APPENDIX B

WASTE MANAGEMENT

SUMMARY

The mission change at Rocky Flats from nuclear weapons production to environmental cleanup has made formerly serviceable buildings and other structures surplus and no longer essential to the nation's national security interests. As a result, one of the objectives of the ASAP process, therefore, is to bring these materials under direct management control (i.e., into the formal accounting system) by making decisions on their future use and/or dispositioning. Such control can be accomplished by (1) dispositioning the material as containerized or bulk wastes or (2) leaving the material in place based on a determination that it does not constitute an appreciable risk to the public and that distributing the material poses a greater risk than leaving it alone. It is recognized that the contaminants in future waste generation are currently present in equipment, building structures, surrounding soils and other assets.

Much of the contamination exists as trace amounts of pollutants suspended in large quantities of a matrix, such as soil or building rubble. As a result, volumetric estimates of potential waste are inflated because of the large quantities of the matrix that must be removed to eliminate the contaminants.

The purpose of the Waste Management section of ASAP is to develop and discuss alternative means of handling the surplus materials requiring dispositioning as containerized or bulk wastes. Eight alternatives for waste handling are presented. Information is developed to allow stakeholders, regulators, and decision makers to evaluate these alternatives; to determine the best course of action for future waste management; and to ensure that the selected alternative is technically prudent, is fiscally responsible, and results in meaningful risk reduction.

The strategy governing development of waste management alternatives is to present information on the bounding conditions (i.e., maximum and minimum waste handling options), and then discuss several options with intermediate amounts of wastes to be handled. The intermediate options attempt to present a sufficient range of alternatives to provide stakeholders, regulators, and decision makers an understanding of the technical feasibility of the alternatives and an awareness of their respective cost and risk consequences. The analysis incorporates the following aspects of different waste management approaches: (1) minimizing the amount of waste generated as containerized or bulk material, (2) consolidating the waste as much as possible to reduce the volume to be handled, (3) treating only those waste forms that pose an appreciable public risk and seeking waivers or exemptions for more innocuous waste forms, and (4) challenging regulatory and historical practice constraints that appear to offer minimal technical value and impede the efficient handling of wastes without commensurate benefit in cost or risk reduction.

Alternative Overview

Waste management activities are influenced by two factors: (1) the volumes of each waste type produced that require handling as either containerized or bulk materials, and (2) the waste handling pathway for the different waste types as defined by the alternatives considered. Table B-1 summarizes the waste volumes produced by each alternative. Alternatives 1, Unrestricted, and 4, Mothball represent the bounding conditions by having the maximum and minimum amounts of wastes, respectively, that require dispositioning. Table B-2 displays the management actions evaluated to disposition the wastes for each alternative. Waste Management costs for the different alternatives are presented in Table B-3.

Table B-1

Containerized and Bulk Waste Volumes

Waste Type	Alternative (units in m³)							
	1 Unrestricted	2 BEMR 1	3 a Phased Shipment	3 b Priority Shipment	3 c Excavation	3 d Leveled Buildings	3 e Entombment and Landfill	4 Mothball
Uncontaminated	180,500	489,000	180,500	180,500	180,500	149,000	149,000	19,000
Hazardous	84,000	37,000	11,000	11,000	11,000	11,000	11,000	9,000
Low-level	905,000	106,000	67,000	67,000	67,000	67,000	60,000	36,000
Low-level mixed	1,233,000	525,000	269,000	269,000	269,000	269,000	269,000	117,000
Transuranic/ transuranic mixed	9,000	15,000	4,500	9,000	4,500	4,500	4,500	2,200
Other	35	-	35	35	35	35	35	35
Totals	2,411,500	1,172,000	532,000	536,500	532,000	500,500	493,500	183,200

Table B-2

Management Actions to Disposition Wastes

Alternatives		TRU/TRM				LLW/LLM		
		Storage	Treatment		Disposal	Land Disposal Restriction (LDR) Treatment	Storage	Disposal
			Non-Residues[1]	Residues				
1	Unrestricted	new bldg	WIPP WAC	WIPP WAC	WIPP	All LLM[2]	new bldgs	Offsite
2	BEMR I	existing bldgs	WIPP WAC	WIPP WAC	WIPP	All LLM	existing bldgs	offsite
3 a	Phased Shipment	new bldg	WIPP WAC	Min Vol	WIPP	All LDR[5], deferred	new bldgs	Offsite
3 b	Priority Shipment	existing bldgs	WIPP WAC	WIPP WAC	WIPP	All LDR[6], upfront	new bldgs	Offsite
3 c	Excavation	new bldg	WIPP WAC	Min Vol	WIPP	high risk only	existing bldgs	Concrete Lined Cell[7] (CLC)
3 d	Leveled Buildings	new bldg	WIPP WAC	Min Vol	WIPP	high risk only	existing bldgs	CLC[7]
3 e	Entombment and Landfill	new bldg	WIPP WAC	Min Vol[3]	WIPP	high risk only[4]	existing bldgs	Landfill
4	Mothball	new bldg	WIPP WAC	Min Vol	WIPP	high risk only	existing bldgs	CLC[7]

1. Treat to meet WIPP waste acceptance criteria (WAC); i.e., ready to ship
2. All low-level mixed waste treated to meet regulatory requirements
3. Packaged to reduce volume to store; requires repack prior to shipment
4. Treat only high risk low level mixed wastes; e.g., liquids, dispersible particulates; more innocuous materials such as pondcrete would not be treated; waivers and/or exemptions would be sought from regulators
5. Low -level mixed waste would be stored and treated immediately prior to shipment
6. Low-level mixed waste would be treated as fast as technically practical and shipped
7. Low-level and low-level mixed waste would be placed in retrievable and monitored facilities that would facilitate offsite disposal at a later date, it desired

Table B-3
Cost Summary

Alternative		Cost Estimate
1	Unrestricted	$11,958,000,000
2	BEMR I	$9,600,000,000
3a	Phased Shipment	$3,243,000,000
3b	Priority Shipment	$2,597,000,000
3c	Excavation	$1,220,000,000
3d	Leveled Buildings	$1,219,000,000
3e	Entombment and Landfill	$1,413,000,000
4	Mothball	$716,000,000

A. <u>Bounding Conditions</u>

Two extreme end state conditions were examined to bound the range of alternatives evaluated (excluding BEMR I which is the previous baseline). These two conditions are (1) to clean the entire Site to residential standards (i.e., Alternative 1, Unrestricted) and (2) to clean buildings to achieve a safe configuration and then leave the main production buildings standing with minimal long-term care (Alternative 4, Mothball).

The total volume of waste material generated in the Unrestricted Alternative is more than 2,400,000 m^3. To give this volume a perspective, it is greater than that of the Great Pyramid in Egypt. Shipment of this volume offsite for disposal would require over 200,000 truckloads to complete. To accomplish this shipping task within 30 years using a two-shift operation 5 days a week, a truck would need to leave Rocky Flats approximately every 30 minutes. Transport by rail would streamline the shipping process. A 50-car train would need to leave the Site every week to complete shipping within 30 years. New storage buildings would be required to properly manage the waste material and to stage for loading and shipping.

Most of this waste volume consists of soils from environmental restoration activities (i.e., 88 percent). For purposes of estimating costs associated with the Unrestricted alternative, it is assumed that 25 percent of the waste does not comply with Land Disposal Restrictions (LDR) and requires treatment. This is considerably less than the 75 percent value requiring treatment used for the other alternatives with offsite disposal of low-level mixed waste (LLMW). In addition, the estimated unit treatment cost used for Alternatives 1, Unrestricted, 3d, Leveled Buildings, and 3e, Entombment and Landfill is $3,500/$m^3$ instead of the $10,000/$m^3$ used for the other alternatives. The rationale for deliberately lowering cost estimate parameters for this alternative is as follows: (1) most of the waste volume consists of environmental restoration soils and, unlike the other alternatives, much of this volume is not from relatively well-characterized contamination sites in or near the Industrial Area (e.g., specific IHSSs) but rather from wide expanses of buffer zone lands exposed to airborne deposition of radioactive particulates and hence less likely to contain solvent and heavy metal pollutants, (2) economies of scale are envisioned for treatment of a single waste matrix (i.e., dirt), and (3) the material is a relatively homogeneous waste form which is typically less expensive to treat. Total waste management cost for the Unrestricted alternative is $12 billion.

For Alternative 4, Mothball, the waste volume to be actively managed is 183,200 m^3 (i.e., handled as bulk or containerized material). Trailers, sheds, tents, and Butler-type buildings would be removed but concrete structures would remain standing. This would include the major production buildings which would be cleaned to remove readily mobile contaminants, but fixed contamination would be left in place. Total cost for implementing the Mothball alternative is $716 million.

B. Baseline Environmental Management Report Alternative

Alternative 2, BEMR I, represents the planning that was envisioned for the Site and published in 1995 in response to a Congressional mandate. It provides a summary of DOE's projected scope, schedule, and estimated life cycle costs for all environmental restoration and waste management activities at Rocky Flats. The BEMR alternative is included here to present DOE's thinking on future Site management. The cost data published in the 1995 BEMR document suggested that the resources required to execute the Site's plan for fiscal year (FY) 1995 through FY2000 exceed the estimated funding projections from DOE Headquarters. This disparity between resource needs and funding availability was part of the impetus driving the ASAP process and the accelerated schedule to develop alternatives. Total waste management cost is $9.6 billion reflecting the extreme time frame for execution (i.e., 65 years) based upon DOE HQ modeling efforts.

C. Intermediate Alternatives

The No. 3 series alternatives, Monitored, Retrievable Storage/Disposal present a range of options that are intermediate in nature in terms of waste volumes to be managed and their costs. The various alternatives differ in the waste volumes handled, extent of LDR treatment, number and size of new storage building construction projects, and whether the material was shipped offsite or retained onsite in a landfill or a concrete-lined cell. The costs for these options range from $3.2 billion to $1.2 billion.

TRU/TRM Wastes

All alternatives assume treatment of transuranic wastes (both TRU and TRM) to meet the Waste Isolation Pilot Project (WIPP) Waste Acceptance Criteria (WAC). For the waste volumes envisioned with ASAP, 35 percent of the wastes will require treatment. The treatment technologies proposed include (1) immobilization by cementation for particulates and liquids and (2) deactivation (e.g., oxidation) to neutralize reactive materials. TRM wastes are not necessarily treated to meet LDR requirements based on the assumption that WIPP will obtain approval of the No Migration Variance Petition from EPA before it opens.

Except for Alternative 3b, Priority Shipment, the alternatives envision construction of a hardened facility to temporarily store TRU/TRM waste onsite until the wastes can be shipped to WIPP. The size of the facility varies depending on the degree of waste consolidation within drums and the shipping rate. In Alternative 3b, existing buildings would be used to store TRU/TRM until these wastes could be shipped to WIPP.

There are a number of uncertainties which could strongly influence selection of a TRU/TRM storage strategy and need to be more fully explored in Phase III of the ASAP. These uncertainties affect not only the size of any future storage facility but also the type of building constructed (e.g., hardened or Butler-type). As the number of drums decreases, opportunities to use existing buildings for storage instead of constructing a new one become more viable. Uncertainties that are being further evaluated include the following:

- WIPP WAC compliant packaging versus packaging to minimize volume
- Allowable plutonium gram loading in nonhardened, non-HEPA filtered buildings
- Allowable plutonium gram loading in transportation vehicles and other factors affecting shipping rate

A. WIPP WAC Compliant Packaging Versus Containment Packaging

If drums are packaged to meet WIPP WAC, then as many as 50,000 drums could be generated. However, if drums are packaged in the minimum storage volume configuration, the drums themselves will meet neither WIPP WAC nor certain transportation requirements because of the amount of plutonium in a single drum. However, the total volume of drums will be significantly less. Thus the size of the storage building could be greatly reduced. With the reduced number of drums, storage in existing buildings becomes possible, thereby avoiding new construction. Under the containment packaging conditions, the drums would require repacking prior to shipping.

B. Allowable Plutonium Limits in Nonhardened Buildings

The type of building needed to store TRU/TRM waste is also unclear. Many of the TRU/TRM waste drums contain relatively small amounts of plutonium (i.e., about 7 g/drum). These wastes could be stored in a nonhardened, non-HEPA filtered building (e.g., Butler-type building) without appreciable risk to workers and/or public. Such storage would require relief from the 10 kg of plutonium limit currently imposed on nonhardened buildings. Recently completed safety analyses indicate that the amount of plutonium contained within a given building can be increased under certain circumstances without compromising public and worker exposure risks. Actions are underway to evaluate the consequences of raising this limit or establishing gram loading criteria on an area basis (e.g., per ft^2) as opposed to a limit for a total building.

Another factor determining if a nonhardened building could be used for TRU/TRM storage is whether or not the pipe component drum configuration can qualify as a storage container that is structurally enhanced to meet design basis accident scenarios. In this configuration, wastes meeting WIPP WAC are sealed in pipes. Several of these pipes can be placed in a single drum for storage. The main benefit of this packaging approach is for the TRU/TRM wastes resulting from residue processing which typically contain significant amounts of plutonium. Because of the enhanced packaging and attendant protection from material being released to the environment, pipe component drums could be stored safely in Butler-type buildings, cargo containers, or other nonhardened structures.

C. Factors Affecting Transportation of TRU/TRM Wastes

A number of constraints affect the amount of TRU/TRM wastes that can be placed in a TRUPACT vessel for transport. These constraints impede the effective use of TRUPACTs for efficient waste transport to WIPP because situations exist in which the vessels can only be partially filled. This results in a greater number of trips being required, which adds to the cost of TRU/TRM management and increases the risk of transport accidents.

Efforts are being initiated to explore changing transport requirements such that TRU/TRM wastes can be shipped more expeditiously within prescribed safety parameters. Initiatives to be reevaluated include but are not necessarily limited to the following: (1) plutonium gram restrictions allowed within a vessel, and (2) the requirement that only wastes from the same waste category be permitted within a single vessel. Current requirements restrict the number of plutonium grams per vessel to 325 g, while the limit for each drum is 200 g. If the gram loading were increased to 2,800 g, then a full complement of drums (i.e., 14 drums) could be packaged to the gram limit and shipped within a vessel. Because of the enhanced design in the TRUPACT II vessels, these changes would not affect transport safety.

In the second example, only wastes from the same category can be placed within a single vessel. If this requirement were relaxed to allow drums from different waste categories to be placed together in a TRUPACT vessel, then the vessels could be more consistently loaded to full capacity, especially when drums of a certain waste category become limiting.

Low-Level Waste and Low-Level Mixed Waste (LLW/LLMW)

The handling options for LLW/LLMW include onsite storage and disposal, onsite and offsite treatment, and offsite shipping for disposal. The variables affecting cost estimates for the different alternatives are: (1) the volumes of waste to be managed, (2) the extent of LDR treatment, (3) whether existing buildings are used for temporary storage or new ones are constructed, (4) the type and size of onsite storage and disposal facilities, and (5) shipping rates.

The onsite storage and disposal options include existing and newly constructed buildings for short-term or long-term waste storing and staging, concrete-lined cells, and/or landfill. Capacity requirements for onsite storage or disposal facilities are based on the specific assumptions and projected waste volumes associated with each alternative. Engineering analysis will determine the most practical size for new storage buildings and may suggest multiple smaller buildings instead of a single large building. Landfill and concrete-lined cell designs are based on a cell capacity of 77,000 m^3 (100,000 yd^3) and would require multiple cells (two cells to five cells) to accommodate disposal of the projected waste volumes. These options include retrievability as a consideration. The ease of retrievability among the options varies from excavation, as would be necessary with landfills (i.e., difficult) to load and ship from buildings (i.e., easy). The costs, effort, and risks associated with retrieval for some of the options are such that future waste removal is unlikely (e.g., landfill). Waste recovery for offsite shipment is considered easiest from buildings, followed in difficulty by retrieval from concrete-lined cells, with the most difficult being retrieval from landfills.

