the ground. This eliminates the need for substantial excavation and reduces the difficulty of monitoring, inspection, and repair, which could enhance its long-term reliability.

E.1.1.4 Vault Disposal (Cement/Flyash Matrix Waste)

A technology for the disposal of selected wastes involves predisposal treatment by solidification in a cement/flyash matrix (CFM) and discharge as a slurry directly into reinforced-concrete vaults, where it cures in-place to a hard, concrete-like substance. Currently, this technology is being considered for the disposal of mixed waste sludges from the M-Area effluent treatment facility (ETF), the F/H ETF, the Fuel Production Facility ETF, and the Naval Fuel Materials Facility wastewater-treatment plant, plus ash from the incineration of hazardous, mixed, and low-level radioactive wastes.

Treatment facility sludges and incinerator ash would be delivered to the treatment/disposal facility by tank truck and unloaded to a storage tank capable of holding 1 month's generated volume. Before disposal, the waste would be blended into a cement/flyash mixture that would be transported to disposal vaults for discharge and curing.

A typical disposal vault would be a large, reinforced-concrete box set either below the surface of the ground or at the surface. Each vault would be divided into cells to allow the pouring of discrete units of CFM waste and would have rain covers to help keep the chambers dry. Water that entered the facility before closure would be collected, monitored, and properly disposed of.

Closure of a filled vault would involve the placement of a concrete cover or roof, which would be either cast in place or precast in sections. A belowground vault would be covered with soil to grade; an aboveground vault would remain exposed or would be mounded with soil to protect the facility and provide added radiation shielding.

The vault technology for CFM disposal differs from the RCRA vaults (Sections E.1.1.2 and E.1.1.3) because it has no liners and no leachate collection systems. Rather, it relies on the solidification of the waste and the concrete structural barrier to prevent the release of waste constituents and to maintain environmental standards. The following features facilitate this waste management objective:

- Pretreatment by CFM solidification, which provides chemical and physical stability of the waste and resists leaching of constituents
- Direct discharge of the slurried mixture into the facility for curing in place, which eliminates channels into or through the waste and further resists leaching of constituents
- Concrete vault containment, which provides a structural barrier between the solidified waste and the environment

TC

- Limitation to specific wastes that are particularly suitable for solidification pretreatment

This technology relies extensively on the solidification pretreatment to prevent release of constituents and to render the waste potentially nonhazardous and eligible for delisting under RCRA. Without this pretreatment, RCRA technology standards would apply. Any future evaluations of this technology should include the predisposal treatment facilities as an integral component.

E.1.1.5 RCRA-Type Landfill Disposal

A RCRA-type landfill facility for hazardous or mixed waste consists of double-lined trenches, cells, or pits with double leachate collection systems. The first liner would be of clay compacted on the bottom and sides of the trench. This would be overlain by a leachate collection system consisting of a permeable material such as sand or crushed stone. An impermeable synthetic membrane liner would be placed above this, followed by another leachate collection system. The final layer would be a working surface of crushed stone. The waste containers would be unloaded and stacked on this surface. TC

Mixed waste emitting radioactivity of more than 300 millirem per hour (intermediate-activity waste) would be handled remotely or with shielded equipment. Containers of such waste would be placed at the bottom level and shielded horizontally and vertically with containers of material emitting less than 300 millirem per hour (low-activity waste).

As a trench was filled, closure would consist of filling void spaces with sand, covering the facility with a low-permeability synthetic membrane, and protecting that membrane with layers of sand, a low-permeability clay cap, and soil. The cover membrane would be fused to the base membrane to provide a water-tight enclosure for the waste. Total space utilization efficiency in the trench would be about 49 percent.

After closure, the ground surface above the facility would be contoured to channel surface runoff away from the landfill and would be seeded with grass or other shallow-rooted vegetation to stabilize the soil and mitigate erosion.

During the operation of the facilities, run-on and leachate water would be collected and monitored. This water would be disposed of in accordance with RCRA regulations. C-114

As with other RCRA facilities, this landfill relies largely on the design and structural integrity of the facility and its backup systems to ensure that hazardous or mixed waste constituents do not migrate from the facility into the surrounding soils or groundwater. The following features facilitate this objective:

- A water-tight sealed membrane that completely surrounds the waste to prevent the entry of water into the facility or the release of potentially contaminated water from the facility

- Sand-filled void spaces to improve stability

- A leachate collection system above the primary (synthetic-membrane) liner to provide a means of detecting and removing accumulated liquids

TE

- A backup (secondary) liner consisting of at least 1.5 meters of compacted clay or the equivalent (40 CFR 264.301)
- A secondary leachate collection system to provide a means of detecting and removing contamination outside the primary liner
- Placement below the surface of the ground to provide structural support, protect the liners, and provide radiation shielding of mixed waste

E.1.1.6 Retrievable-Storage Buildings

The buildings being considered for the retrievable storage of hazardous or mixed wastes would be of metal and/or concrete construction, designed and operated to prevent releases of hazardous or radioactive wastes. Wastes would be delivered to the buildings in containers (e.g., 208-liter drums or 2.5-cubic-meter steel boxes) for storage. Interior partitions would segregate noncompatible wastes. The design of mixed waste facilities would include varying degrees of radiation shielding. Access aisles would facilitate the handling and periodic inspection of the waste containers. Due to the space devoted to items other than waste storage, the estimated space utilization efficiency of such a storage building is 15 to 20 percent.

The long-term storage of hazardous and mixed wastes in a safe and secure manner depends on the design and reliability of the storage facilities and a cognitive operational program. The building design would include the following specific features:

- Separate drains and alarmed sumps for the recovery of any liquids from each partitioned area
- Smoke and fire detection, and automatic foam fire control systems
- Ventilation systems with vapor and radiation detectors to provide occupational protection and warning of potential leakage
- In mixed waste facilities, the routing of ventilated air through high-efficiency particulate filters to preclude the release of radioactive particles

TC

Operations would include waste analysis, site security, periodic inspections of the waste containers and the facility, personnel training, emergency preparedness and procedures, SPCC plans, recordkeeping, and reporting.

TE

The objective of the retrievable-storage technology is to store waste temporarily in anticipation of the development of improved technologies for destruction, detoxification, recycling, or disposal. Pretreatment prior to storage might foreclose future options. Therefore, pretreatment generally is neither required nor desired, with the exception of some forms of volume reduction (e.g., compaction, shredding) to reduce bulk, usually by eliminating air spaces.

TC

The retrievable-storage technology has a major disadvantage; that is, by itself it could not provide a permanent waste management solution. Future expenditures for construction of treatment or disposal facilities, retrieval of the stored waste, decontamination of the storage facilities, and operation of those treatment or disposal facilities would be required. TC

E.1.2 LOW-LEVEL RADIOACTIVE WASTE

E.1.2.1 Applicable Regulations and Criteria

DOE has published general guidelines and policies for the management of low-level radioactive waste in the form of DOE Orders; these are summarized in Chapter 6.

E.1.2.2 Engineered Low-Level Trench Disposal

The engineered low-level trench (ELLT) is a technology for the disposal of low-activity (less than 300 millirem per hour) waste. A typical ELLT disposal facility would consist of an open trench, 40 to 50 meters wide and 150 to 170 meters long, with a floor of crushed stone. Low-activity waste in steel containers would be delivered to the trench, unloaded, and stacked on the crushed stone base. The trench would be closed as it was filled. Sand, soil, or other suitable material would be used to fill void spaces; it would be overlain by a cap of clay, fill, and topsoil. The ground surface would be seeded, and surface water would be channeled away from the facilities to minimize infiltration of the water and erosion of the cap. Subsidence that occurred after closure would be corrected as necessary to eliminate ponding above the trench. The use of metal containers should delay subsidence for some time. TC

Because the ELLT technology includes no engineered barriers or leachate collection, it relies on site selection, a well-constructed low-permeability cap, and postclosure maintenance to minimize the intrusion of water into the closed trench and prevent excessive migration of waste constituents.

E.1.2.3 Vault Disposal

DOE is considering the use of vaults for the disposal of low- and intermediate-activity waste. A typical low-activity disposal vault is a large, reinforced-concrete box set either below or at the surface of the ground. The interior can be open or divided into cells, as appropriate, to accommodate facility operations and waste handling.

Typically, waste would be delivered to the facility in metal containers, which would be packed closely in the vault to minimize void spaces. When it was filled, the vault would be closed with a concrete cap or roof to seal the waste inside. A belowground vault would be covered with soil to grade and the surface would be contoured to channel runoff away from the facility. An aboveground design would remain exposed or would be mounded with soil to protect the vault from weathering or to provide additional radiation shielding.

Due to the relatively low concentration of contaminants in the low-activity waste fraction, this technology requires no additional clay or membrane liners and no leachate collection systems. The low-activity vault relies largely on the sealed concrete structural barrier, the siting, and the surface drainage to minimize the intrusion of water, which could leach waste constituents into underlying soils and groundwater.

The vault design for intermediate-activity waste is similar structurally to that for the low-activity vault; however, due to the higher concentration of radionuclides, the design may contain a complete exterior leachate collection system and a secondary barrier of compacted clay or other suitable material. Containerized or bulk intermediate-activity wastes could be grouted in place to fill void spaces and add stability, or added stability could be incorporated into the structure. Closure would be similar to that described for the low-activity vault.

The vault technology for intermediate-activity, low-level waste differs from that for the RCRA vault; it may contain a single leachate collection system and exterior liner rather than the double (interior and exterior) leachate collection systems and liners required for RCRA facilities. On the other hand, the intermediate-activity vault design requires added stability by either in-place grouting or structural design to minimize the possibility of subsidence and the intrusion of water to ensure that radionuclides are contained within the facility.

DOE Orders require predisposal treatment (i.e., solidification) prior to disposal of liquid low-level waste using vault technologies. Other pretreatments (i.e., volume reduction) are not required but might be desirable to enhance stability or improve the efficiency and cost effectiveness of space utilization.

E.1.2.4 Abovegrade Operations

DOE is considering an abovegrade operation (AGO) for the disposal of low-activity, low-level radioactive waste; however, this technology can be used for the disposal of both low- and intermediate-activity wastes. An AGO consists of a stable stack of waste-filled containers, surrounded by a low-permeability synthetic membrane. Typically, an AGO facility includes a subbase of compacted clay covered by the membrane. A layer of sand protects the membrane and facilitates a leachate-collection field. A geotextile layer separates the sand from the final layer of crushed stone. The subbase is sloped to aid in the collection of run-on water and leachate during operation and after closure.

Wastes would be delivered to the AGO in steel containers, which would be unloaded and stacked on the crushed stone base mat. Intermediate-activity (greater than 300 millirem per hour), low-level wastes that require added shielding would be handled by remotely controlled equipment and placed in specially prepared precast reinforced-concrete casks near the center of the pile.

The AGO would be closed with sand to fill void spaces and clay, a low-permeability synthetic membrane, and a final cover of soil. The cover membrane would be fused to the base membrane to form a water-tight sealed envelope around the stacked waste containers. This should prevent the generation of leachate from the facility; however, any water collected from beneath the facility would be tested and, if contaminated, would be solidified in concrete and disposed of as low-level waste.