For Alternative 3a, Phased Shipment, a building is proposed. A building provides relatively easy waste removal, facilitates segregation for deferred LDR treatment, and offers greater flexibility for waste handling activities. The concrete-lined cell concept is used for Alternative 3c, Excavation, 3d, Leveled Buildings, and 4, Mothball, because it is less expensive to construct than a landfill, offers greater ease of waste retrieval than a landfill, and avoids the intensive day-to-day operational activities associated with buildings (e.g., surveillances, inspections). A landfill is used in Alternative 3e, Entombment and Landfill. It would be designed as a Corrective Action Management Unit (CAMU) or Subtitle C facility. Offsite shipment of wastes is planned for Alternatives 1, 3a, and 3b. Offsite disposal would be accomplished by sending wastes to the Nevada Test Site, Hanford, and commercial facilities.

Treatment of LLMW is necessary to minimize risks associated with disposal and to meet regulatory requirement of Resource Conservation and Recovery Act (RCRA) (i.e., LDR). All noncompliant LDR wastes are treated to meet regulatory requirements in Alternatives 1, Unrestricted, 3a, Phased Shipment, and 3b, Priority Shipment. It is assumed that 25 percent of the LLMW would be LDR noncompliant and require treatment to meet LDR standards in Alternative 1 and 50 percent in Alternatives 3a and 3b. Treatment would be deferred until immediately before shipping in Alternative 3a; for this alternative, the wastes would be stored in buildings during the interim. In Alternative 3b, Priority Shipment, LDR noncompliant wastes would be treated as soon as practicable and readied for offsite disposal.

Alternatives 3c, 3d, 3e, and 4 consider minimal treatment (i.e., treatment of high risk wastes) to be sufficient to ensure safe storage or disposal but not to meet full regulatory compliance requirements. For these alternatives, regulatory waivers and/or exemptions would be necessary. High risk wastes typically consist of wastes that exist or would be generated in a physical or chemical form that would not be amenable to direct disposal. Such wastes include bulk or containerized liquids, semisolids and dispersible particulates. As a result, treatment techniques proposed include immobilization using cementation and polymer encapsulation. Additionally, treatment methods will include chemical and thermal (nonincineration) treatment for the removal and destruction of organic components. In evaluating the minimal treatment alternative, it was determined that only about 15 percent of the current LLMW inventory would require treatment. The balance of the inventory would consist of lower risk wastes including pondcrete, lead, metal, glass, and combustibles.

A number of uncertainties affect the LLW/LLMW management strategy. These uncertainties affect the feasibility of using certain storage and disposal facilities and the reliability of cost estimates for waste treatment. Uncertainties that are being further evaluated include the following:

- Feasibility of using a CAMU
- WAC for onsite landfill and concrete-lined cells
- Reliability of waste treatment volume and cost estimates
- Waste categories by source

A. Feasibility of Using a CAMU

Use of a CAMU offers many advantages to the Site for the emplacement of wastes in landfill cells (e.g., traditional landfill or concrete-lined cell). It allows for consolidation of remediation wastes (i.e., wastes from environmental cleanup activities) from multiple locations and provides relief from LDR requirements. Without the benefit of a CAMU, removal of remediation wastes would normally trigger the application of the LDR storage prohibition while the wastes are in storage, and would trigger the LDR treatment standards prior to placement of the wastes back onto the ground. The use of a CAMU, while still considering the risk and hazard potential of the material, does not trigger the LDR provisions, thereby providing a much wider range of options for efficient remediation. The design parameters of a CAMU and Subtitle C landfill are technically equivalent and would provide the necessary protection from and controls for pollutant migration. Negotiations are underway between the Site and CDPHE for approval of an onsite CAMU and to determine provisions for its use.

A related issue to the siting of a CAMU is the definition of remediation wastes. The Site hopes to include demolition debris as remediation wastes as well as soils and sludges from environmental restoration activities. This would allow direct deposit of contaminated building demolition debris into the landfill for burial and/or emplacement in the concrete-lined cell.

B. Waste Acceptance Criteria for Onsite Waste Facility

Effort is underway to develop waste acceptance criteria for an onsite landfill. The desired specific activity level for low-level waste emplacement in a landfill is not to exceed 100 nCi/g. This level is comparable to other federal waste repositories (e.g., Nevada Test Site, Hanford). It is considerably higher than that used by commercial disposal sites which is typically less than 10 nCi/g. It is important that the higher specific activity level (100 nCi/g) be used in order to accept the full spectrum of waste at Rocky Flats. If 10 nCi/g is established as the WAC, then approximately 75 percent of the Site's LLW would not be eligible for emplacement (based on current inventory).

In addition, measuring specific activity levels at less than 10 nCi/g to verify that the waste in a drum did not exceed that amount would not be possible with currently available instrumentation. A value of 10 nCi/g translates to approximately 24 milligrams of plutonium. This cannot be measured on a drum by drum basis and would necessitate emptying the drum contents, measuring individual waste packages, and computing a total prior to repacking and sealing the drum. Thus, the characterization costs associated with verifying that less than 10 nCi/g was present would be prohibitively expensive.

C. Reliability of Waste Treatment Volumes and Cost Estimates

Significant uncertainty exists in developing reasonable cost estimates for LLMW LDR treatment requirements. Unit cost estimates for potential treatment technologies vary considerably depending on the technology used and range from $1,000/m³ to $20,000/m³. Contributing to the high uncertainty is the fact that many technologies are untested and unproven on a commercial production scale or are sensitive to economies of scale regarding throughput. The uncertainties are further exacerbated by the lack of detailed characterization data for projected LLMW generation volumes, especially for materials resulting from environmental restoration activities. The projected amounts of LLM remediation wastes onsite not meeting LDR requirements range from 25 percent to 75 percent of the total.

These uncertainties, taken together, result in an enormous range of potential cost estimates for treating LDR wastes. Preliminary estimates show that LDR treatment estimates can vary from $308 million to $18,495 million for the projected waste volumes from Alternative 1, Unrestricted. Unit cost treatment values range from $3,500/m³ under Alternatives 1, 3d, and 3e to $10,000/m³ for the remainder of the alternatives. It is also assumed that 25 percent of the remediation wastes from environmental restoration activities will require treatment under Alternatives 3a and 3b, and 15 percent will require treatment under the remainder of alternatives. These assumptions result in an extremely high treatment cost, especially for alternatives involving large amounts of environmental restoration waste materials (e.g., Alternative 1).

Some of the Alternatives evaluated in ASAP Phase II consider limiting treatment to high risk LDR noncompliant wastes. Low and moderate risk LDR wastes would either not be treated or treatment would be deferred until further evaluated to demonstrate that the risks posed by disposal of the waste meet the intent of public protection requirements. This course of action may be technically acceptable for LDR wastes which do not present an appreciable risk to the public (e.g., pondcrete); however, exemption from the regulations will be required. The probability of and mechanism for obtaining the required exemptions is unknown at this time and will be further explored in ASAP Phase III.

The intent of the LDR regulations is to minimize risk posed by disposal of untreated waste; the reality of the actual quantitative treatment standards is that they are based on a concept called Best Demonstrated Available Technology (BDAT), which includes an overall review to ensure that such standards were adequately protective of human health and the environment. The relevance in this is that the current treatment standards are based on concentrations that are currently achievable with conventional technologies. As a result, they may be more restrictive than necessary for adequate protection. This acknowledgment was made by EPA in promulgation of the "First Third" rule. It is this BDAT basis for determining treatment standards that showed that there were perhaps other alternatives equally as protective of human health and the environment. Such recognition happens at a national level through the allowance of national and case-by-case capacity extensions (to the effective date for treatment standard implementation), treatability variances, and no migration variances.

D. Waste Categories by Source

Process wastes are generated by nuclear and nonnuclear manufacturing, stabilization, and maintenance processes. They are typically metals, plastics, glass, spent chemicals, and a variety of other materials generated from processing operations. Demolition wastes arise from deactivation, decontamination, decommissioning, and demolition activities. These wastes consist of excessed equipment (e.g., scrap metal, concrete, piping, and plenums). Materials with recycle and/or salvage value are not included in this category. Remediation wastes are typically environmental media such as soils, sludges, and liquids that are generated as a result of cleanup actions to eliminate source terms and to decrease the potential for migration of radioactive and chemical hazards.

The origin of the waste, in some cases, may determine the regulatory influences that affect how the waste is managed. For example, while process wastes and remediation wastes are both subject to regulation by CDPHE and/or EPA, they may be subject to different requirements. Specifically, process wastes that are considered hazardous under State of Colorado hazardous waste laws may be required to be disposed in landfills that meet the definition of RCRA Subtitle C. Similar remediation wastes can be disposed in a landfill meeting the definition of a CAMU and are subject to different requirements: i.e., need not meet LDR nor minimum technology requirements.

The prevailing statute governing management of backlog process wastes and future waste generation needs to be determined (RCRA or CERCLA). It could be argued that wastes currently present and those generated in the future should be managed as CERCLA waste because the Site is no longer an active production facility, and the work activities being conducted are related to environmental cleanup. Regardless of which statute prevails, wastes will be managed in a safe and compliant manner in accordance with potential risk.

Uncontaminated, Sanitary, and Hazardous Wastes

Based on initial evaluation of the ASAP alternatives, the uncontaminated construction and demolition debris generated could range from approximately 19,000 m^3 to nearly 489,000 m^3. Because there are existing markets for treatment, disposal, and/or reuse of these materials at offsite locations, and based on the desire to minimize the use of onsite disposal, storage, and emplacement capacity for these wastes, such wastes would continue to be managed offsite. An ancillary consideration in the evaluation is the fact that it may be economically desirable to keep certain construction and demolition debris onsite for use as fill or as stabilizers for other onsite disposal and emplacement options. Likewise, because of existing offsite service availability for hazardous and sanitary wastes, these wastes would continue to be shipped offsite for treatment and disposal or reuse.

WASTE MANAGEMENT

1.0 INTRODUCTION

1.1 Task Description

The waste management task describes the activities to be considered to address the large volumes of waste materials that need to be dispositioned in order to successfully realize the goals of the Accelerated Site Action Project (ASAP). Proper waste management is essential for worker and public safety, environmental protection, and retention of a suitable range of future land-use and/or economic development options for the Site. The diverse array of waste forms existing and yet-to-be generated at the Site present special challenges because of the unique hazards, formidable regulatory constraints, and the sheer quantity of materials to be dispositioned.

1.2 Purpose

The purpose of this task is to develop a waste management program to address both standing inventory and newly generated wastes arising from implementation of the ASAP.

A number of treatment, storage, and disposal alternatives are being considered to develop a program that is technically prudent, cost-effective, and efficient in achieving meaningful risk reduction. This will be accomplished by (1) identifying viable alternatives for waste dispositioning; (2) developing information pertinent to issues affecting waste management decisions; and (3) evaluating the alternatives in terms of technical and regulatory feasibility, cost-benefit, risk and liability reduction, stakeholder acceptability, and ease of implementation.

1.3 Scope

The scope of wastes to be addressed includes process wastes from previous and ongoing operations, construction debris from demolition activities, and soils from remediation activities. These materials include uncontaminated demolition debris and soils, hazardous waste, low-level waste (LLW) and low-level mixed waste (LLMW), transuranic and transuranic mixed waste, asbestos, and polychlorinated biphenyls. Sanitary solids (e.g., office trash) are not evaluated here because such wastes will continue to be disposed in the onsite sanitary landfill until such time as arrangements are made for offsite municipal disposal.

1.4 Update to ASAP Phase I

The waste management portion of the ASAP Phase I document examined a narrow range of storage, treatment, and disposal options. Preliminary results in Phase I suggested limiting onsite storage to transuranic (TRU) waste forms (both straight radioactive and mixed); treatment of liquid low-level mixed waste; landfilling most low-level and low-level mixed waste solids; offsite shipment of hazardous and sanitary wastes; and limited shipments (i.e., for 2 years) of saltcrete and low-level wastes until the onsite landfill is constructed.

The ASAP Phase II document broadens the range of options examined by evaluating utilization of (1) existing buildings for long-term storage, (2) other non-landfill onsite waste emplacement options, and (3) more treatment options for mixed waste streams. These changes in the ASAP focus are, in large measure, in support of the Draft Conceptual Vision of the Site, and in response to public comments voiced at meetings, and in letters and phone calls from stakeholders and regulators.

2.0 TASK INTERDEPENDENCIES

2.1 Waste Volume Generation

The waste management task is dependent upon the types of wastes generated and their respective volumes. Differences in the amounts of waste forms produced for the various alternatives greatly influence waste handling strategies because of cost differences, risk potential, and the logistics involved in managing the wastes. This is especially important for handling wastes from building demolition activities and environmental restoration. There exists a 2 million m^3 difference in total volume of wastes to be actively managed when comparing the waste generation potential of the Unrestricted Alternative with the Mothball Alternative.

2.2 Cost-Effectiveness of Using Existing Buildings for Temporary Waste Storage Versus Constructing New Facilities

The cost-effectiveness of using existing buildings for temporary waste storage is dependent on the duration of their operation and hence, the availability of more permanent onsite emplacement or offsite disposal facilities and the completion of residue processing activities. TRU wastes could be stored temporarily in existing buildings (e.g., Buildings 371, 374, and 707). The incremental cost for TRU waste storage in these buildings is negligible as long as residue processing and plutonium consolidation activities are underway. However, operating costs to maintain these facilities are high, and to retain them exclusively for waste storage after residue processing activities are complete may be prohibitively expensive, especially if shipping to WIPP takes several years to complete. As a consequence, the schedules for residue processing and subsequent shipment of TRU wastes offsite significantly influence the economic comparison between using existing buildings or constructing new storage facilities. Using existing buildings to store low-level and low-level mixed waste is influenced by the duration of storage as well; however, the cost and risk implications are not as great as are those for TRU.

2.3 Land-Use Decisions Affecting Waste Storage

Alternatives which consider the release of major portions of the buffer zone to public access may have a significant effect on the amount and type of wastes that can be stored in buildings onsite. The amount of plutonium (i.e., in waste) that can be housed in a given building is directly related to the estimated potential radiation dose at the Site boundary (i.e., potentially released to the public). Distance from the building to the Site boundary is a key factor influencing source term dispersion, and thus, the dose estimate. Reducing this distance by decreasing the buffer zone results in a lesser amount of plutonium that can be stored within a given building in order to remain below acceptable dose limits at the Site boundary.

2.4 Waste Management Impacts to Other Activities

Waste management influences other task activities by providing guidance on packaging methods. Wastes from demolition and environmental remediation activities are more economically managed in bulk as opposed to management in containers. Onsite emplacement options favor bulk management techniques. Should containerization be required, preference is given to larger containers such as sealands, roll-offs, and crates. Larger containers reduce costs (e.g., container, certification, administrative, and labor costs). Fifty-five gallon drums are preferred for TRU materials and typically for wastes that are generated from building operations. To minimize both required onsite storage space and repacking, residue processing wastes will be packaged in double bags to meet the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria (WAC). However, more than one bag will be placed in each drum. Whereas individual packages will be WIPP WAC compliant, individual waste drums may not be, primarily due to containing more than 200 grams (g) of plutonium. Such drums will need to be opened and the packages re-distributed among other drums prior to shipping. In this manner, the waste volume to be stored is significantly reduced, and repack is limited to placing sealed bags into empty drums for transport to WIPP.

3.0 GENERAL ASSUMPTIONS

The following assumptions apply to the ASAP alternatives except as noted. Waste storage and disposal analyses are predicated on these basic assumptions:

- Onsite Disposal/Storage
  - Greater than 10 kilograms (kg) of plutonium will be contained in nonhardened, non-HEPA filtered buildings.
- Treatment
  - Onsite treatment alternative selection will be based on economic considerations and technical feasibility. It is recognized that stakeholder acceptability may subsequently override technical and economic selection criteria.
- Offsite Shipment
  - Waste Isolation Pilot Plant (WIPP) will open in April 1998; however, limitations in transport vehicle availability and WIPP waste acceptance will require prolonged onsite storage of TRU/TRM wastes.
  - Temporary offsite storage of TRU and TRM is neither technically prudent nor economically viable.

4.0 ALTERNATIVES

4.1 Descriptions of Alternatives as Related to Waste Management

Eight alternatives are evaluated in the ASAP Phase II. These alternatives are referred to as (1) Unrestricted Alternative in which the entire Site is cleaned up to residential standards; (2) Baseline Environmental Management Report (BEMR I) Alternative which represents the planning that was envisioned for the Site and published in 1995 in response to a Congressional mandate; and (3) one mothball and five restricted alternatives which present six options for cleaning up the site.