An AGO unit typically measures 50 to 60 meters wide by 150 to 160 meters long at the base; following closure, it would be about 9 meters high.

AGO technology relies primarily on a stable soil base and the waste containers for structural stability and on the synthetic membrane to minimize the intrusion of water and prevent excessive migration of waste constituents. The leachate collection system provides early warning of a leakage and a means to remove contaminated liquids. The aboveground design provides relatively easy access to the facility to conduct appraisals and effect necessary repairs.

As with other low-level waste disposal technologies, liquid wastes must be pretreated (i.e., solidified) before disposal. Other pretreatments might be desirable to enhance stability or improve space utilization.

E.1.2.5 Greater Confinement Disposal

DOE is considering greater confinement disposal (GCD) technologies for the disposal of intermediate-activity, low-level wastes that require a greater degree of isolation from the environment than low-activity wastes. GCD technology involves deeper burial, and hence more shielding, than the ELLT technology; encapsulation of the waste forms after emplacement with grout; and closure to prevent root intrusion and minimize the percolation of water to the waste.

The SRP could use either of two types of GCD facilities - boreholes and trenches. In a typical GCD borehole design, waste is placed in a liner that is 2.1 meters in diameter and 6.1 meters high; the liner rests on a 0.3-meter-thick concrete pad in an augered hole with a diameter of 2.7 meters. The top of the base pad is generally 9 meters below grade and at least 3 meters above the expected high water table. The top of the waste placed in the liner is typically at least 3 meters below grade. The liner is surrounded by a 0.3-meter-thick annulus of grout. Waste in 208-liter drums would be placed in the liner in layers six drums deep and the void space would be filled with grout. The liner would be capped with 0.3 meter of concrete and overlain with a cap of clay, sand, and topsoil. The surface would be seeded and surface water would be channeled away from the holes to eliminate infiltration of the water and erosion of the cap. TE TE

GCD trenches have the same shielding objectives as GCD boreholes. Typically, a facility would consist of a concrete-lined trench with a low-permeability membrane liner. A typical trench might be 7 meters wide, 122 meters long, and 7.5 meters deep. Waste in steel containers or bulky, uncontainerized wastes would be placed in the trench in layers about 0.3 meter from the walls. The void spaces would be filled with grout and the trench would be capped with 0.6 meter of reinforced concrete overlain by a cap of clay, sand, and topsoil. The surface would be seeded and surface water would be channeled away from the trench to eliminate infiltration of the water and erosion of the cap. TE

Total space utilization efficiency would be about 50 percent for trenches and about 40 percent for boreholes. Monitoring wells and leachate collection systems are included in the design of both types of GCD facilities to detect and recover any contaminated water.

GCD technology relies on the following design features to ensure that low-level waste constituents are not released:

- Proper siting to provide adequate depth of disposal, and at least 3 meters between the waste and the expected high water table to prevent contact of the waste with groundwater
- A concrete structure to prevent the intrusion of water into the facility or the release of potentially contaminated water from the facility
- A low-permeability clay cap to divert downward percolating water away from the facility
- Grout encapsulation of the waste after emplacement to improve stability and eliminate channels through which water could flow in contact with the waste
- Backup leachate monitoring and collection systems to provide warning of a release and a means of recovering contaminated liquids

This technology requires predisposal treatment of any liquid wastes (e.g., solidification). Other pretreatments to enhance stability or improve space utilization might be desirable and cost effective.

E.1.2.6 Engineered Storage Buildings

The retrievable-storage alternative for low-level waste involves the segregation of low-activity from intermediate-activity material. The low-activity material is stored in unshielded or lightly shielded facilities. Intermediate-activity material requires heavier radiation shielding and remote handling.

The storage facilities for low-activity wastes would be concrete or metal buildings. The use of concrete block as lining of the walls provides some additional shielding in some buildings.

The building design includes floor drainage sufficient to recover any liquids; heating and ventilation; and fire, smoke, vapor, and radiation detection systems and automatic fire extinguishing systems. Low-activity wastes would
TE be stored in steel containers in racks to facilitate handling and inspection.

Storage of intermediate-activity wastes would occur in concrete buildings or vaults, either above or below the ground, to provide adequate radiation shielding. Each facility would be water-tight and have drainage collection; heat and ventilation; fire, smoke, vapor, and radiation detection, and fire extinguishing systems as required. Intermediate-activity wastes would be stored in steel containers that are handled and inspected remotely.

The objectives of the retrievable-storage technology for low-level radioactive waste are to (1) store waste temporarily in anticipation of the development of
TE more advanced technologies for suitable disposal, and (2) store waste until the radionuclides have decayed to such a point that its disposal using available technology would not violate applicable standards.

This technology requires no pretreatment of wastes other than the immobilization of liquids. Other pretreatments might be desirable (e.g., compaction, shredding) to enhance space utilization efficiency.

The major disadvantage of retrievable storage for low-level waste is the need for future expenditures for retrieval, decontamination, treatment, and/or disposal facilities. TE

E.2 WASTES REQUIRING DISPOSAL

The planning and design of new disposal facilities rely to a great extent on the ability to forecast the volume and the important characteristics of the wastes (i.e., physical state, chemical composition, etc.) to be disposed of. SRP operations generate five basic classes of waste [hazardous, low-level radioactive, mixed, high-level radioactive (including TRU waste), and nonhazardous/nonradioactive]. Some of these wastes can be treated before disposal and some cannot. Some wastes are stored and others are disposed of. Further, the storage or disposal technology that is chosen might require or prevent certain kinds of waste treatment that, in turn, can greatly affect both the volume and the characteristics of the waste. This EIS is concerned only with hazardous, mixed, and low-level radioactive waste; it does not consider high-level radioactive and nonhazardous/nonradioactive wastes, which have been covered by earlier planning efforts and documentation.

Figure E-1 shows a conceptual model of the various waste streams related to the disposal technologies. This model assumes that all wastes are at, or in transit between, any of four types of facilities: waste generators, waste treatment facilities, interim-storage facilities, or waste disposal facilities (including long-term storage). It also assumes that waste generators are the only facilities that produce waste; generally, such generators can be categorized as plant operations, closure actions at existing waste sites, and off-site governmental generators. Waste treatment facilities might change the volume and character of the waste, but they do not create appreciable volumes of new waste except that resulting from the operation of the facility. Interim-storage facilities are used to store wastes until new disposal or reclamation facilities are available. Disposal facilities are engineered repositories for the permanent placement of wastes. Thus, the total volume of waste to be disposed of and the design capacity of disposal facilities are functions of the time during which the facilities are actively used, the volume of waste generated during that time, and the predisposal and disposal technologies employed. TE

The estimate of waste volumes was based on an operational planning period of 20 years and the use of existing facilities, including interim storage, between the present and the startup of new facilities. For hazardous and mixed wastes, the assumed startup date of new facilities is 1992. For low-level radioactive wastes, an assumed startup date is 1989. TE

At present, site-specific actions at existing waste sites that can have a substantial effect on the volume of waste to be disposed of in the future are: TE

- A determination of those existing waste sites that ultimately will require removal of waste and/or contaminated soil prior to closure

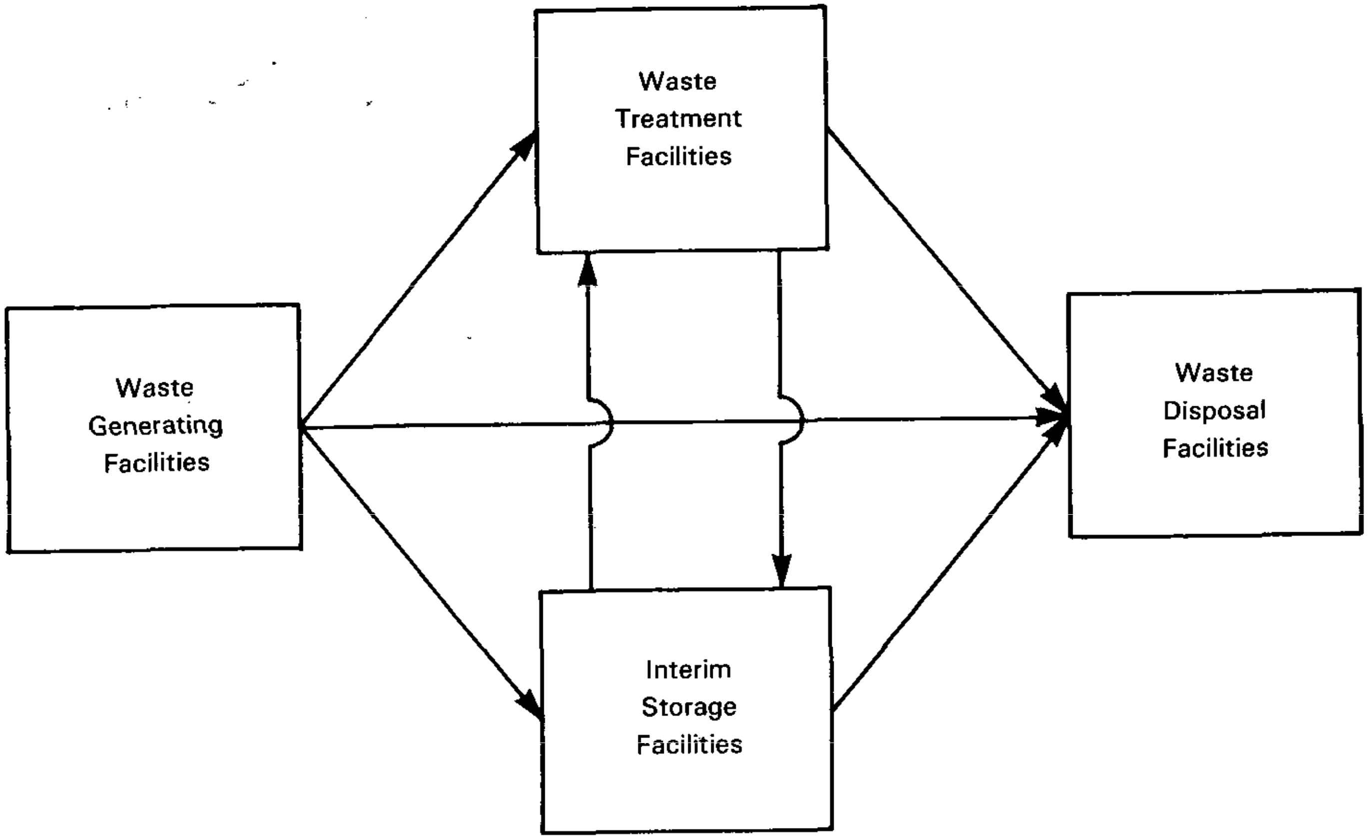

Figure E-1. Integrated Waste Disposal Model

- A determination, based on field testing and examination, of the quantity of waste or contaminated soil to be removed at existing waste sites

- The availability or integration of various predisposal treatment technologies into the management of SRP wastes (see Appendix D)

For the purposes of this EIS, waste volumes are described in terms of a range bounded by upper and lower limit volume figures that are based on current information and certain assumptions. The following assumptions define the upper limit: TC

- Suitable predisposal treatment technologies were assumed if they expand the untreated waste volume, unless a disposal technology requires a specific predisposal treatment (i.e., cement/flyash matrix vault disposal). TE

- Due to the magnitude of waste and contaminated soil at the radioactive waste burial grounds and the mixed waste management facility, total volumes were shown with and without consideration of these sites. TC

The following assumption defines the lower limit:

- Suitable predisposal treatment technologies were assumed if they reduce the untreated waste volume, unless a disposal technology requires a specific predisposal treatment.