The one mothball and five restricted alternatives include: (3a) All Phased Shipment which considers eventual offsite shipment of all retrievable radioactive wastes; (3b) Priority Shipment which ships radioactive wastes offsite for disposal in accordance with an aggressive funding profile; (3c) Excavation which places all radioactive wastes in monitored Phased Shipment facilities preserving the option for later removal; (3d) Leveled Buildings which evaluates the placement of all radioactive wastes which must be transported or moved (i.e., container or bulk) into monitored, Phased Shipment and disposal facilities; (3e) Entombment and Landfill in which most low-level and low-level mixed waste is disposed onsite in RCRA Subtitle C type landfills; and (4) Mothball which involves the cleanup of the Site to necessary and sufficient safety levels with some facilities remaining standing but vacant. A summary of the various alternatives is provided in Section 2 Presentation of Alternatives, of this document. The waste volumes associated with each alternative are presented in Table B-4.

Table B-4

Waste Volumes For Alternatives Considered

WASTE SOURCE & CATEGORY	1. Unrestricted							
EXISTING INVENTORY								
• hazardous	250	142	250	250	250	250	250	250
• low-level wastes	5,400	4,343	5,400	5,400	5,400	5,400	5,400	5,400
• low-level mixed	18,000	1,288	18,000	18,000	18,000	18,000	18,000	18,000
• transuranic	580	280	580	580	580	580	580	580
• transuranic mixed	580	791	580	580	580	580	580	580
• other wastes	35		35	35	35	35	35	35
DEMOLITION WASTES								
• uncontaminated	166,800	170,235	166,800	166,800	166,800	135,300	135,300	5,000
• hazardous	22,000	3,734	2,200	2,200	2,200	2,200	2,200	100
• low-level wastes	38,500	14,997	38,500	38,500	38,500	38,500	31,500	8,100
• low-level mixed	17,200	258,596	17,200	17,200	17,200	17,200	17,200	150
• transuranic	1,300	1,428	1,300	1,300	1,300	1,300	1,300	100
• transuranic mixed		6,263						
• other wastes								
REMEDIATION WASTES								
• uncontaminated								
• hazardous	80,000	31,131	7,500	7,500	7,500	7,500	7,500	7,500
• low-level wastes	850,000	76,563	11,500	11,500	11,500	11,500	11,500	11,500
• low-level mixed	1,195,000	259,920	231,000	231,000	231,000	231,000	231,000	96,000
• transuranic								
• transuranic mixed								
• other wastes								
RESIDUE PROCESSING								
• hazardous								
• low-level wastes	970	289	970	970	970	970	970	970
• low-level mixed	95	1,541	95	95	95	95	95	95
• transuranic	3,135	729	900	3,135	900	900	900	900
• transuranic mixed	3,125	4,074	900	3,125	900	900	900	900
• other wastes								
ROUTINE OPERATIONS								
• uncontaminated	13,650	318,432	13,650	13,650	13,650	13,650	13,650	13,650
• hazardous	1,125	1,718	1,125	1,125	1,125	1,125	1,125	1,125
• low-level wastes	10,200	9,717	10,200	10,200	10,200	10,200	10,200	10,200
• low-level mixed	2,700	3,548	2,700	2,700	2,700	2,700	2,700	2,700
• transuranic	210	583	210	210	210	210	210	210
• transuranic mixed	60	1,243	60	60	60	60	60	60
• other wastes								
Totals by Category								
• uncontaminated	180,450	488,667	180,450	180,450	180,450	148,950	148,950	18,650
• hazardous	83,575	36,725	11,075	11,075	11,075	11,075	11,075	8,975
• low-level wastes	905,070	105,909	66,570	66,570	66,570	66,570	59,570	36,170
• low-level mixed	1,232,995	524,893	268,995	268,995	268,995	268,995	268,995	116,945
• transuranic/trans mixed	8,990	15,391	4,530	8,990	4,530	4,530	4,530	2,170
• other wastes	35		35	35	35	35	35	35
GRAND TOTAL	2,411,115	1,171,585	531,655	536,115	531,655	500,155	493,155	182,945

(1) Values are from 1995 BEMR report to Congress and no attempt was made to revise these estimates nor the earlier assumptions.

These waste volumes were compiled from input from all waste generating functions. The TRU/TRM waste from residue processing reflects either a maximum case resulting in WIPP acceptable containers or minimum case which is intended for long-term onsite storage. Potentially, volumes for the long-term onsite storage case could be lower; however, due to uncertainties related to acceptable packaging configurations, an intermediate volume was used.

4.2 Waste Forms and Attributes

Existing and future waste forms can be grouped into categories according to the nature of the contaminants present (e.g., hazardous, low-level and low-level mixed). To protect personnel handling these waste forms, a variety of containment systems and protective measures are used. These are described below.

4.2.1 Waste Categories by Contaminants

Rocky Flats wastes can be contaminated by radioactive materials, hazardous chemical constituents and/or biomedical hazards.

Radioactive Wastes - Waste materials that contain specific radioisotopes such as alpha-emitting plutonium and americium, as well as naturally occurring elements such as uranium and thorium. Transuranic wastes are contaminated with alpha-emitting radionuclides with half-lives greater than 20 years and in concentrations greater than 100 nanocuries/gram (nCi/g). Low-level waste has concentrations of alpha-emitting radionuclides of less than 100 nCi/g with no specified minimum level of activity.

Hazardous Waste - Hazardous wastes exhibit the characteristics of reactivity, corrosivity, ignitability or toxicity, or contain chemical constituents such as organic solvents or heavy metals that are regulated under RCRA. Other waste forms considered hazardous, but not regulated under RCRA, are (1) asbestos which is regulated under the Clean Air Act and Occupational Safety and Health Act (OSHA), and (2) polychlorinated biphenyls (PCBs) regulated under the Toxic Substances Control Act (TSCA).

Medical Waste - The Colorado Medical Waste Act imposes requirements on the management of medical wastes generated in the diagnosis, treatment, or immunization of humans or animals. Rocky Flats generates limited quantities of these wastes which are handled in accordance with required statutes.

Mixed Wastes - Mixed waste contains both radioactive contaminants and regulated chemical constituents. The more common waste forms at Rocky Flats are transuranic mixed and low-level mixed wastes.

Residues - Residues are radioactive liquids and solids with plutonium concentrations above formerly defined economic discard limits (EDL). Residues for all practical purposes are TRU or TRM waste, but have special management requirements due to their higher plutonium content. These materials have a high radioactive content and are undergoing stabilization as part of the plutonium stabilization initiative. Waste materials resulting from the processing of residues will be managed as low-level and transuranic wastes.

4.2.2 Containment Systems and Protective Measures

Because of the hazards associated with waste forms at Rocky Flats, considerable care is exercised in the packaging and containment of these materials. Wastes are typically managed in containers including steel drums (35-gallon, 55-gallon, 83-gallon), other steel containers (8801, 8802 cans), steel boxes, wooden boxes (half crates and full crates), and triple-walled corrugated cardboard boxes (tri-walls). Certain wastes are managed in bulk form (e.g., construction debris).

Radioactive waste is collected and packaged in accordance with stringent procedures as specified in approved Type A packaging procedures. Type A packaging requirements are governed by the Department of Transportation (DOT). A typical Type A package must be able to withstand a series of standard tests for water resistance, free drop, compression, and penetration. In addition, strong, tight containers are used for storage and shipment of Low Specific Activity waste. Both strong, tight containers and Low Specific Activity are defined by DOT.

Low-level and low-level mixed wastes are packaged in three different types of containers: (1) metal drums, (2) wooden boxes, and (3) triple-walled corrugated cardboard boxes. Within these containers, there are a variety of inner packaging requirements. In the case of metal drums, the packaging configuration includes some or all of the following:

- Fiberboard liner for hard materials
- Double polyethylene or polyvinyl chloride plastic bags
- Carbon composite filter in drum lid to prevent pressurization due to gas buildup
- Bolted drum closure ring

In the case of wooden boxes, the packaging configuration includes a fiberboard liner, polyvinyl chloride plastic liner, and plywood flush panel box. For cardboard boxes, one or more plastic liners are used.

Transuranic and transuranic mixed wastes are collected and stored in two different configurations. The packaging configuration for metal drums consists of the following:

- Fiberboard liner for hard materials
- Double polyethylene or polyvinyl chloride plastic bags
- High density polyethylene rigid liner
- Carbon composite filter in drum lid
- Bolted drum closure ring

In the case of metal boxes (commonly referred to as TRUPACT II Standard Waste Box), the packaging configuration consists of the following:

- Fiberboard liner
- Polyvinyl chloride plastic liner
- Two carbon composite filters in box lid
- Bolted or welded closure

Hazardous wastes are packaged in strong, tight containers (drums or boxes) with rigid liners and plastic bags depending on the nature of the material.

These packaging systems are designed to provide for the highest degree of protection to the worker and to the public during onsite management and offsite transportation. In addition to the physical package, a variety of other protective measures are used to maintain wastes in a safe condition. These measures include (1) nondestructive assay for determination of radioactive content, (2) radiological surveys to confirm container integrity, (3) stringent packaging, collection, storage, and management procedures, (4) frequent inspections, (5) characterization either by process knowledge or chemical analyses, and (6) certification prior to shipment.

4.3 Waste Handling Options

In evaluating waste management requirements to support achievement of ASAP objectives, numerous waste handling options were identified for consideration and detailed analysis. These options are discussed in the following sections.

4.3.1 Onsite Waste Disposal/Storage

Onsite disposal/storage was considered for all categories of waste (LLW, LLMW, TRU, TRM, hazardous, sanitary) with all reasonable options being evaluated. This can include several different concepts which can vary by waste category. Options/concepts that were considered are identified below.

Low-level/Low-level Mixed Waste

- Emplacement in a landfill
- Emplacement in a concrete-lined storage cell
- Emplacement in a waste vault
- Emplacement on a concrete slab
- Storage in converted, existing site facilities
- Storage in new facilities
- In-place entombment (of building demolition debris)
- Combination of the above options

Transuranic/Transuranic Mixed Waste

- Storage in converted, existing Site facilities
- Storage in new facilities
- A combination of the above options

Hazardous Waste

- Emplacement in a landfill facility (CAMU and/or Subtitle C)

Construction Debris/Sanitary Waste

- Emplacement in a Subtitle D Landfill
- In-place entombment (of building demolition debris)

Each option was defined and analyzed based on the waste type and volumes requiring management/emplacement. Specific details for these options are presented in Subsection 4.4 of this Appendix.

4.3.2 Offsite Disposal

Offsite disposal options are currently available or are expected for all waste types. However, there are uncertainties related to offsite disposal capabilities for TRU/TRM waste and LLW/LLMW. TRU/TRM waste is destined for disposal at WIPP in Carlsbad, New Mexico; DOE currently expects this facility to open for receipt of waste in April 1998. Not all stakeholder and regulatory concerns have been closed and some uncertainty continues about when or if the facility will be available. LLW is currently disposed at the DOE Nevada Test Site (NTS); however, continuing issues with waste acceptance requirements and stakeholder support for continued use of this facility for waste disposal pose some uncertainty for the future. Some LLMW has been disposed at the Envirocare facility in Utah; however, recent restrictions on radioactive contamination levels will further limit the quantities of waste that can be disposed at this facility. NTS has been identified for future disposal of LLMW with a current planning date of September 1998 to initiate mixed waste disposal. Stakeholder and regulator issues are of major concern and significant uncertainty exists on the viability of this option. Offsite disposal of hazardous waste, construction debris, and solid sanitary waste is expected to continue as a viable option. A listing of offsite disposal options is provided below:

TRU/TRM Waste

- WIPP

LLW/LLMW

- Nevada Test Site
- Envirocare
- Other DOE facilities
- Other commercial facilities

Hazardous Waste

- Commercial facilities

Construction Debris/Sanitary Waste

- Commercial landfills

Offsite waste disposal options are discussed in greater detail in Subsection 4.5.

4.3.3 Treatment

Treatment options are being considered primarily for LLMW to achieve compliance with RCRA Land Disposal Restriction standards. Both onsite and offsite options are considered feasible and have been extensively studied. Minimal treatment of TRU/TRM waste to achieve compliance with WIPP WAC is also considered. Quantities of waste to be treated are dependent on regulatory requirements and potential regulatory flexibility based on risk assessments. This could result in treatment of all or only some small portion of LDR noncompliant LLMW based on the risk assessments and negotiated regulatory flexibility. Treatment options are discussed in detail in Subsection 4.6 of this Appendix.

4.4 Onsite Emplacement

Onsite emplacement is the term used to describe options which retain bulk and containerized wastes on the Site. It includes above-ground storage buildings, landfills, and other surface, subsurface, or partially buried structures. Since the emplacement options all have a degree of retrievability associated with them, the term avoids the semantic differences between whether an alternative is strictly storage or strictly disposal.

Onsite emplacement of waste includes a variety of potential options depending on the waste category. Detailed discussions of the options considered are provided in the following sections. Onsite emplacement options discussed below include:

- Using existing facility
  - for TRU/TRM wastes
  - for LLW/LLMW

- Constructing new hardened facilities for TRU/TRM wastes
  - a pre-engineered facility design
  - a more traditionally designed fully hardened facility

- Constructing new steel storage buildings (e.g., Butler-type)
  - for TRU/TRM wastes
  - for LLW/LLMW

- Constructing concrete-lined cells
- Constructing landfill facilities
- Constructing concrete slabs

Some of the options discussed in this section are not specifically included as part of the eight alternatives evaluated in ASAP Phase II. They are included here to show the types of facilities analyzed and to provide a more complete range of options for consideration in ASAP Phase III.

4.4.1 Use of Existing Facilities

An evaluation is underway to determine the minimum number of existing buildings that could be used for storing the current and projected waste inventories so that (1) facility decontamination and decommissioning can proceed pursuant to proposed schedules, (2) other facilities could be placed in stand-down configuration at significantly reduced mortgage costs, and (3) new facility construction can be avoided or at least minimized. A number of hardened and nonhardened buildings were identified which offered waste storage capability. These facilities were visually surveyed to determine the maximum number of drum equivalent storage spaces possible with minimal equipment strip-out requirements and upgrades. The facilities examined are shown in Table B-5.

The number of drum spaces needed cannot be definitely determined at this time because of uncertainty associated with waste packaging requirements and allowable gram loading of plutonium for different types of buildings (e.g., hardened, Butler-type). The present strategy is to develop a progression of candidate buildings so that present and future wastes can be accommodated as storage requirements are better defined.

A key element to consider in evaluating whether it is better to retain existing buildings for waste storage versus constructing new ones is the period of time wastes would remain in the facility after all other activity ceases. Existing buildings are expensive to maintain in a safe configuration, especially hardened buildings in the Protected Area. If storage time periods are going to be lengthy, it may be more economical to construct new buildings with substantially lower annual operating costs.

As an additional tool, there is an ongoing effort to evaluate the basis and define the necessary (but not conservative) requirements for operation within a building commensurate with the risks posed by specific activities within a building. This effort could result in the reduction of some building requirements (while still maintaining appropriate levels of safety protection), thereby reducing the cost of conducting operations within the facility.

Buildings selected will require modification of the existing building authorization baselines and updating of the safety analysis report to ensure that the safety envelope of the facility is not compromised due to new activities within the selected facilities. All activities will be required to follow and implement federal and state regulations and Department of Energy Orders.

TRU and TRM Waste Storage in Existing Buildings

Transuranic wastes can be divided into two categories based on plutonium gram content of drums: (1) wastes from residue processing activities which typically have gram loadings greater than 100 g/drum, and (2) wastes from general building operations which have gram loadings of from 7 to 10 g/drum (e.g., gloves, protective clothing, rags, debris).

Table B-5
Existing Candidate Facilities For Waste Storage

BUILDING	POTENTIAL CAPACITY (drum equivalent)	CURRENT INVENTORY						AVAILABLE SPACES
		residue	TRU	TRM	LLW	LLMW	HAZ	
334	8746						2	8748
374*	2500			221	187	394		2500
374**	10,500			221	187	394		10,500
440	8000				1			8000
551	18,979				1			18,979
664	9500		622	1107	4388	239		3000
865	8628				145	23		8628
881	34,477				596	17	8	34,477
883	3631				307	2		3631
906	15,000					9658		5000
991	6497							6497
750 Pad	21,876				646	21,222		
904	49,995				212	48,897		
444 Cargo	14,575							2000

* No stripout
** With stripout

For residue processing wastes, the following buildings are being evaluated for storing existing residues and future waste products:

- Building 374
- Building 707
- Building 883
- Building 865
- Building 881

Building 374 is preferred because it is contiguous with Building 371 that will be retained for a prolonged period to accommodate residue and SNM management activities, has large floor space area, and allows easy removal of existing equipment in order to store wastes. Use of this building will require relocating waste treatment capability elsewhere.

Building 374 has the capability to store approximately 10,500 drum equivalents within rooms 2804, 3801, 3803, 3809, 3810, 3811, and 3813. The 10,500 drum capacity is based upon stacking of drums four-high. Currently, efforts are underway to ensure that stacking residue drums in a four-high array does not create criticality safety issues or safety analysis issues. If stacking four-high is allowed, Building 374 would be able to house the existing inventory with a remaining capacity of over 2,000 drum equivalents. If residues are only allowed to be stacked in a two-high or in a single planar array, Buildings 707, 865, and 883 could be used for storage of the remaining residue waste.

Once a criticality safety evaluation has been performed to determine whether stacking of residue waste will be allowed, the schedule and the cost for upgrading of facilities will commence. Building 374 will require the removal of tanks and supporting equipment in the already mentioned rooms, while Building 707 modules will require some strip-out activities. Exemption from the National Conversion Pilot Project (NCPP) to store residues in Buildings 865 and 883 will be requested from DOE, RFFO. If they are not available, Building 881 would be the final place to house the remaining residues. Utilization of Building 881 would require a significant effort to relocate equipment and activities.

For TRU and TRM wastes from routine building operations, buildings outside of the Protected Area are being explored. Storage of TRU/TRM wastes in nonhardened facilities requires relief from the Site-imposed 10 kg plutonium content limit for such buildings. Building 664 is being recommended to store the existing inventory of TRM wastes. Straight TRU wastes could be placed in Building 551. Relocating TRU and TRM wastes to Buildings 664 and 551 would eliminate eight other existing storage areas, most of which are in the Protected Area.

LLW and LLMW Storage in Existing Buildings

To accommodate the existing population of 21,506 drum equivalents of LLW, the following facilities are being considered:

- Building 440
- Building 444 Cargo
- Building 883
- Building 865

This consolidation would eliminate 35 storage areas of LLW and would provide four LLW storage areas across the Site. Areas that eliminate their inventory of LLW would be evaluated to determine if the storage area should be closed or made available for future generation of waste if shipping or disposal were not readily achievable.

Low-level mixed wastes include containerized wastes (e.g., combustibles, plastics, light metals) as well as treated homogeneous waste forms, such as cemented solar evaporation pond sludge (i.e., pondcrete) and cemented aqueous process waste salts (i.e., saltcrete). These wastes could be stored in the following buildings:

- Building 440
- Building 444 Cargo
- Building 551
- 750 Pad
- Building 865
- Building 883
- 904 Pad
- Building 906

This consolidation would reduce 22 areas of storage across the Site to eight. Areas emptied of LLMW inventory would be evaluated to determine if the storage area should be closed or made available for future generation of waste if shipping or disposal were not readily achievable. If the NCPP facilities (Buildings 865, 883) would not be available, use of the 750 Pad would be required until waste could be shipped to an onsite or offsite waste management facility.

Facility Upgrades

Upgrades to existing facilities will be required at various levels of effort for each facility identified. During walkdowns of facilities, storage spaces were identified that required minimal effort. The areas of greatest strip-out will be Building 374 and Building 881 if the NCPP facilities do not become available. South-side facilities that are given the notice to proceed to store waste will be further evaluated to determine the actual cost for facility upgrades. A rough order of magnitude of cost for upgrades is approximately $6.75 million and work should be able to be completed within eight months. Timely transfer of facilities, development of building authorization baseline activities, and permitting activities can cause delays to the proposed schedule. If priority and resources are given to this activity, the eight month schedule for completion should be attainable.

4.4.2 Hardened Facilities

Hardened storage facilities (robust structures with enhanced ventilation and alarm systems) would potentially be required for storage of TRU/TRMW which contains significant quantities of plutonium. These facilities could be existing onsite buildings converted to TRU/TRMW storage or newly constructed facilities. Storage of LLW/LLMW would not require hardened facilities.

TRU/TRM Waste Storage

Onsite storage capacity requirements for TRU/TRM waste will vary by ASAP Alternative and the associated projected generation rates and projected shipping rates to WIPP. The projections include current on-hand inventory plus projected generation from all ASAP Tasks.

The major impact on the projected TRU/TRM waste volumes is determined by the path chosen for residue stabilization activities. The residue processing options are bounded by (1) the minimum waste generation path which processes and repackages residues to satisfy the Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-1 for safe, long-term onsite storage, and (2) the maximum waste generation path which processes and repackages residues to meet WIPP WAC and transportation (TRUPACT II) requirements, which restrict the plutonium content to 200 grams per drum and 325 grams per TRUPACT II vessel, respectively.

The decisions on residue processing could also influence the storage facility requirements due to total plutonium content in each drum. Processing for long-term storage will minimize the number of drums but will increase the typical plutonium content per drum to greater than 200 grams. This higher plutonium content per drum may require a hardened storage facility based on existing storage limitations.

New Waste Storage Building (TRU/TRM Waste Storage)

The scope of this activity is to develop cost and schedule estimates to construct a new TRU/TRM Waste Storage Facility at Rocky Flats. Two options were considered in developing those estimates. Option 1 consists of a preengineered building ranging in size from 70,000 ft^2 for waste packaged for safe long-term storage (more efficient packaging) to 122,500 ft^2 for waste packaged in a WIPP compliant fashion. The preengineered building option assumes that sufficient engineering enhancements will be incorporated to reduce the hardened requirements and thus the cost of the facility. Option 2 is to construct a fully hardened facility. This facility would be constructed of reinforced concrete, contain HEPA filtration and range in size from 81,500 ft^2 to 132,500 ft^2 depending on waste volume stored. The size ranges identified for each option were used only to establish representative cost factors (cost per m^3 of storage capacity) to construct the specific type of facility; actual facility sizes may be different based on the various alternatives and inventories requiring onsite storage.

The building layout and drum configuration for each of these options is similar. A conceptualization of the drum configuration in these facilities is shown in Figure B-1. Figure B-2 illustrates the proposed Site location for construction.

OPTION 1 - PREENGINEERED FACILITY

The size of the preengineered facility will be determined by TRU/TRM waste packaging requirements as mentioned above. The larger preengineered style facility consists of approximately 122,500 ft^2 with 116,000 ft^2 dedicated for drum storage, while the smaller building consists of 70,000 ft^2 with 63,000 ft^2 dedicated for drum storage. The remaining 6,500 ft^2 (for both buildings) consists of occupied areas such as offices, a break room, shower/locker/toilet areas, staging, repack and loading dock including an overhead crane for TRUPACT II loading capability. The larger building will store approximately 57,000 drums of TRU/TRM waste while the smaller building will handle approximately 33,000 drums. The storage area consists of a concrete floor and berm, coated with epoxy paint for RCRA secondary containment requirements, insulated walls and ceilings, no interior wall covering and no mechanical heating systems. The occupied areas are insulated and have finished interior wall/ceiling and industrial heating. The entire building has a Pre-Action fire suppression system. Industrial fencing surrounds the entire facility. Tie-ins to utility systems include water, sewer, telephones, electrical power and natural gas. The location of this building will be west of the northwest access road close enough to other existing or planned facilities remaining onsite such that all utility tie-ins are within 300 lineal feet in length.

Other Remarks/Assumptions/Design Features include the following:

- A repack area will be constructed having a separate HVAC system that includes HEPA filtration in the event of an incident with a drum.

- Drums will be stored four levels high, on seismically qualified drum racks. Interior sizing of the storage area includes space for aisles to maintain accessibility to all drums.

- The drum storage area will be compartmentalized into four equal areas using two hour fire rated gypsum walls.

- Alarm systems assumed to be required include fire alarm, security alarm, SAAM alarms, and criticality detection.

- The storage area will include a Closed Circuit TV (CCTV) system for RCRA surveillance requirements.

Construction Schedule

This project assumes a 43 month schedule including all expense support items required for successful startup of the new facility. Figure B-3 provides a top level schedule. It must be noted, however, that the schedule is contingent on project approval and funding availability. The actual dates should be disregarded because they reflect only activity duration times.

Construction Costs

The total project cost for the larger of the two facilities is $16.2 million. The total project cost includes all expense support activities to support the successful startup of the facility (i.e., procedures, Permitting, Operational Readiness Review, NEPA). The total project cost

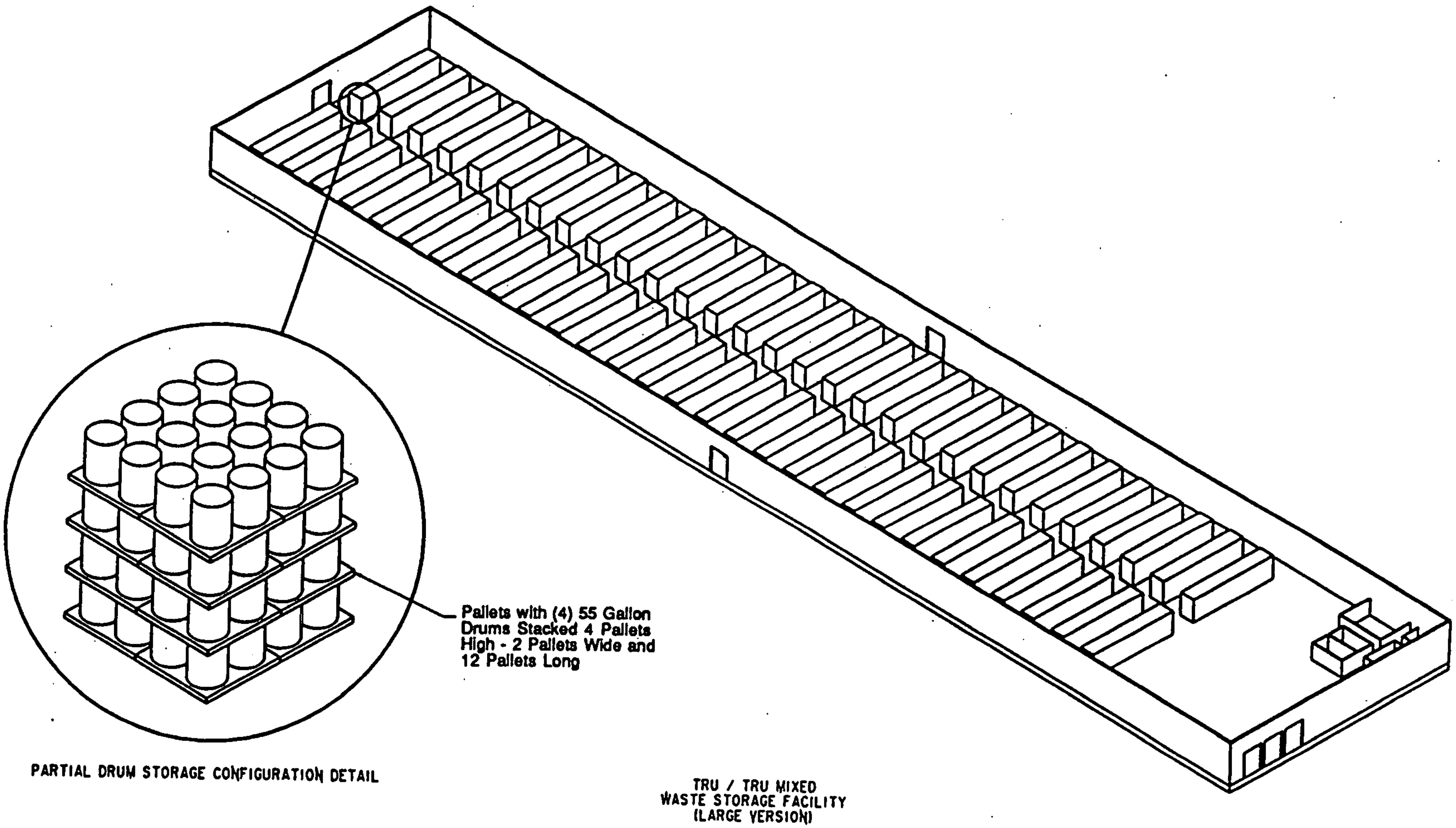


Figure B-1 Conceptual Layout of New TRU/TRM Waste Storage Facility (Exploded View)