These assumptions represent the extreme situations that probably would result in a volume range that bounds the estimated 20-year volumes of hazardous, mixed, and low-level radioactive wastes. TE

Tables E-1 through E-3 summarize available information on SRP waste streams. The first three columns identify the sources or type of facility, the facility, and the waste. The fourth column defines the waste as solid, semisolid, or liquid. Column five lists the untreated volumes of waste estimated for the 20-year period. The sixth column presents the estimated 20-year volume of waste following predisposal treatment by incineration or evaporation (i.e., volume reduction). The seventh column lists the estimated 20-year volume of waste following predisposal treatment by solidification or incineration and solidification. The waste volume ranges provided in Section E.3 were derived from Tables E-1 through E-3, based on the upper and lower limit assumptions previously defined. TC

E.3 SITING OF FACILITIES

For the purpose of providing a basis for particular environmental evaluations in this EIS (e.g., groundwater modeling), the identification of specific sites was necessary. Based on the information currently available, the most likely candidate sites for the construction of new waste management facilities were identified and used. However, at the current stage of planning, detailed site-specific analyses and final site selection have not been completed. This section describes the process by which candidate sites were identified and ranked, the rationale for selecting sites for EIS evaluation purposes, and the continuing process by which the detailed site-specific analyses and final site selection will be carried out. TC

Table E-1. Hazardous Waste Volumes[a] (cubic meters)

Source	Facility[b]	Waste	Physical state[c]	Untreated volume	Treated volume	Solidified volume[d]
Operations	Lab	Organics, Hg, oil	LD	375	9.5[e]	13.3
Operations	Maintenance	Lathe coolant, oil	LD	83	2.0[e]	2.8
Operations	Raw materials	Li-Al dross	SD	291	-	-
Operations	Raw materials	Oil with lead	LD	541	-	-
Operations	Raw materials	TCE sludge	SS	125	9.0[f]	12.6
Operations	Monitoring	Inorganic acids	LD	4	-	-
Operations	Construction	Paint solvent	LD	833	21.0[e]	29.4
Operations	Engineering	Solvents	LD	125	3.0[e]	4.2
Operations	Health protection	Toluene, xylene	LD	4	0.5[e]	0.7
Operations	Forest Service	Pesticides	LD	4	0.5[e]	0.7
Operations	Miscellaneous	Misc. HW	SD	112	9.0[f]	12.6
Storage	HWSF	CMP pit soil similar	SD	1,062	1062.0[g]	1,486.8
Storage	HWSF	CMP pit liquids	LD	33	2.5[f]	3.5
Storage	HWSF	Sodium dichromate	LD	1	0.1[f]	0.14
Storage	HWSF	Trichloroethane	LD	39	2.9[f]	4.06
Storage	HWSF	Methylene chloride	LD	1	0.1[f]	0.14
Storage	HWSF	Hg-contaminated mat'l.	SD	4	0.3[f]	0.42
Storage	HWSF	Machine coolant	LD	16	1.2[f]	1.68
Storage	HWSF	Misc. solvents	LD	1	0.1[f]	0.14
Storage	HWSF	Naphtha-methylene cl	LD	1	0.1[f]	0.14
Storage	HWSF	Nitrates	SD	10	0.8[f]	1.12
Storage	HWSF	Pesticides	LD	2	0.2[f]	0.28
Storage	HWSF	Paint solvents	LD	90	6.8[f]	9.52
Storage	HWSF	Teargas concentrate	LD	1	0.1[f]	0.14
Storage	HWSF	Toluene-isopropanol	LD	12	0.9[f]	1.26
Storage	HWSF	Varnish and thinners	LD	5	0.4[f]	0.56
Storage	HWSF	Waste oil with lead	LD	61	-	-
Storage	HWSF	Waste paint	LD	5	0.4[f]	0.56
Storage	HWSF	Alkalies	SD	7	-	-
Storage	HWSF	Be-Cu alloy	SD	1	-	-
Storage	HWSF	Lead smelter waste	SD	10	-	-
Storage	HWSF	Lab chemicals	LD	2	-	-
Storage	HWSF	Reactive metals	SD	9	-	-
Storage	HWSF	DWPF pilot plant sludge	SS	5	-	-
Storage	HWSF	Misc. HW - incinerable	-	500	25.0[h]	35
Storage	HWSF	Misc. HW - nonincinerable	-	373	-	-
Closure	716-A motor shop S.D.	Cont. soil and waste	SD	900	900[g]	1,260
Closure	Metals burning pit Misc. Chemical Basin	Cont. soil and waste	SD	21,700	21,700[h]	30,380
Closure	Silverton Road waste site	Cont. soil and waste	SD	39,800	39,800[g]	55,720
Closure	Met. lab. basin	Cont. soil and waste	SD	340	340[g]	476
Closure	Burning rubble pits (15)	Cont. soil and waste	SD	25,260	25,260[g]	35,364
Closure	Acid/caustic basins (6)	Cont. soil and waste	SD	3,080	3,080[g]	4,312
Closure	Hydrofluoric acid spill area	Cont. soil and waste	SD	230	230[g]	322
Closure	D-Area oil seepage basin	Cont. soil and waste	SD	5,900	5,900[g]	8,260
Closure	CMP pits (7)	Cont. soil and waste	SD	1,500	1,500[g]	2,100
Closure	SRL oil test site	Cont. soil and waste	SD	150	150[g]	210
Closure	Gunsite 720 rubble pit	Cont. soil and waste	SD	40	40[g]	56

TC

[a] Adapted from Cook, Grant, and Towler, 1987a; and Moyer, 1987.
[b] Number in parentheses indicates number of separate facilities where more than 1 exist.
[c] SD-Solid, LD-Liquid, SS-Semi-solid (sludge).
[d] Solidification of ash or residue with volume increase of 40 percent.
[e] Assumes incineration with volume reduction of 97.5 percent.
[f] Assumes incineration with volume reduction of 92.5 percent.
[g] Assumes incineration for destruction of organics with no volume reduction.
[h] Assumes incineration with volume reduction of 95.0 percent.

Table E-2. Mixed Waste Volumes[a] (cubic meters)

Source	Facility[b]	Waste	Physical state[c]	20-year untreated volume	Treated volume	Solidified volume
Operations	Separations	Hg-contaminated waste	LD	2,266	56.7[d]	79.3[e]
Operations	SRL, SREL	Scintillation fluid	LD	6	0.2[d]	0.2[e]
Operations	H-3 facility	Tritiated oil	LD	170	4.3[d]	6.0[e]
Operations	DWPF	Benzene	LD	3,965	99.1[d]	138.8[e]
Operations	Separations	Hg-contaminated equip.	SD	680	-	-
Operations	H-3 facility	Tritiated mercury	LD	6	-	-
Operations	SRL, H-3 facility	Lead shielding	SD	11	-	-
Operations	FMF	WWTF sludge	SS	6,435	107.3[f]	12,870.0[g]
Operations	F- & H-Area	ETF sludge	SS	39,743[h]	4,967.9[f]	79,486.0[g]
Operations	M-Area	ETF sludge	SS	27,252	3,293.0[f]	5,4504.0[g]
Operations	FPF	ETF sludge	SS	14,534	302.8[f]	29,068.0[g]
Storage	DWPF	Benzene	LD	396	9.9[d]	13.9[e]
Storage	Separations	Hg-contaminated waste	LD	113	2.8[d]	4.0[e]
Storage	Storage tanks	Scintillation fluid	LD	5	0.4[d]	0.5[e]
Storage	H-3 facility	Tritiated oil	LD	119	8.9[d]	12.5[e]
Storage		PCB-contaminated oil	LD	6	-	-
Storage	SRL, H-3 facility	Lead shielding	SD	4	-	-
Storage	H-3 facility	Tritiated mercury	LD	2	-	-
Storage	Separations	Hg-contaminated equip.	SD	227	-	-
Storage	M-Area stg.	ETF sludge (9 mo.)	SS	1,022	123.5[f]	2,044.0[g]
Closure	SLR seepage basins (4)	Cont. soil and waste	SD	2,000	2,000[i]	2,800[e]
Closure	M-Area settling basin	Cont. soil and waste	SD	46,300	46,300[i]	64,820[e]
Closure	Mixed Waste B.G.	Cont. soil and waste	SD	1,477,920	1,477,920[i]	2,069,088[e]
Closure	F-Area seepage basins (3)	Cont. soil and waste	SD	9,410	9,410[i]	13,174[e]
Closure	Old F-Area S.B.	Cont. soil and waste	SD	5,370	5,370[i]	7,518[e]
Closure	H-Area seepage basins (4)	Cont. soil and waste	SD	24,950	24,950[i]	34,930[e]
Closure	Ford Bldg. seepage basin	Cont. soil and waste	SD	170	170[i]	238[e]
Closure	Old TNX basin	Cont. soil and waste	SD	670	670[i]	938[e]
Closure	New TNX basin	Cont. soil and waste	SD	470	470[i]	658[e]
Closure	Road A chem. basin	Cont. soil and waste	SD	1,070	1,070[i]	1,498[e]
Closure	L-Area oil & chem. basin	Cont. soil and waste	SD	740	740[i]	1,036[i]

TC

[a]Adapted from Cook and Grant, 1987; Cook, Grant and Towler, 1987a; and Moyer, 1987.
[b]Number in parentheses indicates number of separate facilities where more than 1 exist.
[c]SD - Solid, LD - Liquid, SS - Semisolid (sludge).
[d]Assumes incineration with volume reduction of 97.5 percent.
[e]Assumes solidification of ash or residue with volume increase of 40 percent.
[f]Assumes pretreatment by evaporation to dry salt form.
[g]Assumes solidification of untreated sludge using Cement/Flyash Matrix with volume increase of 100 percent.
[h]Average estimated 20-year volume.
[i]Assumes incineration for destruction of organics with no volume reduction.