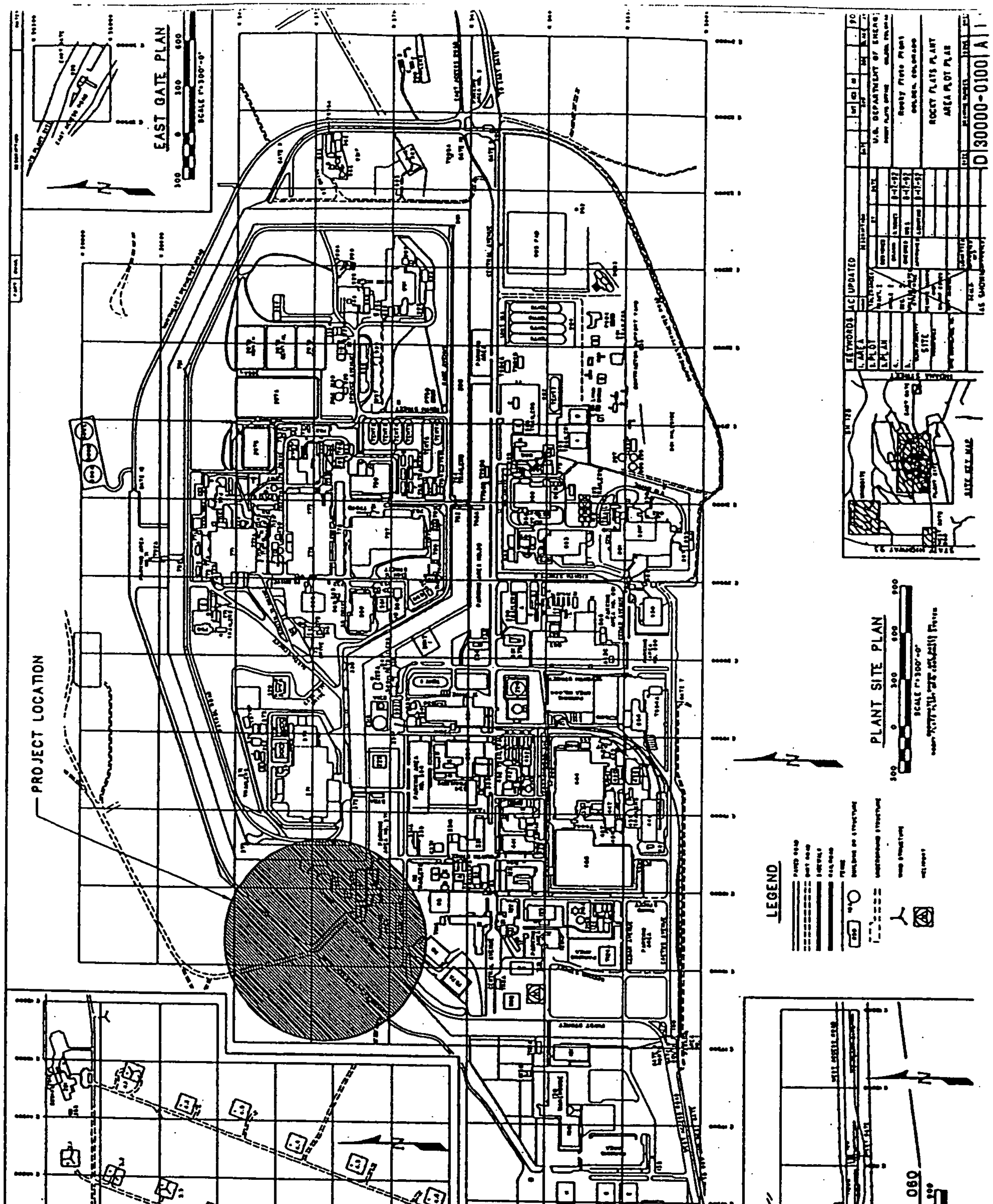
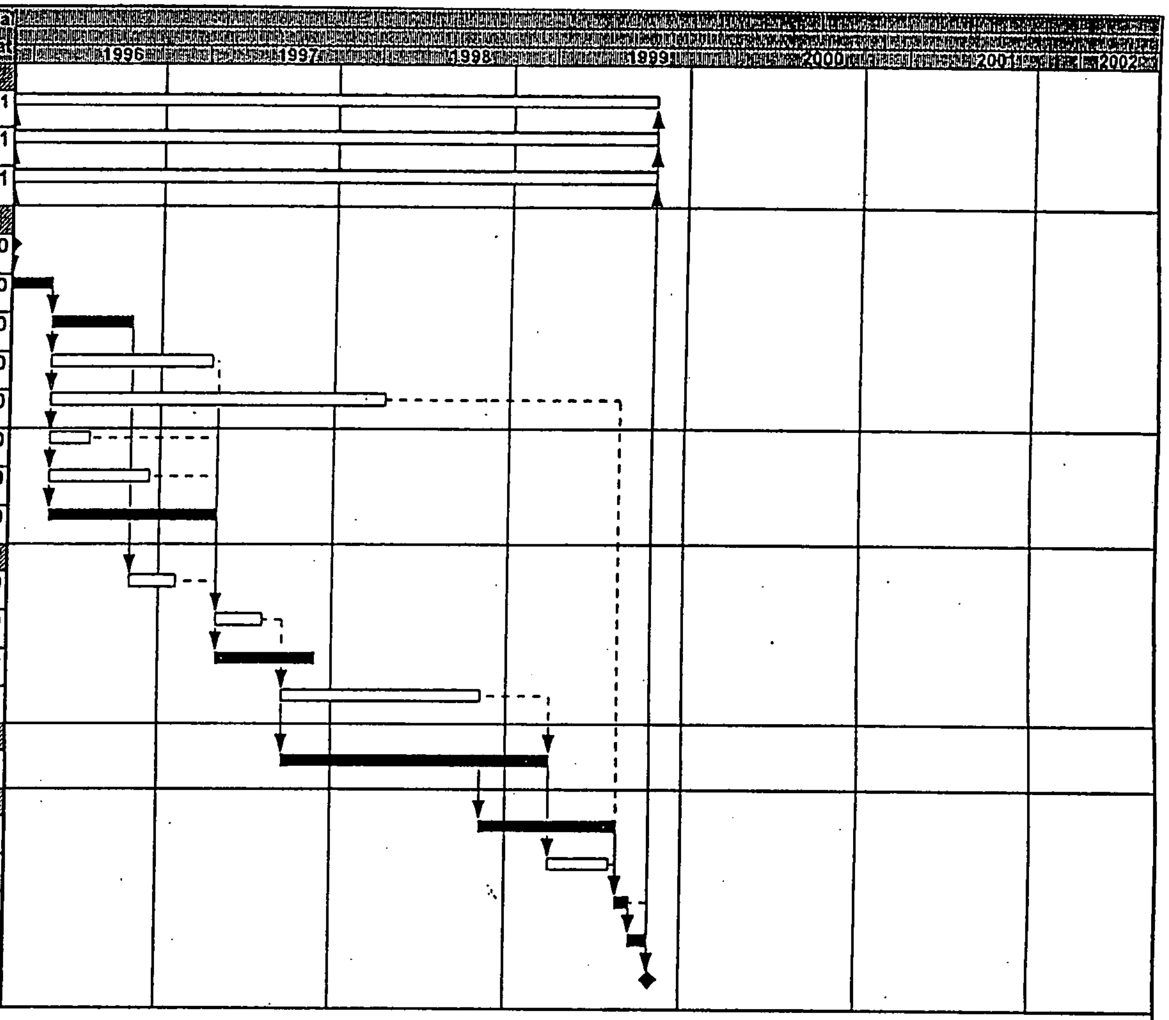


Figure B-2 Proposed Location of New TRU/TRM Waste Storage Facility

Act ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float
Project Support					
100	Program Management	959	22NOV95	26JUL99	1
150	Project Management	959	22NOV95	26JUL99	1
300	Construction Management	959	22NOV95	26JUL99	1
Conceptual Design					
50	Start Project	0	21NOV95		0
175	Planning	60	21NOV95	12FEB96	0
250	Conceptual Design	120	13FEB96	29JUL96	0
350	NEPA Reqs(EA/EIS)	240	13FEB96	13JAN97	10
400	RCRA	500	13FEB96	12JAN98	30
450	Clean Air Act	60	13FEB96	06MAY96	190
650	USQD	150	13FEB96	09SEP96	100
850	SAR	250	13FEB96	27JAN97	0
Design					
500	Procurement-D/B	70	30JUL96	04NOV96	60
425	RCRA Temp Permit Const	70	28JAN97	05MAY97	30
550	Design	150	28JAN97	25AUG97	0
575	Procurement-GFE	300	17JUN97	10AUG98	100
Construction					
600	Construction/Title III Engr	400	17JUN97	28DEC98	0
Operations					
750	RA/ORR	200	11AUG98	17MAY99	0
700	SOPs/Training	90	29DEC98	03MAY99	10
800	Test/Check-out/Start-up	20	18MAY99	14JUN99	0
900	Project Close-out	30	15JUN99	26JUL99	0
1000	CD-4	0		27JUL99	0



Project Start	21NOV95	Early Bar	ASAP
Project Finish	27JUL99	Progress Bar	Sheet 1 of 1
Data Date	21NOV95	Critical Activity	Kaiser-Hill
Plot Date	08DEC95		Accelerated Site Action Plan
© Primavera Systems, Inc.			Current Schedule

Figure B-3 Proposed TRU/TRM Building Construction Schedule for the smaller facility is \$8.8 million. This estimate is based on the above referenced cost estimate and is scaled down to reflect the smaller square footage of the building.

For buildings in this size range, the cost factor is \$100 million per 100,000 cubic yards. Assumptions for the cost estimates include operating costs for a large facility of \$1.3 million per year and for a small facility, \$1 million per year.

Operating cost for both sizes of the preengineered facility are based on actual cost (FY95) of similar facilities (i.e., Building 906 and 569). Consideration was given to the processes within those buildings since this new storage building will have relatively few process operations. Also, square footage for those facilities was considered and compared to the new facility estimated to be 122,500 ft^2 or 70,000 ft^2.

OPTION 2 - FULLY HARDENED FACILITY

Two sizes were considered in developing this alternative. First, a building was conceived ranging in size of 81,500 ft^2 for waste packaged for safe long-term storage (more efficient packaging), and secondly, a 132,500 ft^2 building was considered for waste packaged in a WIPP-compliant fashion.

Building Design

The large hardened facility consists of a concrete structure of approximately 132,500 ft^2 with 126,000 ft^2 dedicated for drum storage, or for the smaller facility, 81,500 ft^2 with 75,000 dedicated for drum storage depending on waste packaging requirements. The remaining 6,500 ft^2 (for both options) consists of occupied areas such as offices, a break room, shower/locker/toilet areas, staging, repack and loading docks including an overhead crane for TRUPACT II loading capability. The larger building will store approximately 57,000 drums of TRU/TRMW while the smaller will handle approximately 33,000 drums. The storage area consists of cast-in-place concrete construction with HEPA-filtered ventilation systems. All interior floor surfaces/berms in the storage area, staging area and repack area will be coated with epoxy paint to meet RCRA secondary containment requirements. The occupied areas will be insulated and have finished interior wall/ceiling and industrial heating. The entire building has a Pre-Action fire suppression system. Industrial fencing surrounds the entire facility. Tie-ins to utility systems include water, sewer, telephones, electrical power and natural gas. The location of this building will be west of the northwest access road close enough to other existing or planned facilities remaining onsite such that all utility tie-ins are within 300 lineal feet in length. The building conceptual layout, drum arrangement, and siting location are similar to that shown for the preengineered facility.

Other Remarks/ Assumptions/Design Features include the following:

- The repack area will have a separate HVAC system that includes HEPA filtration in the event of an incident with a drum.
- Drums will be stored four levels high on pallets.
- All interior floor surfaces/berms in the storage area, staging area, and repack area will be coated with epoxy paint to meet RCRA secondary containment requirements.
- Alarm systems assumed to be required include fire alarm, security alarm, SAAM alarms, and criticality detection.
- The storage area will include a CCTV system for RCRA surveillance requirements.

Construction Schedule

This project assumes a 43 month schedule including all expense support items required for successful startup of the new hardened facility. The construction schedule is similar to that shown previously for the preengineered facility.

Construction Costs

The total project cost for the larger hardened facility is $137 million. The total project cost includes all expense support activities to support the successful startup of the facility (i.e., procedures, Permitting, Operational Readiness Review, NEPA). The total project cost for the smaller hardened facility is $81.7 million, based on the above referenced cost estimate and scaled down to reflect the smaller square footage of the building. For hardened facilities in this size range, the cost factor is $900 million per 100,000 cubic yards.

Operating Costs

Large Facility = $9 million/year
Small Facility = $6 million/year

Operating costs for both of the hardened facilities are based on actual cost (FY95) of similar facilities (i.e., Building 371, 776, and 777). Consideration was given to the processes within those buildings since this hardened storage building will have relatively few process operations.

4.4.3 Preengineered Steel Storage Buildings

Most of the radioactive waste (LLW/LLMW and TRU/TRM) generated from ASAP tasks will be acceptable for storage in preengineered steel buildings, which are sheet metal structures. Ongoing analyses will define specific plutonium content limitations and necessary storage configurations (e.g., stacking limits, area limits) to accommodate use of these facilities to satisfy most onsite waste storage needs.

TRU/TRM Waste Storage

The overall strategy to accommodate TRU/TRM waste storage needs is to use preengineered steel buildings for all storage, where technically feasible. Several factors are considered key to establishing the feasibility of TRU/TRM waste storage in nonhardened facilities. Currently, a general inventory limit of 10 kilograms (kg) of plutonium is in place for nonhardened buildings; relief from this limit is being sought based on the findings of recent safety analyses that demonstrate that the gram loading of plutonium within a single building can be increased without compromising safety and exposure protection to workers and the offsite public.

Analyses have been performed which establish storage configuration requirements that effectively limit the plutonium source term for credible accident alternatives and will allow significantly increased inventories (from 10 kg) to be stored in nonhardened facilities. These increased inventory limits will make storage of significant quantities of TRU/TRM waste in nonhardened buildings a viable option.

Even with the expected relief from the current 10 kg limit, some TRU/TRM waste may contain levels of plutonium that require hardened storage facilities. Most surveillance and maintenance waste, D&D waste, and current inventory will average approximately 7 grams of plutonium per drum, while TRU/TRM waste from residue processing/repackaging will contain greater than 100 grams per drum. The waste from residue processing may still require hardened storage facilities.

LLW/LLMW Storage

Storage requirements for these two waste categories are expected to be fully satisfied by preengineered steel buildings. Facilities for LLMW will require RCRA permitting actions and must satisfy all RCRA facility requirements.

Specialty Wastes

Minimal quantities of special wastes currently exist at Rocky Flats and small quantities are projected from ASAP tasks. These wastes consist of radioactive PCBs and asbestos waste. Storage capacity for these wastes could be added to facilities established for the other waste categories.

New LLW/LLMW Storage Building Design

The possibility exists that a new facility will need to be constructed to support the storage of LLW/LLMW. This facility would range in size from approximately 1.7 million ft^2 to 14.5 million ft^2 and in costs from $59.8 million to $480.3 million. This range is the result of the various assumptions being evaluated in the overall ASAP effort. Assumptions relating to such activities as shipping, generation, onsite disposal, and activity durations play a major role in the range size for possible building configurations. The higher end of the range would need over 300 acres of land. For purposes of this analysis, both ends of the range will be evaluated and a cost factor developed ($ per 100,000 yds^3) for use in evaluating costs for facilities within the range. Figures B-4, B-5, and B-6 provide a conceptual view of the smaller of the two facilities and the proposed site location for construction. As can be noted, this facility covers about 40 acres. Engineering analysis may indicate that it would be more practical to construct multiple smaller facilities totalling the required storage area rather than one large facility.

The facility that would be constructed would contain from 1.7 million to 14.5 million ft^2 of storage space and 18,000 to 36,000 ft^2 of staging/loading/repacking area, and 2,000 to 4,000 ft^2 of office/rest room/change room/lunch room area. The facility would be constructed as a preengineered steel building located on a concrete slab on grade with raised edges for containment. The storage area has no HVAC system, but is insulated for condensation prevention. The floor of the storage area would be epoxy-coated. The occupied areas would have HVAC systems (heat pumps), and the staging/loading/ repacking area would have a HEPA filtration system. The entire building would have a Pre-Action fire suppression system, and the office/rest room/change room/lunch room area would have the necessary plumbing systems. The storage area would contain a CCTV surveillance system (for performing RCRA surveillances). The utility systems tie-ins would include sanitary water, sanitary sewer, electrical power, and telephones.

Construction Schedule

Construction (including conceptual design, construction, and preparation for operations) of the smaller facility is estimated to take approximately 3.6 years (see Figure B-7). The larger facility is estimated to take approximately 5.6 years (see Figure B-8). The high-level schedules presented take into account estimated environmental and safety documentation along with training, procedures, and any required operations readiness review. The schedules shown are intended to show a time frame within which these facilities could be constructed and not to depict specific start and finish dates for the projects. Actual dates could be entered into the schedule upon approval of the projects and funding.

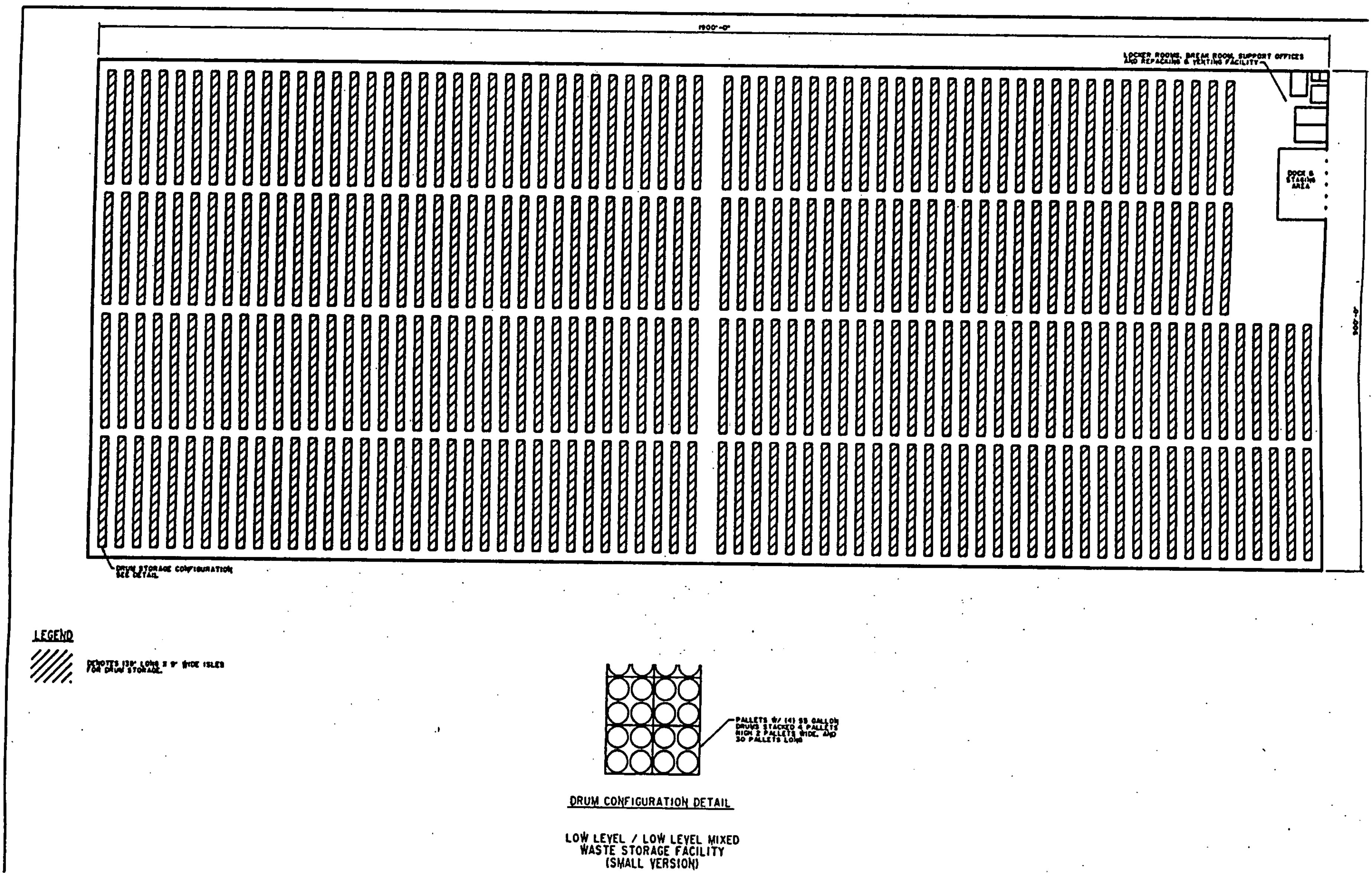


Figure B-4 Conceptual Layout for New LLW/LLMW Storage Facility

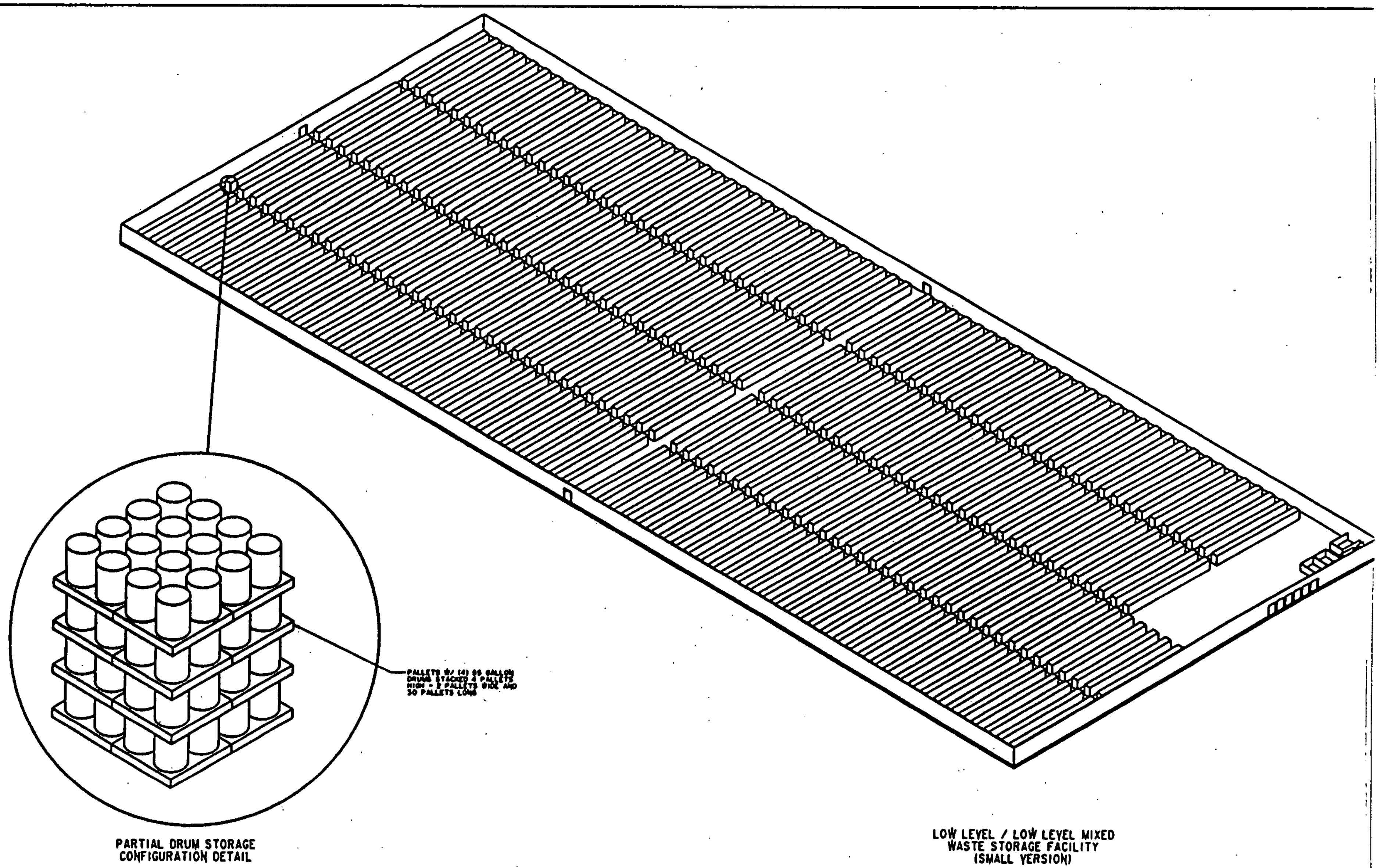


Figure B-5 Conceptual Layout for New LLW/LLMW Storage Facility (Exploded View)

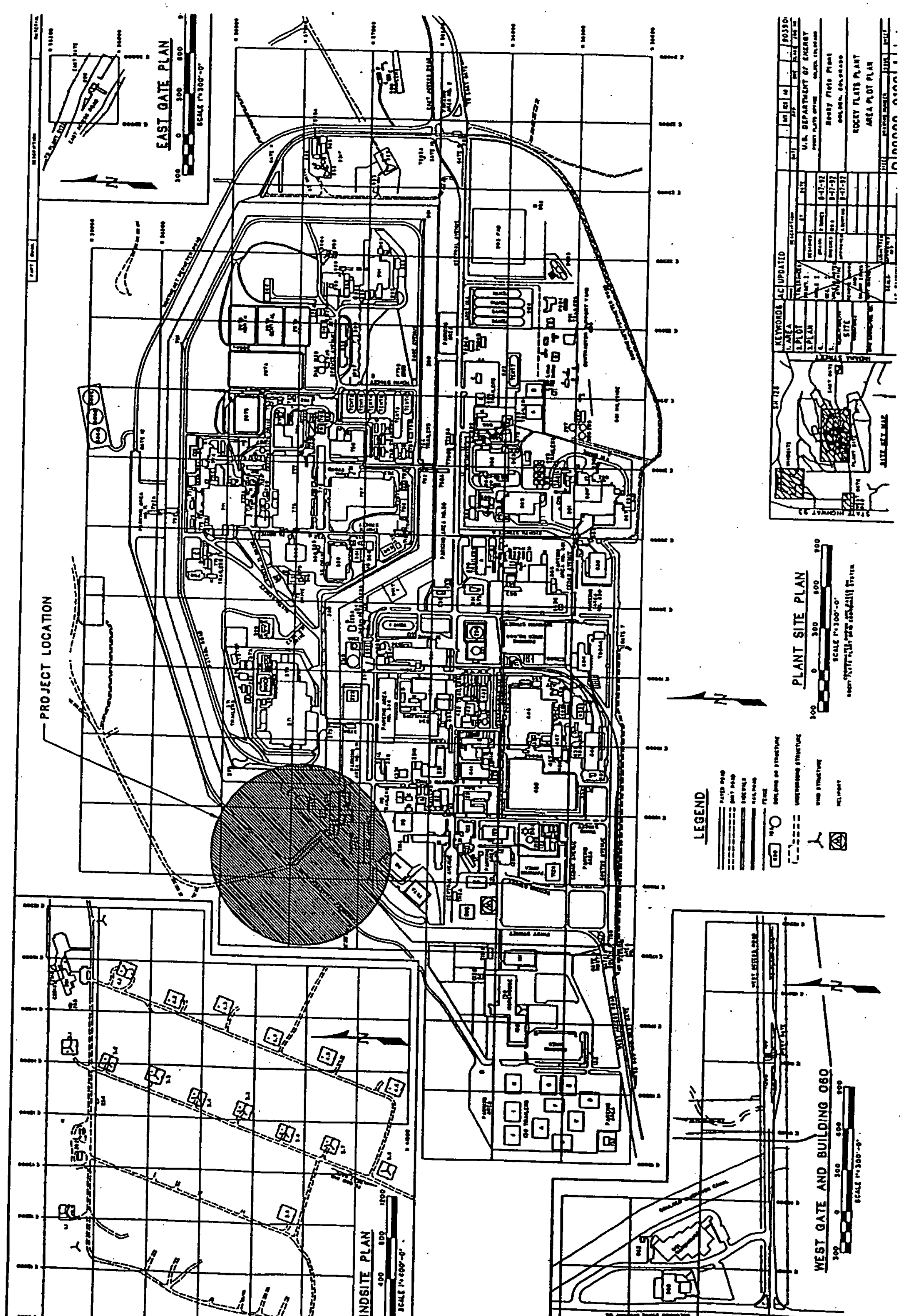
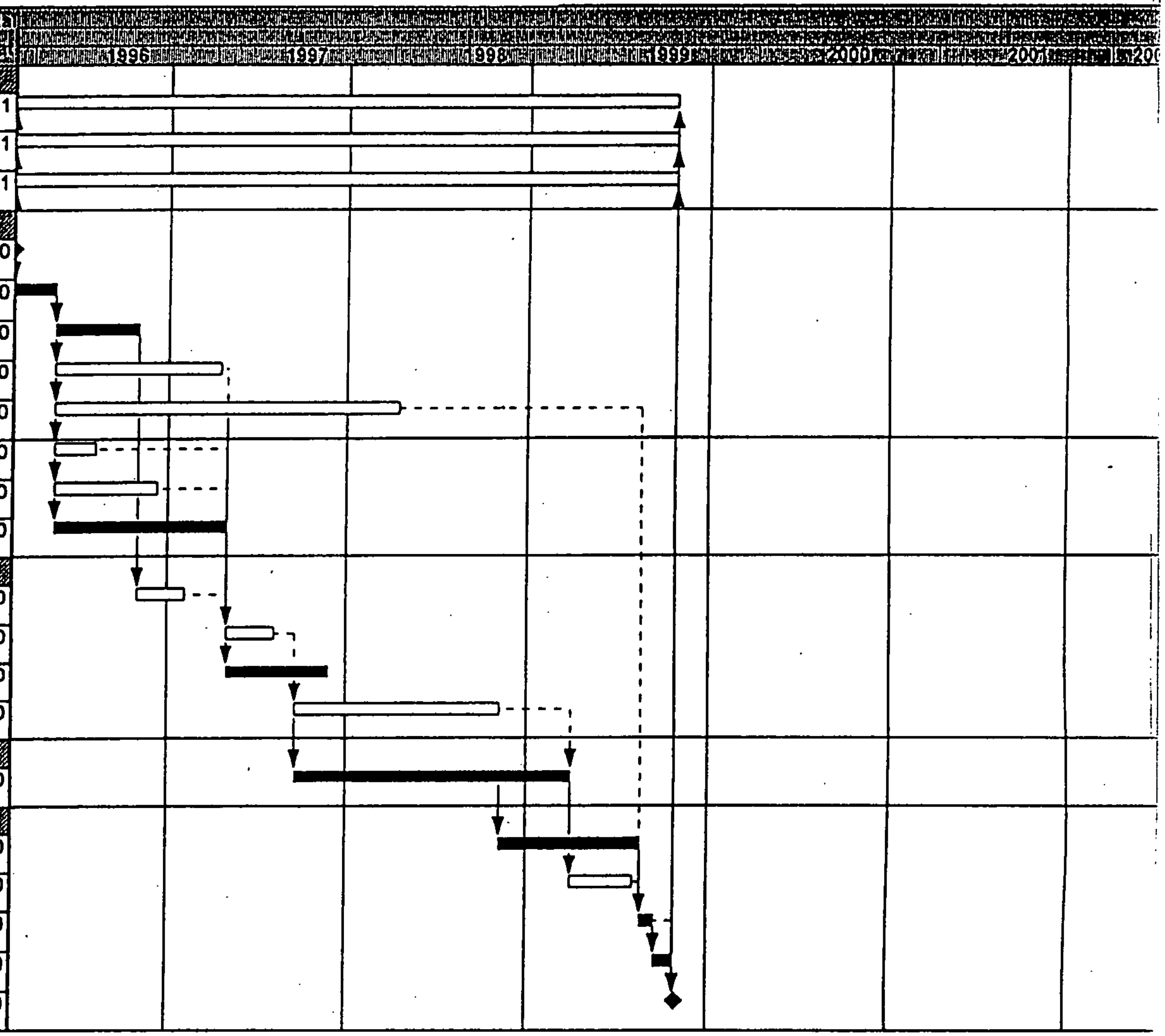


Figure B-6 Proposed Location of New LLW/LLMW Storage Facility

Act ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float
Project Support					
100	Program Management	959	22NOV95	26JUL99	1
150	Project Management	959	22NOV95	26JUL99	1
300	Construction Management	959	22NOV95	26JUL99	1
Conceptual Design					
50	Start Project	0	21NOV95		0
175	Planning	60	21NOV95	12FEB96	0
250	Conceptual Design	120	13FEB96	29JUL96	0
350	NEPA Reqs(EA/EIS)	240	13FEB96	13JAN97	10
400	RCRA	500	13FEB96	12JAN98	30
450	Clean Air Act	60	13FEB96	06MAY96	190
650	USQD	150	13FEB96	09SEP96	100
850	SAR	250	13FEB96	27JAN97	0
Design					
500	Procurement-D/B	70	30JUL96	04NOV96	60
425	RCRA Temp Permit Const	70	28JAN97	05MAY97	30
550	Design	150	28JAN97	25AUG97	0
575	Procurement-GFE	300	17JUN97	10AUG98	100
Construction					
600	Construction/Title III Engr	400	17JUN97	28DEC98	0
Operation					
750	RA/ORR	200	11AUG98	17MAY99	0
700	SOPs/Training	90	29DEC98	03MAY99	10
800	Test/Check-out/Start-up	20	18MAY99	14JUN99	0
900	Project Close-out	30	15JUN99	26JUL99	0
1000	CD-4	0		27JUL99	0



Project Start	21NOV95
Project Finish	27JUL99
Data Date	21NOV95
Plot Date	06DEC95

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Early Bar
Progress Bar
Critical Activity