Table E-3. Low-Level Waste Volumes[a] (cubic meters)

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Source	Facility[b]	Waste	20-year untreated volume	Treated volume[c]	Solidified volume[d]
Operations	Tritium	Combustible	20,676	1,034	1,447
Operations	Tritium	Noncombustible	13,784	-	-
Operations	Raw Materials	Combustible	35,806	1,790	2,506
Operations	Raw Materials	Noncombustible	23,870	-	-
Operations	Reactors	Combustible	29,566	1,478	2,070
Operations	Reactors	Noncombustible	19,711	-	-
Operations	Separations	Combustible	125,727	6,286	8,801
Operations	Separations	Noncombustible	83,818	-	-
Operations	Waste Management	Combustible	74,058	3,703	5,184
Operations	Waste Management	Noncombustible	49,372	-	-
Operations	Laboratories	Combustible	24,142	1,207	1,690
Operations	Laboratories	Noncombustible	16,095	-	-
Operations	Services	Combustible	3,711	186	260
Operations	Services	Noncombustible	2,474	-	-
Operations	SRL	Combustible	26,426	1,321	1,850
Operations	SRL	Noncombustible	17,617	-	-
Operations	Other	Combustible	19,534	977	1,367
Operations	Other	Noncombustible	13,023	-	-
Operations	Offsite sources	Combustible	28,302	1,415	1,981
Operations	Offsite sources	Noncombustible	18,868	-	-
Closure	H-Area ret. basin	Cont. soil and waste	6,200	-	8,680
Closure	F-Area ret. basin	Cont. soil and waste	9,200	-	12,880
Closure	Rad. waste burial ground	Cont. soil and waste	1,524,080	-	2,133,712
Closure	R-Area BPOPs (3)	Cont. soil and waste	7,130	-	9,982
Closure	R-Area seepage basins (6)	Cont. soil and waste	8,430	-	11,802
Closure	Ford Building waste site	Cont. soil and waste	400	-	560
Closure	TNX burying ground	Cont. soil and waste	1,220	-	1,708
Closure	K-Area BPOP	Cont. soil and waste	7,700	-	10,780
Closure	K-Area seepage basin	Cont. soil and waste	590	-	826
Closure	L-Area BPOPs (2)	Cont. soil and waste	8430	-	11,802
Closure	P-Area BPOP	Cont. soil and waste	3,870	-	5,418

[a]Adapted from Cook, Grant and Towler, 1987b and Moyer, 1987.
[b]Number in parentheses indicates number of separate facilities where more than 1 exist.
[c]Assumes incineration with average volume reduction of 95 percent.
[d]Assumes solidification of ash volume increase of 40 percent.

E.3.1 GENERAL METHODOLOGY

Currently, the only criteria in RCRA/HSWA or the South Carolina Hazardous Waste Management Regulations (SCHWMR) that govern site selection for hazardous and mixed waste facilities relate to seismic considerations, floodplains, and recharge zones (40 CFR 264.18). There are no specific criteria under DOE Orders for siting low-level radioactive waste facilities (DOE Order 5820.2, Chapter III, Section 3.c). Criteria used in the initial identification and ranking of candidate sites implicitly encompass facility siting criteria established by Executive Orders (i.e., wetlands and floodplains), the Nuclear Regulatory Commission's Licensing Requirements for Land Disposal of (Commercial) Radioactive Waste (10 CFR 61.50) and DOE Orders 5480.2 (Hazardous and Radioactive Mixed Waste Management) and 5820.2 (Radioactive Waste Management).

The general methodology for SRP site selection consisted of three levels of evaluation. Level 1 of the site screening process involved the identification, using topographic maps, of 17 candidate sites that were located on hilltops and ridge-tops.

Level 2 of the analysis employed limited screening criteria, a ranking system, and available site-specific data to rate and rank the 17 sites numerically. It is at this level of the siting methodology that the EIS required site-specific data for evaluation purposes. Therefore, based on the site rankings from the Level 2 analysis plus the professional judgment of the evaluation team, the most likely candidate sites were selected for this purpose.

The ongoing Level 3 analysis consists of the site-specific characterization of the five top-ranked candidate sites in relation to surface water, groundwater, geology, geomechanics, meteorology, air quality, ecology, land use, and cultural resources. The prime objective of this characterization is to develop the technical information eventually needed to select and permit suitable sites for construction of new waste management facilities. F-12 J-8 TE

E.3.2 LEVEL 1 SITE SELECTION PROCEDURE

The first major criterion used in the identification of suitable candidate sites for the construction of waste management strategies was to restrict the site to the 780-square-kilometer area of the SRP. This criterion eliminates all areas outside the SRP boundary including potential sites where "projected population and future development" in close proximity could be a major site selection issue (i.e., 10 CFR 61.50(a) Criterion No. 3). Also, the SRP area provides many excellent opportunities to identify sites that will result in the "isolation of wastes" (i.e., 10 CFR 61.50(a) Criterion No. 1).

In consideration of the screening criteria to be applied at the Level 2 analysis (i.e., distance to the public, depth to water table, distance to the nearest stream, available surface area, topography/slope, and distance to waste generators), 17 candidate sites were delineated by identifying specific hilltops and ridgetops using topographic maps. The identification of hilltops and ridgetops implicitly eliminates flood-prone areas (i.e., 40 CFR 264.18(b) Criterion No. 5, and E.O. 11988) and wetlands (E.O. 11990), and includes areas that generally exhibit the greatest depth to groundwater (i.e., 10 CFR 61.50(a) Criterion No. 7), relatively flat topography (i.e., 10 CFR 61.50(a) Criterion No. 10) and minimal upstream drainage area (i.e., 10 CFR 61.50(a)

Criterion No. 6). Locations of the 17 candidate sites, designated A through Q, are shown in Figure E-2.

E.3.3 LEVEL 2 SITE SELECTION PROCEDURE

Level 2 of the site selection procedure involved screening the 17 sites in relation to specific characteristics important in the disposal of hazardous or mixed waste and low-level radioactive waste. Each characteristic was assigned a weighting factor in a range from 1 to 6 representing increasing importance in achieving maximum performance of the site for waste disposal. Also, a table was devised for each characteristic to provide a basis for evaluating available site-specific data and assigning a rating factor. Each candidate site was evaluated in relation to each characteristic by multiplying its rating by the respective weighting value. The scores for all characteristics were summed and ranked from highest to lowest indicating relative "best" to "worst." Because the weighting and rating values are highly subjective and a full range of evaluation data was not available for analysis, the procedure was used only to identify a group of the "best" sites (rather than a single site) that would be subjected to the Level 3 (site-specific) analysis.

E.3.3.1 Hazardous or Mixed Waste Disposal

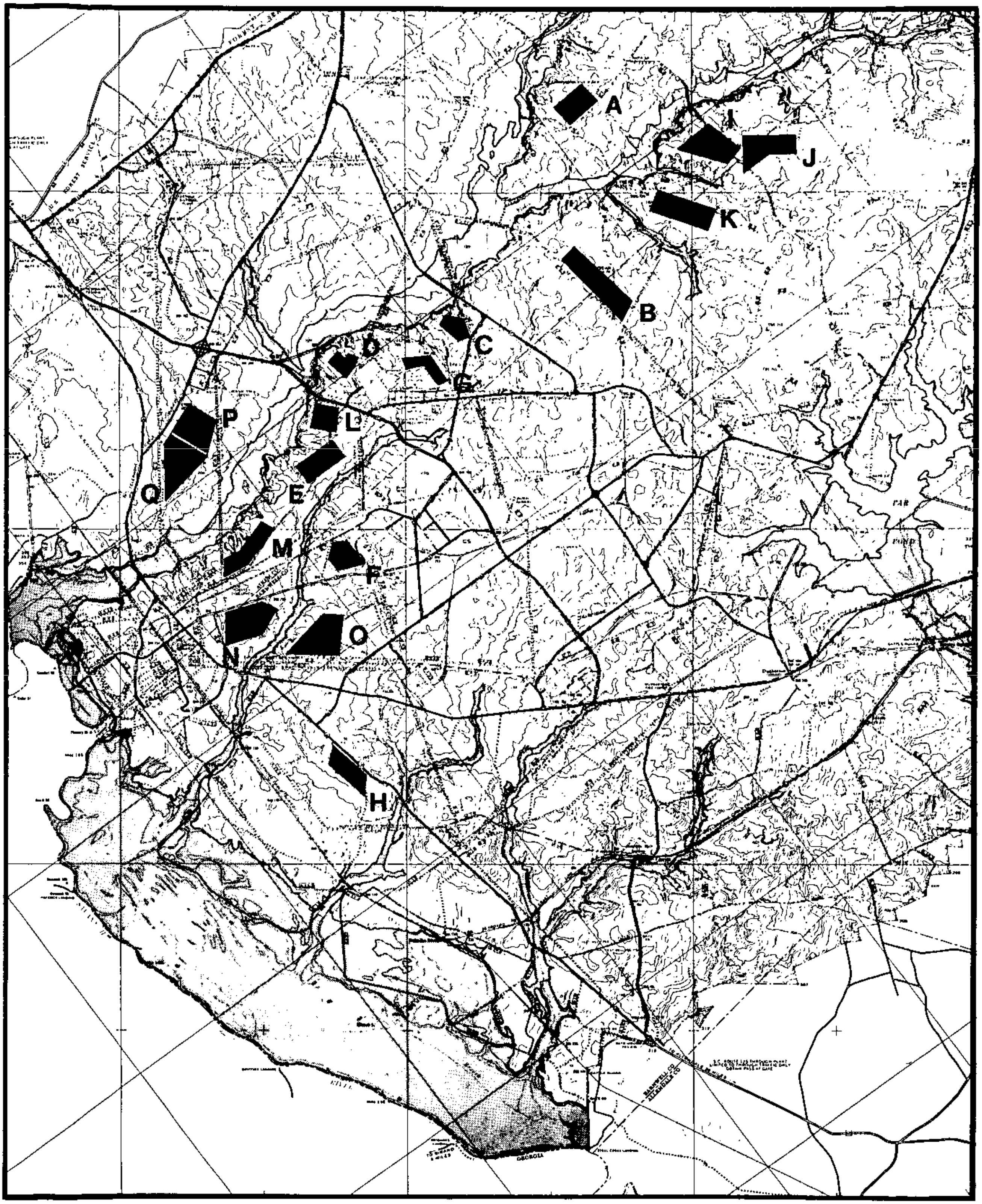
Three characteristics were used to rank the candidate sites for hazardous or mixed waste disposal; (1) depth to water table, (2) available area, and
F-12 J-8 (3) surface topography.

Depth to Water Table

Depth to water table was considered to be the most important characteristic and was given a weighting factor of 6. The development of the rating table considered that at least one of the alternative disposal technologies required wastes to be a minimum of 5 meters deep and at least 1.5 meters above the water table. To meet these requirements and provide sufficient depth for construction of the facility, the groundwater table would have to be a minimum of 14 meters below the surface. Sites exhibiting greater depth to groundwater would receive a higher rating in accordance with the following:

Depth to water table

Depth (meters)	Rating factor
>24	5
22 - 24	4
19 - 21	3
14 - 18	2
<14	0



F-12
J-8

Figure E-2. Candidate Sites for New Waste Management Facilities

Available Area

Available area was given a weighting factor of 4 to indicate its intermediate importance as a siting characteristic. Its importance is derived from the need to identify sites with sufficient space for disposal/storage facilities, service facilities, and buffer zones. The following ratings were devised for hazardous or mixed waste disposal sites:

Available Area

Size (acres)	Rating factor
>90	4
80 - 90	3
70 - 79	2
60 - 69	1
<60	0

Surface Topography

F-12 J-8 The forces of erosion by precipitation runoff are directly proportional to the slope of the land surface. Because a low slope will erode more slowly than a steep slope, it is rated higher. This characteristic was given a weighting factor of 2 because it is subject to alteration as required by the design.

Surface Topography

Maximum slope (%)	Rating factor
0 - 1.2	4
1.2 - 2.5	3
2.5 - 3.7	2
3.7 - 5.0	1
>5.0	0

E.3.3.2 Low-Level Radioactive Waste Disposal

Six characteristics were used to rank the candidate sites for low-level radioactive waste disposal facilities: (1) depth to water table, (2) distance to the public, (3) distance to waste generators, (4) distance to nearest stream, (5) available surface area, and (6) surface topography.

Depth to Water Table

Depth to water table was considered to be among the most important characteristics in the selection of sites for low-level radioactive waste disposal and was given a weighting factor of 6. As discussed above for hazardous/mixed waste siting, the minimum acceptable depth was determined to be 14 meters, with greater depths rated more highly in accordance with the table in Section E.3.3.1.

Distance to the Public

Another important characteristic in the siting of low-level waste disposal facilities was distance to the public, which was given a weighting factor of 6. The rating of this characteristic assumes that the more distant the site is from public lands or public access areas, the lower the probability is of an accidental exposure and contamination of public drinking-water supplies. The following rating factors were devised:

Distance to the Public

Distance (kilometers)	Rating factor
>6.4	4
4.8 - 6.4	3
3.2 - 4.8	2
1.6 - 3.2	1
0 - 1.6	0

F-12
J-8

Distance to Waste Generators

The volume of waste and the distance it must be transported impacts the dose to waste transport personnel, the probability of a transportation accident, and the economics of waste management. Accordingly, this characteristic was given a weighting factor of 6. At the SRP, the multiple waste generators are widely dispersed, so a volume-of-waste weighted method was used to rate the potential sites. The distance from each potential site to each operating area was rated using the following table, weighted by the percentage of waste produced by each operating area, and multiplied by the weighting factor.

Distance to Waste Generators

Distance (kilometers)	Rating factor
<3.2	4
3.2 - 6.3	3
6.4 - 9.6	2
9.7 - 12.9	1
>12.9	0

Distance to Nearest Stream

Surface water in the humid southeastern United States generally represents areas of groundwater discharge, and transport by surface water is much more rapid than by groundwater. The desirability of maximizing the distance from the waste to surface water received the relatively high weighting factor of 5. The following ratings were developed for distances of less than 152 meters
F-12 J-8 to more than 610 meters:

Distance to Nearest Stream

Distance (meters)	Rating Factor
>610	4
457 - 610	3
305 - 457	2
152 - 305	1
<152	0

Available Area

Available area was considered to be of intermediate importance in the siting of low-level radioactive waste facilities, with a weighting factor of 4. Its importance stems from the need to identify sites with sufficient space for all facilities and buffer zones. The following ratings were devised for evaluating candidate sites for low-level waste facilities:

Available Area

Area (acres)	Rating factor
>200	4
100 - 200	3
50 - 100	2
25 - 50	1
<25	0

Surface Topography

Surface topography, with a weighting factor of 2, was considered to be among the less important characteristics, but it is worthy of evaluation because of its effect on erosion. The surface topography rating table in Section E.3.3.1 also applies to low-level waste facility siting evaluations.

Tables E-4 and E-5 list the available data used in the ranking of the candidate sites. Each of the candidate sites was evaluated in accordance with F-12 the procedures described above, in relation to the hazardous/mixed waste J-8 facility siting characteristics and the low-level radioactive waste facility siting characteristics. Table E-6 lists 15 of the 17 candidate sites in the order of their ranking for each evaluation and provides the corresponding ranking scores. Two sites, K and I, were eliminated from consideration because of a potential conflict with SRP security operations. Due to the subjectivity of the weighting and rating values and the limited available data on a relatively few siting characteristics, a group of five of the top-rated candidate sites was selected for additional site-specific analysis (Level 3). These candidate sites are B, G, L, P, and Q.

At this stage of the siting process, the EIS modeling effort required site-specific input data. Because final siting had not been completed, it became necessary to select sites for EIS evaluation purposes. The objective was to select the most likely candidate site for each of the new waste management facilities assuming the most site-stringent technology (i.e., shallow land disposal). Based on the professional judgment of the siting team, the evaluation of hazardous and mixed waste facilities, cement/flyash matrix facilities, and low-level radioactive waste facilities would be carried out using data from candidate sites B, L, and G, respectively, as shown in Figure E-3. If, as a result of the additional site-specific (Level 3) analysis, the final chosen sites are different than those selected for the EIS analysis, an additional evaluation will be conducted to demonstrate that the chosen sites will result in facilities performance that is equal or superior to that documented in the EIS evaluations.

Table E-4. Available Candidate Site Data[a]

	Candidate site	Available area (acres)	Distance to stream (m)	Depth to water table (meters)	Topography (% slope)	Distance to public (km)
	A	135	762	N/A[b]	0.0 to 1.2	3.9
	B	200	762	16.8 to 19.8	1.2 to 2.5	8.0
	C	90	152	16.8	1.2 to 2.5	8.4
	D	80	457	12.2 to 21.3	Greater than 5.0	5.8
	E	185	762	13.7 to 19.8	0.0 to 1.2	4.3
	F	115	457	12.2 to 18.3	1.2 to 2.5	4.0
	G	200	610	13.7 to 18.3	0.0 to 1.2	7.7
	H	135	1067	15.2 to 18.3	1.2 to 2.5	0.6
	I	215	610	12.2 to 25.9	0.0 to 1.2	4.8
F-12	J	220	152	N/A	0.0 to 1.2	5.5
J-8	K	220	610	19.8	0.0 to 1.2	6.6
	L	100	518	12.2 to 24.4	0.0 to 1.2	4.8
	M	160	610	N/A	2.5 to 3.7	2.3
	N	210	457	N/A	1.2 to 2.5	1.1
	O	225	305	N/A	2.5 to 3.7	1.1
	P	240	1524	18.3 to 24.4	1.2 to 2.5	1.6
	Q	255	1524	13.7 to 27.4	1.2 to 2.5	1.0

[a]Source: Cook, Grant, and Towler, 1987a.
[b]Not available.

E.3.4 LEVEL 3 SITE SELECTION PROCEDURE

Level 3 of the siting methodology, which is currently under way, is intended to provide a complete site-specific characterization of the five "best" candidate sites. This characterization addresses surface water, groundwater, geology, geomechanics, meteorology, air quality, ecology, land use, and cultural resources. The primary objective is to develop the site-specific technical information needed to select and permit the best overall sites for

Table E-5. Distance to Generators (kilometers)

Candidate Sites	SRP operating area							
	A	C	F	H	K	L	M	P
A	11.1	13.0	9.3	7.7	16.4	15.9	11.4	14.3
B	11.6	9.3	6.4	3.9	12.2	11.4	12.1	9.8
C	9.3	6.3	2.7	1.4	10.0	10.3	9.2	10.1
D	7.7	4.7	1.0	3.9	8.9	10.5	7.4	11.7
E	9.7	2.4	2.1	4.3	6.6	8.7	9.2	10.6
F	12.2	0.8	4.7	6.1	4.0	6.8	11.6	9.7
G	9.0	4.8	1.3	1.9	8.7	9.5	8.9	10.3
H	17.9	6.6	10.8	11.6	2.9	6.1	17.2	10.3
I	14.5	14.2	11.1	8.9	16.9	15.8	14.8	13.2
J	15.9	14.8	12.1	9.5	17.4	15.8	16.1	12.9
K	14.2	12.4	9.7	7.1	15.1	13.7	14.3	11.3
L	8.9	3.2	1.4	4.2	7.6	9.5	8.4	11.1
M	11.7	4.2	6.6	8.9	6.0	9.7	11.1	12.9
N	13.4	4.8	8.0	10.1	5.5	9.3	12.6	13.0
O	14.8	3.9	7.9	9.2	2.4	6.4	14.3	10.1
P	7.7	5.8	5.3	8.2	9.3	12.4	7.1	14.8
Q	8.7	5.6	5.8	8.7	8.9	12.1	7.9	14.6
Percentage of waste	7.8	3.3	33.2	28.9	2.0	2.8	8.2	2.1

Source: Cook, Grant, and Towler, 1987b.

F-12
J-8

construction of the new waste management facilities. Specifically, the information will be used to:

- Demonstrate that the performance objectives and minimum technical requirements on site suitability will be achieved

Table E-6. Ranking of Candidate Sites

Hazardous or mixed waste facilities[a]		Low-level rad waste facilities[b]	
Site	Score	Site	Score
P	46	G	98
Q	46	B	97
L	42	L	88
B	40	P	84
J	36	E	80
G	36	Q	78
C	34	D	75
D	34	C	72
F	34	F	71
H	34	J	66
A	28	A	60
E	28	H	55
N	22	M	55
M	20	N	45
O	20	O	37

F-12
J-8
[a]Source: Cook, Grant, and Towler, 1987a.
[b]Source: Cook, Grant, and Towler, 1987b.

- Evaluate the capability of site characteristics to contribute to the isolation of wastes

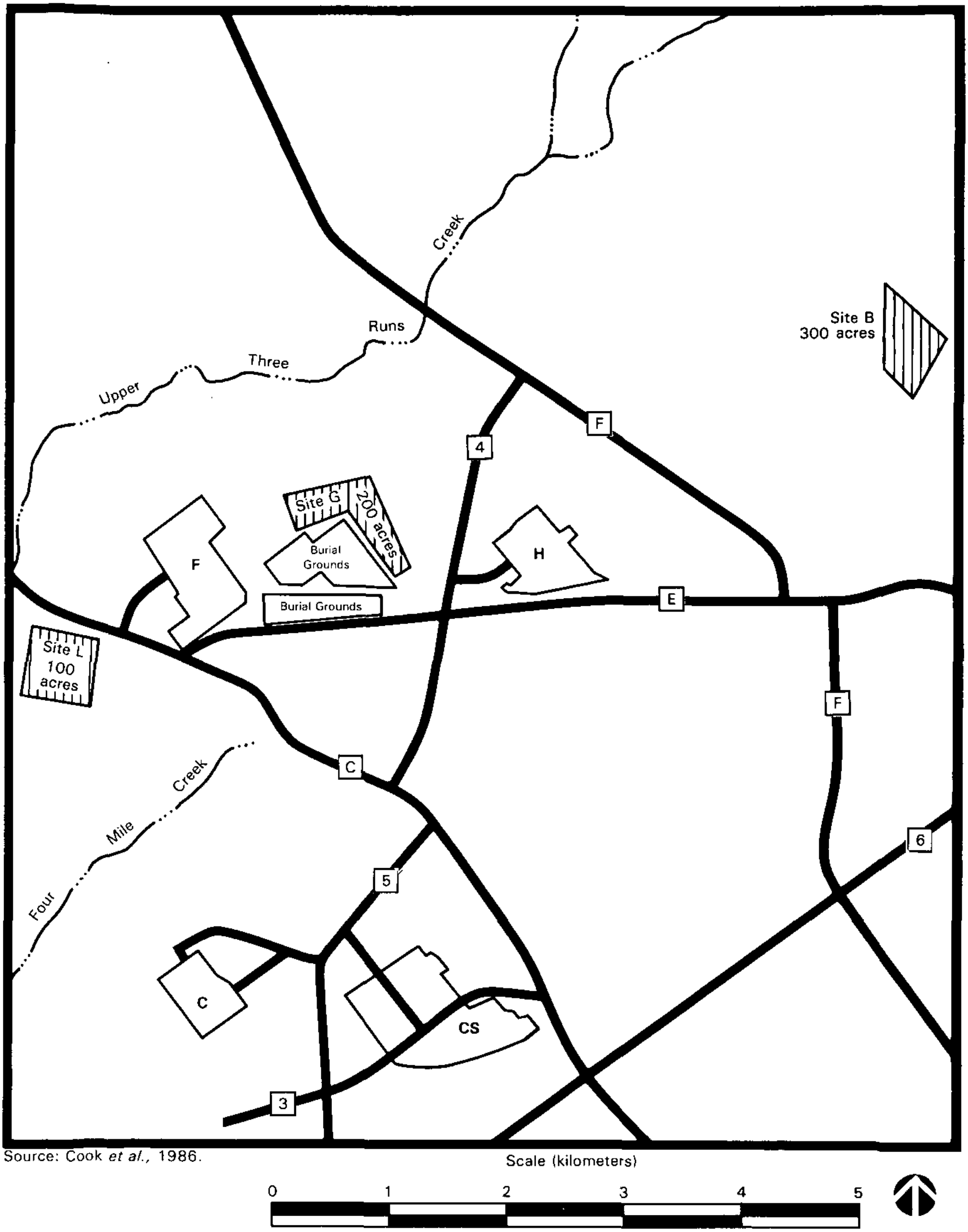
- Identify interactions between low-level radioactive wastes/containers and various site characteristics