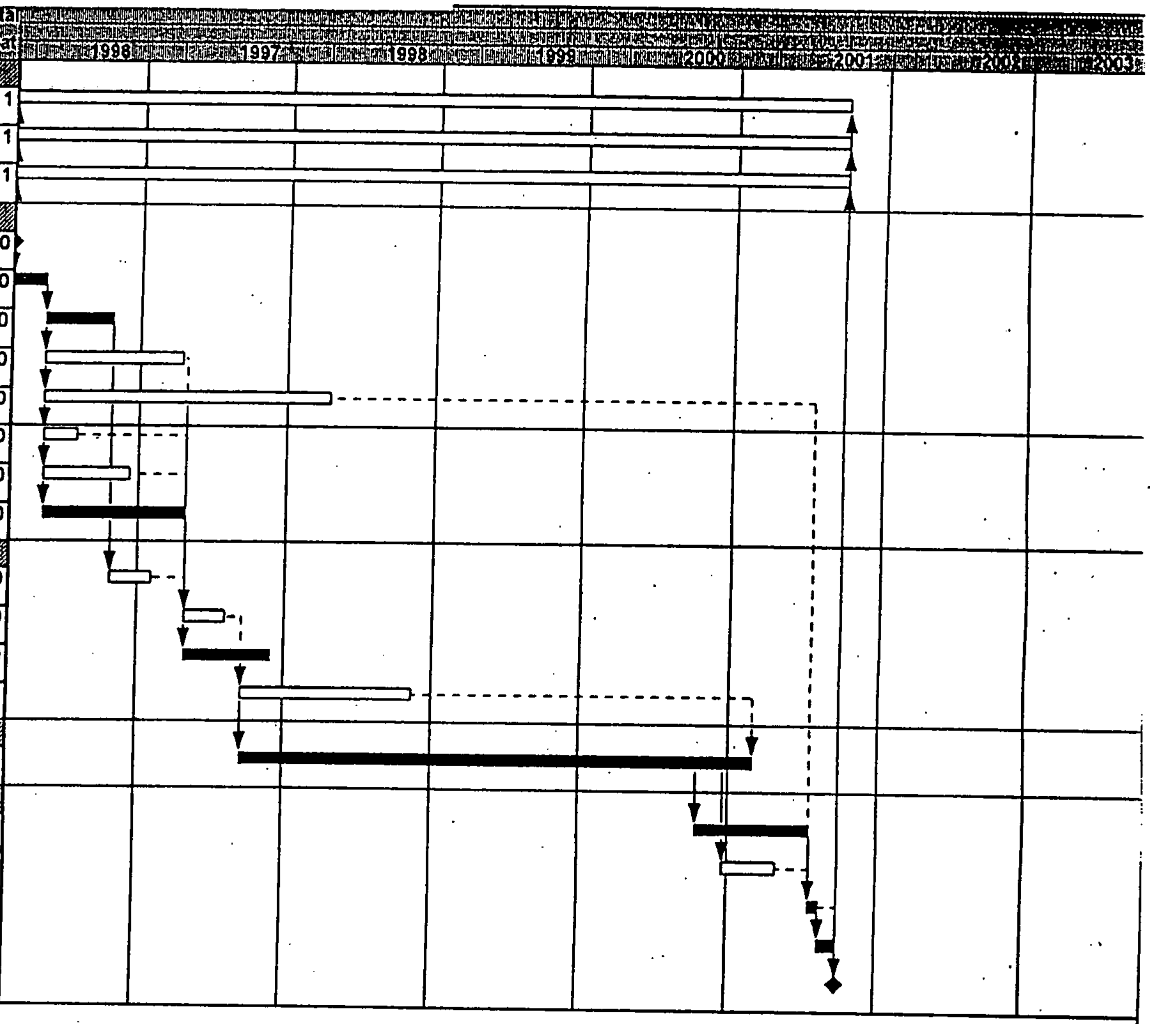
ASAP

Sheet 1 of 1

Kaiser-Hill
Accelerated Site Action Plan
Current Schedule

Figure B-7 Proposed LLW/LLMW Facility Construction Schedule

Act ID	Activity Description	Orig Dur	Early Start	Early finish	Total float
Project Support					
100	Program Management	1,460	21NOV95	25JUN01	1
300	Construction Management	1,460	21NOV95	25JUN01	1
150	Project Management	1,459	22NOV95	25JUN01	1
Conceptual Design					
50	Start Project	0	21NOV95		0
175	Planning	60	21NOV95	12FEB96	0
250	Conceptual Design	120	13FEB96	29JUL96	0
350	NEPA Reqs(EA/EIS)	240	13FEB96	13JAN97	10
400	RCRA	500	13FEB96	12JAN98	30
450	Clean Air Act	60	13FEB96	06MAY96	190
650	USQD	150	13FEB96	09SEP96	100
850	SAR	250	13FEB96	27JAN97	0
Design					
500	Procurement-D/B	70	30JUL96	04NOV96	60
425	RCRA Temp Permit Const	70	28JAN97	05MAY97	30
550	Design	150	28JAN97	25AUG97	0
575	Procurement-GFE	300	17JUN97	10AUG98	600
Construction					
600	Construction/Title III Engr	900	17JUN97	27NOV00	0
Operations					
750	RA/ORR	200	11JUL00	16APR01	0
700	SOPs/Training	90	19SEP00	22JAN01	60
800	Test/Check-out/Start-up	20	17APR01	14MAY01	0
900	Project Close-out	30	15MAY01	25JUN01	0
1000	CD-4	0		26JUN01	0



Project Start 21NOV95 Project Finish 26JUN01 Data Date 21NOV95 Plot Date 06DEC95 © Primavera Systems, Inc.	Early Bar Progress Bar Critical Activity	ASP2 Kaiser-Hill Accelerated Site Action Plan Complete Storage Schedule	Sheet 1 of 1

Figure B-8 Proposed LLW/LLMW Facility Construction Schedule

Construction Costs

The range of costs for the LLW/LLMW storage facility is dependent upon the size of the facility as stated above. The range of costs start at $59.8 million for the smaller facility to $480.3 million for the larger facility. This translates into approximately $28.6 million/100,000 yds^3 unburdened, unescalated costs.

Operating Costs

Operating Costs are estimated based on current costs to operate similar facilities at the Site. Then, conceptual crew sizes were developed and costs estimated along with other appropriate support staff. For the smaller building (1.7 million ft^2) the following was estimated:

3 crews of 4 people
1 foreman
1 shift manager
1 RCRA Custodian
1 Radiation Control Technician (RCT)
Utilities and maintenance at $100,000 annually

This would cost about $2.5 million per year in operating and maintenance cost.

For the larger facility (14.5 million ft^2), the following was estimated:
10 crews of 4 people
3 foremen
1 shift manager
4 RCRA custodians (includes one lead)
4 maintenance staff
6 RCTs
Utilities and maintenance materials

This would cost about $10 million per year in operating and maintenance cost.

4.4.4 Concrete-Lined Cell Facility

LLW/LLMW Emplacement

For the purpose of comparison between alternative designs of waste management facilities, it was assumed that each design would be sized to accommodate 100,000 yds^3 of LLW, LLMW, and straight hazardous wastes. Discussions of possible facility designs presented below are based on preconceptual ideas developed by the Waste Management Facility team. Aspects of facility designs or descriptions may change as conceptual and Title II design phases are completed.

Specialty Wastes

Special waste, such as radioactive PCBs and asbestos will contribute a small volume toward potential emplacement in a concrete-lined cell. Treatment options for these waste types are discussed in Subsection 4.6.

Facility Design

The concrete-lined cell (CLC) facility would be designed to accommodate wastes in bulk form, packaged in cargo containers, or a combination of both. The cell will be designed with a double composite liner including a leachate collection system as well as composite final cover system. The liner and cover will comply with the RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 and 6 CCR 1007-2, Part 2. Figure B-9 shows a conceptual drawing of a CLC facility.

The liner and leachate collection system used in the cell will consist of, from the bottom upward:

- A bottom (secondary) composite liner incorporating three feet of compacted clay and a geosynthetic clay liner (GCL) overlain by an 80-mil. High Density Polyethylene (HDPE) geomembrane

- A geonet leak detection system

- A top (primary) composite liner consisting of a GCL overlain by an 80-mil. HDPE geomembrane with a protective geotextile filter fabric

- A leachate collection system consisting of a one foot gravel bottom or geonet side slopes overlain with geotextile filter fabric

- A one foot layer of common fill or select waste (initial layer of low-level mixed waste of select grading that will not damage liner) to protect the liners and leachate collection system

A self-supporting concrete structure would be placed on the liner system. This structure will include four concrete modules, each with dimensions of 500 feet long by 125 feet wide. Current plans are for one module to be constructed per year. The entire facility will encompass 5.7 acres. The concrete would be 18 inches thick on both the reinforced base slab and the reinforced walls.

Support facilities for this design concept include a waste staging area, contamination building, leachate collection tanks (if waste is managed in bulk form) and an evaporation pond.

Upon completion of and/or during operations, the modules will be covered with an earthen cap in compliance with RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 and 6 CCR 1007-2, Part 2. The final cover is described more fully in Appendix D, Environmental Restoration.

Waste Monitoring and Retrievability Considerations

The liner system will include a leak detection and leachate collection system. During operations the facility will be monitored for leaks and the leachate would be collected, characterized, and treated as necessary. The leak detection system would allow for detection, collection, and removal of any liquid leaking through the primary liner.

During operations the waste will be mapped and gridded in the modules as it is placed for retrievability. The concrete base will allow for ease of operations as well as ease of retrievability if needed. If any of the waste were required to be retrieved, the modularized nature of this facility would allow individual waste streams to be removed without damaging the integrity of the entire system. Additionally, despite the large cost, if the waste is placed in a containerized form, retrievability is further enhanced. Upon completion of the cap installation, the facility will be monitored for leaks and necessary maintenance for a minimum of thirty years.

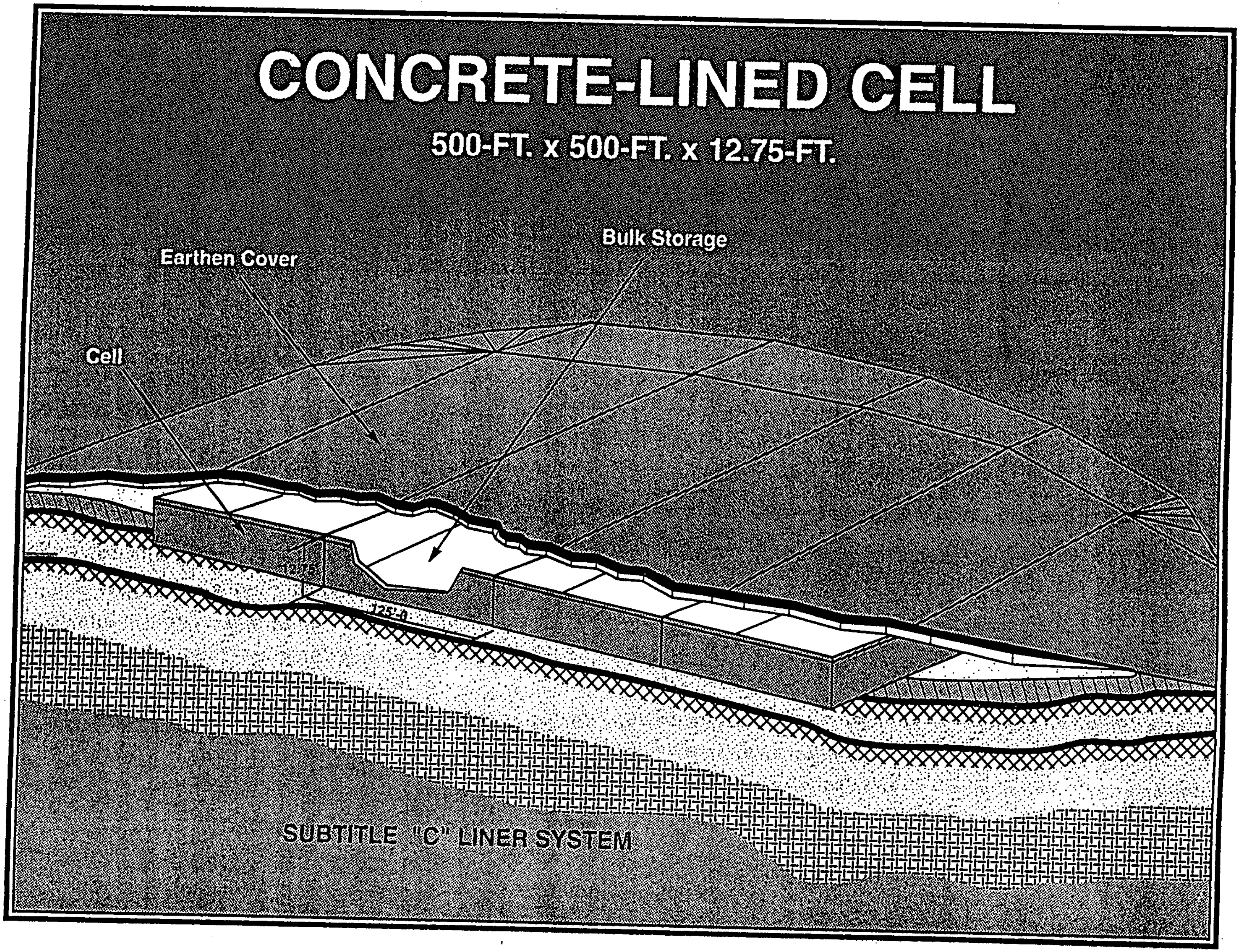


Figure B-9 Concrete-Lined Cell Conceptual Design

Construction Schedule

The construction schedule is dependent upon the siting of this facility. For the purposes of this discussion the Solar Pond location was chosen for comparison. The anticipated construction start of the first module would occur during the first quarter of Fiscal Year 1998. Completion of this module would occur during the third quarter of FY98. Operations would then immediately follow after completion of systems operations testing. Figures B-10 and B-11 present construction schedules for bulk emplacement and emplacement in cargo containers.

Construction Costs

The following is the planning estimate of the construction costs for the facility designed to manage the waste in bulk form:

Construction Task	($K)
Design	$ 1,300
Permitting	300
Pre-Construction	400
Site Preparation	6,100
Construction of Cell	15,600
Cap	4,900
Contingency	8,900
TOTAL	$37,500

The following is the planning estimate of the construction costs for the facility designed to manage the waste in containerized form:

Construction Task	($K)
Design	$ 1,500
Permitting	300
Pre-Construction	400
Site Preparation	11,900
Construction of Cell	11,600
Cap	3,000
Contingency	9,200
TOTAL	$37,900

Operating Costs

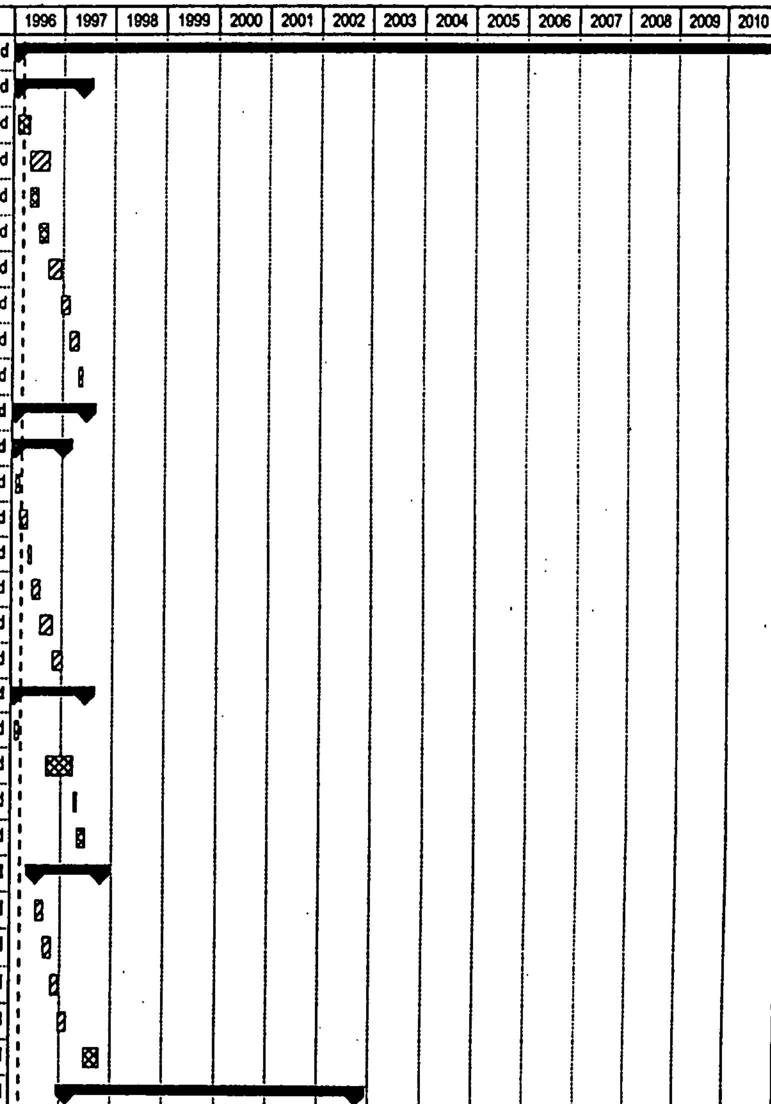
The following is the planning estimate of the operation costs for the facility designed to manage the waste in bulk form:

Operations Component	($K)
Packaging	$ 2,400
Treatment/Characterization	7,300
Transportation	600
Operations	9,500
Postclosure & Monitoring	13,000
Contingency	10,400
TOTAL	$43,600