- Identify and prevent potential adverse environmental impacts resulting from construction, operation, and closure/decontamination of the facilities

- Establish data collection points and an environmental baseline for the sites

- Provide the basis for site-specific design of the facilities (Cook, 1985)

The general plan for the geologic and hydrologic characterizations is to obtain hydrologic and chemical data from 10 water-table piezometers and one piezometer cluster within each of the selected candidate sites. Continuous core samples are to be taken at each new boring to provide the data necessary to produce site-specific geologic profiles.



Source: Cook *et al.*, 1986.

F-12
J-8

Figure E-3. Candidate Sites Selected for Environmental Analysis

Information from the Level 3 site selection procedure, together with the results of advanced planning to define specific technologies for implementing the chosen strategy, will provide the basis for a future decision on the locations of new waste management facilities.

E.4 WASTE DISPOSAL/STORAGE ALTERNATIVES

TC The waste management strategies - No Action, Dedication, Elimination, and Combination - could be implemented in a number of ways using a number of technologies. To provide a basis for determining the magnitude of environmental impacts, analyses herein identify the implementation technologies and explain their use. If DOE intends the concurrent use of more than one technology, the description uses the word "and" (e.g., storage buildings and RCRA landfill). If there is to be a future choice between two or more technologies, the description uses the word "or" (e.g., RCRA landfill or vaults). Table E-7 lists the technologies being considered for inclusion in each of the four waste management strategies. Cost reported herein were based on the range of waste volumes estimated and unit costs derived from the Venture guidance appraisal (Moyer, 1987). The following subsections provide additional detail for evaluation of waste management strategies.

E.4.1 NO-ACTION STRATEGY

The No-Action strategy provides an assessment of the consequences of implementing a waste management strategy that would require that no new facilities be constructed to accommodate future needs. Facilities include sites, buildings, landfills, vaults, engineered trenches, boreholes, and appurtenances. For the purposes of comparative analysis, DOE assumed that SRP would continue to operate and generate wastes and that the applicable regulations and criteria would continue to remain in force.

E.4.1.1 Hazardous or Mixed Waste

The No-Action strategy for hazardous or mixed waste would continue current operating practices, using existing interim storage facilities until reaching full capacity in 1992. After 1992, the No-Action strategy assumes that hazardous or mixed waste would be stored in existing structures, on existing concrete pads, or, if these were not available, on prepared areas at existing waste sites. As much as possible, mixed waste with radioactivity greater than 300 millirem per hour would be stored in unused existing shielded structures, such as the R-Reactor building. No new (undeveloped) sites would be used to store wastes under this strategy.

Before storage, wastes would be placed in steel containers (i.e., 208-liter drums, 2.5-cubic-meter boxes). Noncompatible wastes would be segregated administratively by storing them at different locations. All stored material, except intermediate-activity wastes, would be accessible for inspection. Inspections would be conducted on a regular basis. Damaged or deteriorated containers would be replaced and any spillage or leakage would be attended to expeditiously.

Table E-7. New Disposal/Storage Facility Implementation Technologies

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Waste management strategy	Disposal/storage project alternative	Disposal/storage technologies		
		Hazardous waste	Mixed waste	Low-level waste
No Action	No new facilities	Storage at existing facilities and at other available structures, pads, and areas	Storage at existing facilities and at other available structures, pads, and areas	Disposal at existing facilities and storage at other available structures, pads, and areas
Dedication	Disposal facilities	RCRA landfill or vaults[a]	RCRA landfill or shielded vaults[a], with or without CFM[b] vaults	ELLT[c], vaults[a], or AGO[d], for low-activity waste; and vaults or GCD[e] for intermediate activity waste
Elimination	Retrievable storage facilities	Storage buildings	Shielded storage buildings	Engineered storage buildings
Combination	Disposal/storage combination	Storage buildings and RCRA landfill or vaults[a]	Shielded storage buildings and RCRA landfill or shielded vaults[a], with or without CFM[b] vaults	Engineered storage buildings; and ELLT[c], vaults[a], or AGO[d], for low-activity waste; and vaults[a] or GCD[e] for intermediate-activity waste

[a]Vaults may be above or below the ground.
[b]Cement/flyash matrix.
[c]Engineered low-level trench disposal.
[d]Abovegrade operation disposal.
[e]Greater confinement disposal.

The No-Action strategy assumes that hazardous and mixed wastes would receive no pretreatment prior to storage (e.g., no new facilities). Table E-8 lists the estimated 20-year volumes for hazardous and mixed waste, as calculated from Tables E-1 and E-2.

TE

Table E-8. Estimated Hazardous and Mixed Waste 20-Year Storage Volumes Under the No-Action Strategy (cubic meters)

TC

Waste type	Estimated waste volume[a]
Hazardous waste	4,700
Mixed waste	97,000

[a]Rounded to the nearest 100 cubic meters.

TE Cost estimates associated with the management of hazardous and mixed wastes under this strategy are listed in Table E-9.

TE

Table E-9. Estimated Costs for Hazardous and Mixed Waste Management Under the No-Action Strategy[a]

TC

Item	Hazardous waste	Mixed waste
Site preparation	251	3,301
Operations	2,929	22,863
Total (20 years)[b]	3,180	26,164

[a]Cost in thousands of 4th Quarter 1985 dollars for 20-year planning period.
[b]Does not include costs of waste retrieval, decontamination, any subsequent treatment, or disposal.

TE The primary advantages of the No-Action strategy for hazardous or mixed waste would be the delay of expenditures associated with the construction of disposal/storage facilities and, perhaps, the use of existing available structures for storage, which otherwise would have remained unused.

The No-Action strategy has many disadvantages. As described above, hazardous or mixed wastes would be placed in sealed containers, segregated, and stored in a manner that would facilitate periodic inspection. Further, inspections would be performed on a regular basis; damaged or deteriorated containers would be replaced; and any spillage or leakage would be corrected expeditiously. Under this strategy, the release of hazardous or radioactive waste and the associated health and environmental effects would be insignificant as long as no substantial leakage or spills occurred due to any cause (e.g., fire, explosion, container deterioration, containers breached by an impact).

Because this type of storage is not designed and constructed specifically to include the backup systems and safety equipment required in a RCRA facility (i.e., double liners, leachate collection, special fire protection, automatic vapor detection, leakage recovery), the risk of a serious accidental release of hazardous or mixed waste and the associated effects would be much greater than with any of the "action" strategies. The magnitude of a potential performance failure of the No-Action strategy could range from zero (no releases from any cause) to release and dispersion of all waste stored in this manner. Because there are no backup systems and built-in safety equipment, the risk of a mixed waste release, including a catastrophic release, would be higher than with any other strategies. Although this higher risk cannot be quantified, it is unacceptable under RCRA.

In addition, the No-Action strategy would result in noncompliance with RCRA, HSWA, the Safe Drinking Water Act, DOE Orders, and the Clean Water Act; would involve the use of unpermitted facilities; and could result in noncompliance with other permits or applicable laws. Finally, because no action only delays future expenditures for waste management, the life-cycle cost of the No-Action strategy could exceed that of the other strategies, particularly in the event of an accidental release of wastes.

E.4.1.2 Low-Level Radioactive Waste

The No-Action strategy for low-level radioactive waste also consists of a continuation of current operating practices using shallow-land and greater confinement disposal at the existing burial facility until its capacity is reached in 1989. After 1989, this strategy assumes that low-level waste would be stored in existing structures, on existing concrete pads, or, if these are not available, on prepared areas at the current burial facility. As much as possible, low-level waste with radioactivity greater than 300 millirem per hour would be stored in unused existing shielded structures, such as the R-Reactor building. No new (undeveloped) sites would be used for the storage of wastes.

This EIS assumes that low-level waste would be stored in sealed steel containers. The intermediate-activity wastes would be segregated and handled with shielded equipment. All stored material, except the intermediate-activity waste, would be accessible for inspection, which would be conducted on a regular basis. Damaged or deteriorated containers would be replaced, and any spillage or leakage would be collected or recovered expeditiously.

Because the No-Action strategy requires "no new facilities," low-level waste would be stored without pretreatment. The 20-year volume, therefore, is estimated at 646,500 cubic meters. TC

Estimated costs for the management of low-level waste under the No-Action strategy are listed in Table E-10 and are directly related to the waste volume estimated above. TE

The advantages and disadvantages of the No-Action strategy for low-level radioactive waste management are the same as those discussed for hazardous and mixed waste. TE

TE

Table E-10. Estimated Cost for Low-Level Waste Management Under No-Action Strategy[a]

Item	Estimated cost
Site preparation	11,632
Operations	60,529
Total (20 years)[b]	72,161

TC

[a]Cost in thousands of 4th Quarter 1985 dollars for 20-year planning period.
[b]Does not include costs of waste retrieval, decontamination, any subsequent treatment, or disposal.

TE

E.4.2 DEDICATION STRATEGY

The Dedication strategy involves the construction of hazardous, mixed, and low-level radioactive waste disposal facilities.

E.4.2.1 Hazardous or Mixed Waste

The technologies for implementing the Dedication strategy for hazardous waste are belowground or aboveground vaults or RCRA landfills. For mixed waste, the disposal technologies are belowground vaults, aboveground vaults, RCRA landfills, belowground vaults with CFM vaults, aboveground vaults with CFM vaults, or RCRA landfills with CFM vaults.

Hazardous or mixed waste disposal using above- or belowground vaults or RCRA landfills (i.e., CFM vaults not used for any portion of mixed waste) would require some specific predisposal treatment. Treatment for volume reduction and detoxification would be in accordance with new HSWA regulations. The three mixed waste alternatives, which include cement/flyash matrix disposal for a portion of the waste, require that this portion be solidified to a concrete-like material to render the waste nonhazardous under RCRA. The remainder of the mixed waste under these alternatives would be disposed of in above- or belowground vaults or RCRA landfills.

TE

Under the Dedication strategy, the site-specific actions regarding predisposal treatment (i.e., volume reduction, detoxification, solidification) lead to a range of possible hazardous and mixed waste disposal volumes. Table E-11 lists the estimated volume ranges, as calculated from the values in Tables E-1 and E-2. Under the Dedication strategy, no wastes would be generated by removal/closure of existing waste sites.

TE

Estimated costs associated with the management of hazardous and mixed wastes under the Dedication strategy were prepared for this EIS; these costs attempt to bracket site-specific actions regarding technologies, design details, and predisposal treatment effects. Table E-12 indicates the relative magnitude of the costs associated with the implementation of the Dedication strategy for hazardous and mixed waste. These costs are not complete (e.g., those for most predisposal treatment considerations have not been included), and no cost-effectiveness analysis has been performed.

Table E-11. Estimated Range of Hazardous and Mixed Waste 20-Year Disposal Volumes Under the Dedication Strategy (cubic meters)[a] TE

Waste type	Lower limit[b]	Upper limit
Hazardous waste	2,500	5,200[c]
Mixed waste	9,900	185,900[d]

TC

[a]Rounded to the nearest 100 cubic meters.
[b]Maximum volume reduction.
[c]No volume reduction for hazardous waste.
[d]Volume expansion of mixed waste caused by CFM solidification of ETF sludges.

The major advantages of the Dedication strategy for the future management of SRP wastes are the following:

- During the 20-year operation period, wastes would be disposed of permanently.
- The disposal of waste would comply with all applicable Federal and state regulations.
- Facilities would be capable of achieving compliance with environmental standards (e.g., groundwater, surface water).

The Dedication strategy has the following disadvantages:

- Facilities would be costly to construct and operate.
- Land would be dedicated to use as a waste repository in perpetuity.
- In the event of a failure that released waste constituents, retrieval of the waste packages could be difficult where certain practices were employed (e.g., grouting in place).

E.4.2.2 Low-Level Radioactive Waste

The technologies for implementing the Dedication strategy are ELLTs, AGOs, or vaults (above or below the ground) for the disposal of low-activity waste (i.e., less than 300 millirem per hour); and vaults (above or below the ground) or GCD trenches/boreholes for the disposal of intermediate-activity waste (i.e., greater than 300 millirem per hour).

Low-level waste disposal using any of the optional technologies would not require predisposal treatment other than liquid immobilization (e.g., by sorbents or solidification); however, treatments that provide volume reduction could be cost-effective and desirable.

Table E-12. Estimated Cost Range for Hazardous and Mixed Waste Management Under Dedication Strategy[a, b]

Item	Hazardous waste		Mixed waste	
	Lower limit	Upper limit	Lower limit	Upper limit[c]
Site Preparation	0.9	0.7	3.5	1.1
Construction[d]	3.0	18.2	12.1	181.1
Operation	3.0	9.2	12.1	111.5
Closure	1.4	0.2	5.5	0.3
Subtotal, 20 years	8.2	28.3	33.2	294.0
Maintenance	0.6	1.3	2.5	7.9
Monitoring[e]	1.2	2.6	5.0	27.7
Subtotal, 100 years	1.9	3.9	7.5	35.6
Total, 120 years	10.1	32.2	40.7	329.6

[a]Adapted from Cook and Grant, 1987; Cook, Grant, and Towler, 1987a; and Moyer, 1987.
[b]Cost in millions of 4th Quarter 1985 dollars.
[c]Includes estimated costs for predisposal treatment of ETF sludges by CFM solidification.
[d]Includes monitoring well installations assuming an average cost of about $8,000 per well for an average depth of 42.7 meters using PVC materials.
[e]Includes sampling, analysis, and reporting of data assuming annual sampling for 31 parameters, plus 3 quarterly samples costing about $1,200/well/year for the first 5 years, and annual sampling for 31 parameters thereafter, costing about $700/well/year.

TC

Under the Dedication strategy, project-specific actions regarding predisposal treatment lead to a range of possible low-level disposal volumes. Based on the values in Table E-3, this range extends from a low of 278,000 cubic meters to an upper limit of 646,600 cubic meters. The low end of this range assumes maximum volume reduction through predisposal treatment; the upper limit assumes no volume reduction, and solidification where applicable. Under the Dedication strategy, no wastes would be generated by removal/closure of existing waste sites. TC

Estimated costs associated with the management of low-level wastes under the Dedication strategy were prepared for this EIS; they bracket project-specific actions regarding specific technologies, design details, and predisposal treatment effects. The cost ranges listed in Table E-13 indicate the relative magnitude of costs associated with implementing this strategy for low-level waste. However, these costs are not complete (e.g., they do not contain costs for predisposal treatment considerations); also, cost effectiveness has not been analyzed. Thus, the ranges should not be used for a direct comparative analysis or as a basis for decisionmaking. TE

Table E-13. Estimated Cost Range for Low-Level Radioactive Waste Management Under Dedication Strategy[a], [b] TC

Item	Lower limit	Upper limit
Site preparation	5.5	5.6
Construction[c]	86.8	412.2
Operation	35.8	137.0
Closure	24.5	18.3
Subtotal, 20 years	152.6	573.1
Maintenance	2.9	6.8
Monitoring[d]	14.7	34.2
Subtotal, 100 years	17.7	41.1
Total 120 years	170.3	614.2

[a]Adapted from Cook, Grant, and Towler, 1987b; and Moyer, 1987.
[b]Cost in millions of 4th Quarter 1985 dollars.
[c]Includes monitoring well installations assuming an average cost of about $8,000 per well for an average depth of 42.7 meters using PVC materials.
[d]Includes sampling, analysis, and reporting of data.

E.4.3 ELIMINATION STRATEGY

The Elimination strategy for new waste management facilities involves the construction of hazardous, mixed, and low-level radioactive waste storage facilities. The technology for implementing this strategy uses retrievable-storage buildings, which are described in Section E.1.1.6 for hazardous and mixed wastes, and in Section E.1.2.6 for low-level radioactive waste.

TC RCRA regulations define "storage" as "the holding of hazardous waste for a temporary period, at the end of which the waste is treated, disposed of, or stored elsewhere" (40 CFR 260.10). The term "temporary" is not defined by a specific time period, rather it is taken to mean "not permanent" and implies an intention to retrieve the waste for future treatment and/or disposal. Facilities which accumulate hazardous waste for more than 90 days, such as those proposed under the Elimination strategy, are considered storage facilities under RCRA and can be permitted and operated in accordance with 40 CFR 270 and 40 CFR 264, respectively (40 CFR 262.34).

Because a major objective of retrievable storage is a delay of permanent deposition of wastes in anticipation of advanced methods of treatment, recycling, or disposal, the predisposal treatment of waste could close out future waste management options. Thus, the only predisposal techniques considered applicable are liquid immobilization by sorption techniques and compaction of bulky wastes to reduce volume. Under the Elimination strategy, wastes would be generated from the removal/closure of all existing waste sites.

On this basis, Table E-14 lists the estimated retrievable-storage volumes of hazardous, mixed, and low-level waste as calculated from Tables E-1 through E-3, with and without consideration of the mixed and low-level radioactive waste burial grounds.

TC

Table E-14. Estimated Hazardous, Mixed, and Low-Level Waste 20-Year Storage Volumes Under the Elimination Strategy (cubic meters)[a]

	Estimated waste volumes	
Waste type	Without burial grounds	With burial grounds
Hazardous	103,600	103,600
Mixed	188,100	1,666,000
Low-level radioactive	699,800	2,223,800

[a]Rounded to the nearest 100 cubic meters.

TE The estimated costs of implementing the Elimination strategy bracket project-specific actions associated with specific regulatory requirements and design details. Therefore, the costs listed in Table E-15 indicate the relative magnitude of cost associated with the strategy; they should not be used for direct comparative analysis or as a basis for decisionmaking. TC Unlike disposal alternatives, the Elimination strategy contains no closure or postclosure costs because the intent is to retrieve the waste at some future time during the 20-year operational period.

Table E-15. Estimated Costs for Hazardous, Mixed, and Low-Level Waste Management Under Elimination Strategy[a, b]

Item	Hazardous waste	Mixed waste[c]		Low-level waste[d]	
		Without MWBG	Including MWBG	Without LLBG	Including LLBG
Site preparation	22.8	24.7	349.5	7.6	24.0
Construction	119.2	158.1	1857.2	387.8	1205.5
Operation	126.2	137.1	1936.1	106.7	336.1
Retrieval/decontamination	NA[e]	NA	NA	NA	NA
Total, 20 years	268.2	319.9	4142.8	502.0	1565.6

[a]Adapted from Cook, Grant, and Towler, 1987a; Cook, Grant, and Towler, 1987b; Cook and Grant, 1987; and Moyer, 1987.
[b]Cost in millions of 4th Quarter 1985 dollars.
[c]Without Mixed Waste Burial Ground and including Mixed Waste Burial Ground.
[d]Without Low-level Waste Burial Ground and including Low-level Waste Burial Ground.
[e]NA - Not available.

TC

The major advantages of the Elimination strategy with regard to future waste management facilities are the following:

TE

- No SRP land would be dedicated in perpetuity as a hazardous, mixed, or low-level waste repository.
- In the event of a failure in which wastes are spilled or leaked from their containers, facilities, equipment, and procedures would provide a rapid and efficient retrieval of the waste, such that no leakage outside the facility would occur.

TC

- Storage of the wastes would comply with applicable Federal and state regulations, presuming the necessary permits for long-term storage of hazardous and mixed wastes were granted by the regulatory agencies.
- Facilities would be capable of achieving compliance with all environmental standards (e.g., groundwater, surface water).

The Elimination strategy has the following disadvantages:

- Storage facilities would be costly to construct and operate.

TE

- Additional future costs for retrieval of the waste, decontamination of the storage facilities, and construction and operation of treatment or disposal facilities would be inevitable and substantial.

E.4.4 COMBINATION STRATEGY

The Dedication and Elimination strategies would provide adequate management of all SRP hazardous, mixed, and low-level wastes. However, the management of specific wastes might be more economical, technologically feasible, or environmentally reliable under one or the other strategy. Thus, the objective of the Combination strategy is to identify and implement the best mix of disposal (Dedication) and storage (Elimination) technologies based on specific hazardous, mixed, and low-level waste volumes and characteristics.

E.4.4.1 Hazardous or Mixed Waste

The Combination strategy for hazardous waste includes retrievable-storage buildings, and belowground or aboveground vaults or RCRA landfills for disposal. The Combination strategy for mixed waste consists of retrievable-storage buildings and belowground or aboveground vaults or RCRA landfills, below-ground vaults with CFM vaults, aboveground vaults with CFM vaults, or RCRA landfills with CFM vaults.

TE

Under this strategy, project-specific actions regarding predisposal treatment (i.e., volume reduction, detoxification, solidification) lead to a wide range of possible hazardous and mixed waste disposal volumes. Removal and closure of existing hazardous and mixed waste sites have been specified to occur only at the old F-Area seepage basin. Table E-16 lists the estimated 20-year volume ranges, calculated from the values in Tables E-1 and E-2.

Table E-16. Estimated Range of Hazardous and Mixed Waste 20-Year Disposal/Storage Volumes Under the Combination Strategy (cubic meters)[a] TE

Waste Type	Lower limit[b]	Upper limit
Hazardous waste	2,500	5,200[c]
Mixed waste	15,600	191,300[d]

TC

[a]Rounded to the nearest 100 cubic meters.
[b]Maximum volume reduction.
[c]No volume reduction.
[d]Volume expansion caused by CFM solidification of ETF sludges.

The estimated cost ranges in Table E-17 bracket site-specific actions regarding the mix of specific technologies, design details, and volume capacity. These ranges indicate the relative magnitude of potential costs associated with the implementation of the Combination strategy for hazardous and mixed waste; they should not be used for direct comparative analysis or as a basis for decisionmaking. TE

In addition to the advantages and disadvantages of Dedication and Elimination described in Sections E.4.2.1 and E.4.3, the Combination strategy would allow the selection of a mix of technologies that would optimize performance and minimize cost.

E.4.4.2 Low-Level Radioactive Waste

The technologies for implementing the Combination strategy for low-level waste are engineered storage buildings, and ELLTs or vaults or AGOs for the disposal of low-activity waste (i.e., less than 300 millirem per hour); and vaults or GCD for the disposal of intermediate-activity waste (i.e., greater than 300 millirem per hour).

Site-specific actions regarding predisposal treatment (i.e., volume reduction, solidification, encapsulation) lead to a range of possible low-level waste disposal volumes. Also, removal and closure of existing low-level waste sites have been specified to occur only at the R-Area Seepage Basins. Based on the values listed in Table E-3, this range extends from a lower limit of 286,500 cubic meters to an upper limit of 658,400 cubic meters. The lower limit assumes maximum volume reduction, whereas the upper limit assumes no volume reduction and some volume expansion by solidification of closure action wastes. TC

Table E-18 lists cost ranges associated with low-level waste management under the Combination strategy. These ranges bracket the site-specific actions regarding the technological mix, design details, and volume capacity. They indicate the relative magnitude of potential costs associated with the implementation of this strategy for low-level waste; they should not be used for direct comparative analysis or as a basis for decisionmaking. TE

Table E-17. Estimated Cost Range for Hazardous and Mixed Waste Management Under the Combination Strategy[a, b]

Item	Hazardous waste		Mixed waste	
	Lower limit	Upper limit	Lower limit	Upper limit[c]
Site preparation	1.1	1.3	6.9	3.4
Construction[d]	4.5	20.8	29.2	207.1
Operation	3.2	9.8	21.2	123.4
Closure/retrieval[e]	2.0	0.3	12.4	0.8
Subtotal, 20 years	10.7	32.2	69.7	334.7
Maintenance	1.3	2.1	8.2	5.2
Monitoring[f]	2.6	4.9	16.4	12.2
Subtotal, 100 years	4.0	6.9	24.5	17.5
Total, 120 years	14.7	39.1	94.2	352.2

[a]Adapted from Cook, Grant, and Towler, 1987a; Cook and Grant, 1987; and Moyer, 1987.
[b]Cost in millions of 4th Quarter 1985 dollars.
[c]Includes estimated costs for predisposal treatment of ETF sludges by CFM solidification.
[d]Includes monitoring well installations assuming an average cost of about $8,000 per well for an average depth of 42.7 meters using PVC materials.
[e]Includes costs of decontaminating the storage facilities.
[f]Includes sampling, analysis, and reporting of data assuming annual sampling for 31 parameters, plus 3 quarterly samples costing about $1,200/well/year for the first 5 years, and annual sampling for 31 parameters thereafter, costing about $700/well/year.

TC

Table E-18. Estimated Cost Range for Low-Level Radioactive Waste Management Under the Combination Strategy[a]

Item	Lower limit	Upper limit
Site preparation	3.4	0.0
Construction[b]	114.6	424.7
Operation	48.8	139.5
Closure/retrieval and decontamination	33.5	35.8
Subtotal, 20 years	200.0	600.0
Maintenance	9.4	7.0
Monitoring[c]	14.1	35.2
Subtotal, 100 years	23.5	42.2
Total, 120 years	223.8	642.2

[a]Cost in millions of 4th Quarter 1985 dollars

[b]Includes monitoring well installations assuming an average cost $8,000 per well for an average depth of 42.7 meters using PVC material.

[c]Includes sampling analysis and reporting of data.

TC

The advantages and disadvantages of the Combination strategy are discussed in Section E.4.4.1.

E.5 SUMMARY

Tables E-19 through E-22 summarize the four strategies for the modification of SRP waste management practices with regard to new disposal/storage facilities. TE

TE

Table E-19. No-Action Strategy

Item	Description
Objective	Waste management with no new facilities
Technologies	Indefinite storage of hazardous and mixed waste at existing facilities, then at other available structures, pads, or areas Disposal of low-level waste at existing burial grounds, then indefinite storage at other available structures, pads, or areas
Limitations	No new facilities, including pretreatment
Volume (m^3)	Hazardous 4,700 Mixed 97,000 Low-level 646,500 Total 748,200
Cost range ($Mil)[a]	Hazardous 3.2 Mixed 26.2 Low-level 72.2 Total 101.6
Cost uncertainties	Total and types of storage capacity available No specific existing facilities identified
Advantages	Would delay expenditures for waste management facilities Would make use of structures that otherwise would remain unused
Disadvantages	Unquantified higher risk of environmental releases of waste and the associated occupational, public health, and environmental impacts Noncompliance with RCRA, DOE Orders, and other regulations eliciting enforcement actions Probable judicial intervention Inevitable future expenditures for waste treatment/disposal

TC

TE

[a]Costs through the 20-year period. (Note: Site-specific actions prevent costs from being used for direct comparative analysis).

Table E-20. Dedication Strategy TE

Item	Description
Objective	Waste management by disposal
Technologies	Hazardous - Belowground vaults, aboveground vaults, or RCRA landfills
	Mixed - Belowground vaults, aboveground vaults, or RCRA landfills with or without CFM vaults
	Low-level - ELLTs, AGOs, or vaults for low-activity waste; vaults or GCD for intermediate-activity waste
Limitations	Mixed waste options using CFM vaults require pre-disposal treatment by cement/flyash solidification
Volume range (m^3)	Hazardous 2,500 to 5,200 Mixed 9,900 to 185,900 Low-level 278,000 to 646,600 Total 290,400 to 837,700 (TC)
Volume uncertainties	Volume reduction by predisposal treatment
	Volume expansion by solidification
Cost range ($Mil)[a]	Hazardous 10.1 to 32.2 Mixed 40.7 to 329.6 Low-level 170.3 to 614.2 Total 221.1 to 976.0 (TC)
Cost Uncertainties	Total disposal capacity required
	Optional disposal technologies
	Pretreatment technologies and capacities
	Pretreatment costs not included except with CFM portion
	Postclosure requirements
Advantages	Final placement of waste
	Compliance with applicable regulations
	Compliance with environmental standards

Footnote on last page of table.

TE

Table E-20. Dedication Strategy (continued)

Item	Description
Disadvantages	Facilities costly to construct and operate
	Land dedicated in perpetuity
	Waste retrieval difficult in a failure

TC

[a]Costs for 20-year period through closure plus postclosure maintenance for 100 years.

Table E-21. Elimination Strategy | TE

Item	Description		
Objective	Waste management by retrievable storage		
Technologies	Storage buildings for hazardous, mixed, and low-level wastes		
Limitations	Prestorage treatments limited to liquid sorption and compaction		
Volume (m^3)		Without Burial Grounds	Including Burial Grounds
	Hazardous	103,600	103,600
	Mixed	188,100	1,666,000
	Low-level	699,800	2,223,800
	Total	991,500	3,993,400
Volume uncertainties	Removal volume from existing waste sites		
	Volume reduction by compaction		
Cost range ($Mil)[a]		Without Burial Grounds	Including Burial Grounds
	Hazardous	268.2	268.2
	Mixed	319.9	4,142.8
	Low-level	502.0	1,565.6
	Total	1,090.1	5,976.6
Cost uncertainties	Total storage capacity required		
	Compaction capacity and cost (not included)		
Advantages	No land dedicated in perpetuity		
	Waste retrieval relatively simple in a failure		
	Compliance with applicable regulations, presuming waivers are granted		
	Compliance with environmental standards		
Disadvantages	Facilities costly to construct and operate		
	Inevitable future expenditure for continued storage or waste retrieval, treatment, and/or disposal		

TC (volume) TC (cost range)

[a]Costs through the 20-year period; does not include waste retrieval, treatment, or disposal. (Note: Site-specific actions prevent costs from being used for direct comparative analysis.)

TE

Table E-22. Combination Strategy

Item	Description
Objective	Waste management by combination of storage and disposal
Technologies	Storage buildings for storage of hazardous, mixed, and low-level wastes; vaults or RCRA landfills for hazardous waste; vaults or RCRA landfills with or without CFM vaults for mixed waste; ELLTs, AGOs, or vaults for low-activity low-level waste; vaults or GCD for intermediate-activity low-level waste.
Limitations	Mixed waste options using CFM vaults require predisposal treatment by cement/flyash solidification. Prestorage treatments limited to liquid sorption and compaction.
Volume range (m^3)	Hazardous 2,500 to 5,200 Mixed 15,600 to 191,300 Low-level 286,500 to 658,400 Total 304,600 to 854,900
Volume uncertainties	Removal volume from existing waste sites Volume reduction by pretreatment Volume expansion by solidification
Cost range ($Mil)[a]	Hazardous 14.7 to 39.1 Mixed 94.2 to 352.2 Low-level 223.8 to 642.2 Total 332.7 to 1,033.5
Cost uncertainties	Total storage and disposal capacities required Optional disposal technologies Pretreatment technologies and capacities No pretreatment costs, except CFM solidification Postclosure requirements on disposal facilities

TC

TC

Footnote on last page of table.

Table E-22. Combination Strategy (continued) | TE

Item	Description
Advantages	Allows selection of a mix of disposal and storage technologies that would optimize performance and minimize cost Other advantages are the same as those for the Dedication and Elimination strategies
Disadvantages	Same as those for the Dedication and Elimination strategies

[a]Costs for 20-year period through closure including postclosure maintenance or retrieval and disposal of stored wastes. (Note: Site-specific actions prevent costs from being used for direct comparative analysis.)