Concrete Cell/Container Placement WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
1	OU 4 CONCRETE CELL, CONTAINERS, rev5	10/31/95	4/15/31	9251d
2	DESIGN	10/31/95	2/14/97	339d
3	Procure designer	10/31/95	1/30/96	66d
4	Confirm no competent fault	1/31/96	6/18/96	100d
5	Prepare conceptual design	1/31/96	4/2/96	45d
6	Review, revise, and approval conceptual design	4/3/96	6/11/96	50d
7	Prepare Title II design through 90%	6/12/96	9/11/96	66d
8	Revelws and approvals of 90% design	9/12/96	11/13/96	45d
9	Complete Title II design	11/14/96	1/15/97	45d
10	Final reviews and approvals of Title II design	1/16/97	2/14/97	22d
11	PERMITTING AND AUTHORIZATION	10/31/95	3/18/97	361d
12	IAG Process/Decision Document	10/31/95	10/3/96	243d
13	Prepare draft Decision Document based on existing draft	10/31/95	11/27/95	20d
14	Review, prepare RS, revise, and obtain approvals on draft DD	11/28/95	1/26/96	44d
15	Prepare proposed Decision Document	1/29/96	2/23/96	20d
16	Review, revise, and obtain approvals to release proposed DD	2/26/96	4/25/96	44d
17	Perform public involvement, comment period, notices, mailings, h	4/26/96	7/25/96	65d
18	Prepare RS, revise DD, prepare final DD, receive approvals	7/26/96	10/3/96	50d
19	Prepare draft permit modification request (Subpart S)	10/31/95	3/18/97	361d
20	Submit permit modification request	10/31/95	11/27/95	20d
21	Prepare draft permit modification (CDPHE)	6/12/96	12/24/96	140d
22	Comment on draft permit modification	12/25/96	1/21/97	20d
23	Complete permit modification and issue	1/22/97	3/18/97	40d
24	PROCUREMENT	4/3/96	7/8/97	330d
25	Prepare prequalification packages	4/3/96	5/28/96	40d
26	Respond to prequalification request	5/29/96	7/23/96	40d
27	Request proposals for construction	7/24/96	9/17/96	40d
28	Receive proposals	9/18/96	11/12/96	40d
29	Evaluate, select, obtain approvals for constractor	3/19/97	7/8/97	80d
30	PRECONSTRUCTION	11/14/96	7/2/02	1469d



RMRS
Waste Management Facility
KCL 11/30/95

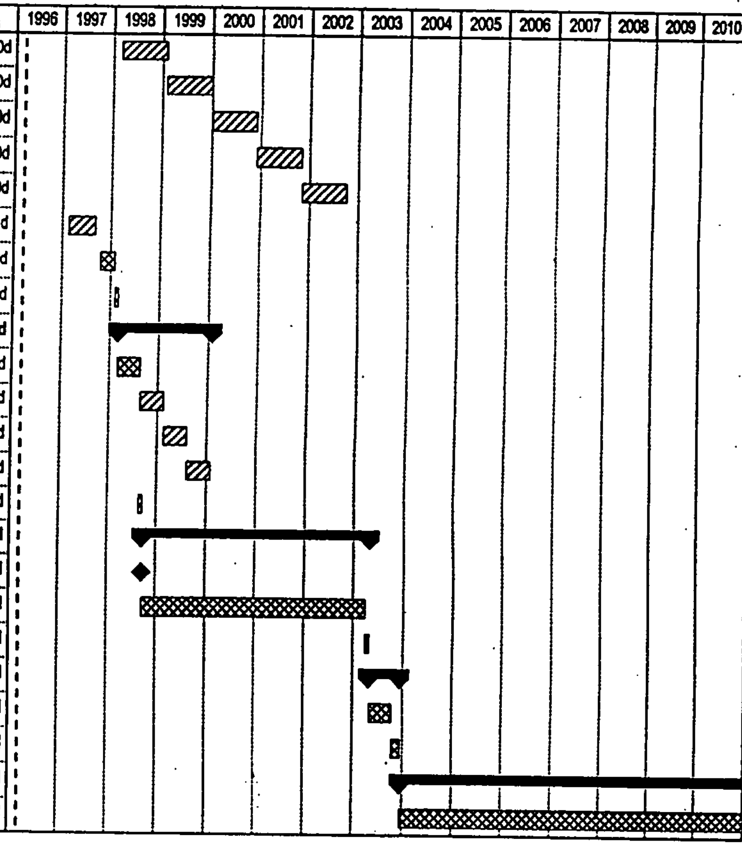
Critical — Progress — Summary
Noncritical — Milestone ◆ — Rolled Up ◇

Figure B-10 Concrete Cell/Bulk Placement WMF at Solar Ponds

Concrete Cell/Container Placement WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
31	Perform long-lead procurement: containers for 1st year of operation	11/26/97	10/27/98	240d
32	Perform long-lead procurement: containers for 2nd year of operations	10/28/98	9/28/99	240d
33	Perform long-lead procurement: containers for 3rd year of operations	9/29/99	8/29/00	240d
34	Perform long-lead procurement: containers for 4th year of operations	8/30/00	7/31/01	240d
35	Perform long-lead procurement: containers for 5th year of operations	8/1/01	7/2/02	240d
36	Procure workforce and prepare site for contractor	11/14/96	6/3/97	144d
37	Prepare contractor documents, perform training, etc.	7/9/97	10/28/97	80d
38	Perform contractor site preparation	10/29/97	11/25/97	20d
39	CONSTRUCTION	11/26/97	10/26/99	500d
40	Construct facility, phase 1	11/26/97	5/19/98	125d
41	Construct facility, phase 2	5/20/98	11/10/98	125d
42	Construct facility, phase 3	11/11/98	5/4/99	125d
43	Construct facility, phase 4	5/5/99	10/26/99	125d
44	Perform operational testing and readiness for initial storage campaign	5/20/98	6/16/98	20d
45	OPERATION	6/16/98	1/21/03	1200d
46	Begin Operations	6/16/98	6/16/98	0d
47	Transfer waste to storage	6/17/98	12/24/02	1180d
48	Perform final quality tasks	12/25/02	1/21/03	20d
49	CAP	1/22/03	9/9/03	165d
50	Install cap	1/22/03	7/8/03	120d
51	Perform operational readiness on systems	7/9/03	9/9/03	45d
52	MONITORING	9/10/03	4/15/31	7200d
53	Perform monitoring	9/10/03	4/15/31	7200d



RMRS
Waste Management Facility
KCL 11/30/95

Critical ▒ Progress ▬ Summary
Noncritical ▨ Milestone ◆ Rolled Up ◇

Figure B-10 Concrete Cell/Bulk Placement WMF at Solar Ponds (Cont.)

Concrete Cell/Bulk Placement WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
1	OU 4 CONCRETE CELL, BULK, rev5	10/31/95	4/15/31	9251d
2	DESIGN	10/31/95	2/14/97	339d
3	Procure designer	10/31/95	1/30/96	66d
4	Confirm no competent fault	1/31/96	6/18/96	100d
5	Prepare conceptual design	1/31/96	4/2/96	45d
6	Review, revise, and approval conceptual design	4/3/96	6/11/96	50d
7	Prepare Title II design through 90%	6/12/96	9/11/96	66d
8	Revelws and approvals of 90% design	9/12/96	11/13/96	45d
9	Complete Title II design	11/14/96	1/15/97	45d
10	Final reviews and approvals of Title II design	1/16/97	2/14/97	22d
11	PERMITTING AND AUTHORIZATION	10/31/95	3/18/97	361d
12	IAG Process/Decision Document	10/31/95	10/3/96	243d
13	Prepare draft Decision Document based on existing draft	10/31/95	11/27/95	20d
14	Review, prepare RS, revise, and obtain approvals on draft DD	11/28/95	1/26/96	44d
15	Prepare proposed Decision Document	1/29/96	2/23/96	20d
16	Review, revise, and obtain approvals to release proposed DD	2/26/96	4/25/96	44d
17	Perform public involvement, comment period, notices, mailings, h	4/26/96	7/25/96	65d
18	Prepare RS, revise DD, prepare final DD, receive approvals	7/26/96	10/3/96	50d
19	Prepare draft permit modification request	10/31/95	3/18/97	361d
20	Submit permit modification request	10/31/95	11/27/95	20d
21	Prepare draft permit modification (CDPHE)	6/12/96	12/24/96	140d
22	Comment on draft permit modification	12/25/96	1/21/97	20d
23	Complete permit modification and issue	1/22/97	3/18/97	40d
24	PROCUREMENT	4/3/96	7/8/97	330d
25	Prepare prequalification packages	4/3/96	5/28/96	40d
26	Respond to prequalification request	5/29/96	7/23/96	40d
27	Request proposals for construction	7/24/96	9/17/96	40d
28	Receive proposals	9/18/96	11/12/96	40d
29	Evaluate, select, obtain approvals for contractor	3/19/97	7/8/97	80d
30	PRECONSTRUCTION	11/14/96	11/25/97	269d

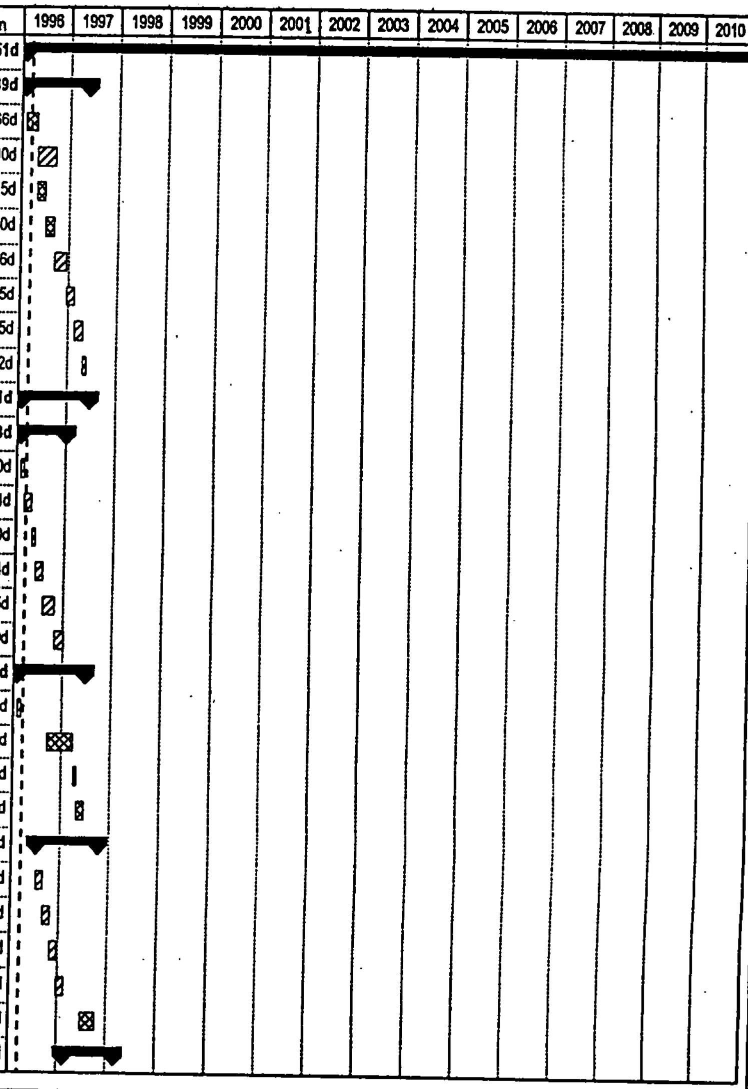


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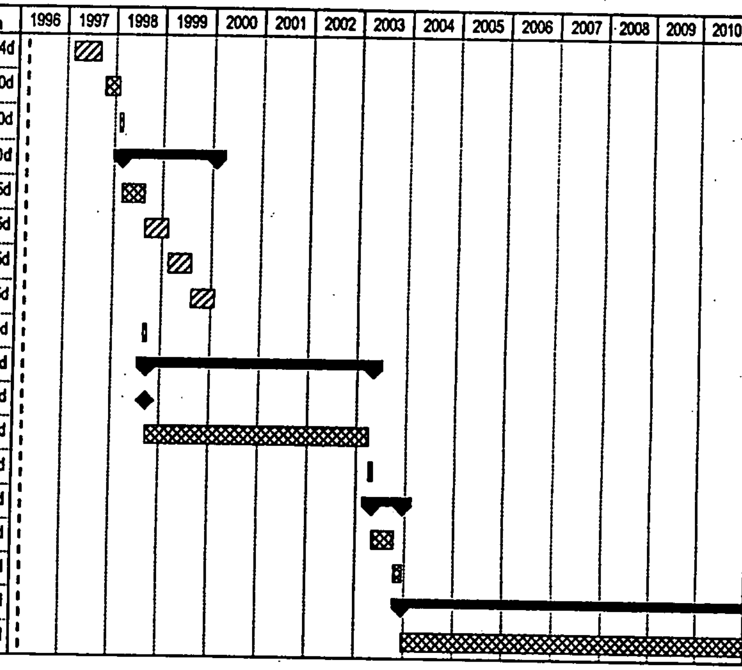
Figure B-11 Concrete Cell/Container Placement WMF at Solar Ponds

Concrete Cell/Bulk Placement WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
31	Procure workforce and prepare site for contractor	11/14/96	6/3/97	144d
32	Prepare contractor documents, perform training, etc.	7/9/97	10/28/97	80d
33	Perform contractor site preparation	10/29/97	11/25/97	20d
34	CONSTRUCTION	11/26/97	10/26/99	500d
35	Construct facility, phase 1	11/26/97	5/19/98	125d
36	Construct facility, phase 2	5/20/98	11/10/98	125d
37	Construct facility, phase 3	11/11/98	5/4/99	125d
38	Construct facility, phase 4	5/5/99	10/26/99	125d
39	Perform operational testing and readiness for initial storage campaign	5/20/98	6/16/98	20d
40	OPERATION	6/16/98	1/21/03	1200d
41	Begin Operations	6/16/98	6/16/98	0d
42	Transfer waste to storage	6/17/98	12/24/02	1180d
43	Perform final quality tasks	12/25/02	1/21/03	20d
44	CAP	1/22/03	9/9/03	165d
45	Install cap	1/22/03	7/8/03	120d
46	Perform operational readiness on systems	7/9/03	9/9/03	45d
47	MONITORING	9/10/03	4/15/31	7200d
48	Perform monitoring	9/10/03	4/15/31	7200d



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Critical | Progress | Summary
Noncritical | Milestone ◆ | Rolled Up ◇

Figure B-11 Concrete Cell/Container Placement WMF at Solar Ponds (Cont.)

The following is the planning estimate of the operation costs for the facility designed to manage the waste in containerized form:

Operations Component	($K)
Containers	$ 52,800
Packaging	2,400
Treatment/Characterization	7,300
Transportation	600
Operations	9,000
Postclosure & Monitoring	13,000
Contingency	27,200
TOTAL	$112,300

As can be seen from the Figure 3 above, there is a significant cost advantage to bulk management based primarily on the added cost of containers and packaging materials required for containerized waste management.

Summary of Costs (x $1000)

	CLC with waste in bulk	CLC with waste in Cargo Containers
Construction Costs	$37,500	$37,900
Operating Costs	43,600	112,300
Total Life-Cycle Costs	$81,100	$150,200

4.4.5 Landfill(s)

Several types of landfills are under consideration for emplacement of LLW/LLMW, small quantities of specialty wastes, construction debris from demolition activities, and solid sanitary waste. Landfill types being evaluated include CAMU and Subtitle C for hazardous, LLW, and LLMW and Subtitle D for uncontaminated demolition debris and/or sanitary wastes. The CAMU and Subtitle C designs would be technically equivalent in terms of protective measures and environmental controls installed to prevent contaminant migration. The potential waste types and candidate landfill types are discussed in the following subsections.

Low-level Waste/Low-level Mixed Waste Storage

For the purpose of comparison between alternative designs of waste management facilities, it was assumed that each design would be sized to accommodate 100,000 yds^3 of LLW, LLMW, and straight hazardous wastes. Discussions of possible facility designs presented below are based on preconceptual ideas developed by the Waste Management Facility team. Aspects of facility designs or descriptions may change as conceptual and Title II design phases are completed.

Regulatory initiatives are underway to determine which wastes (based on the source of generation) will be acceptable for disposal in the various types of landfill. Specific decisions must be made on emplacement of demolition waste and containerized operations waste in a CAMU as remediation waste.

Specialty Waste

Specialty waste, such as radioactive PCBs, asbestos, and uncontaminated PCBs will contribute a small volume toward potential emplacement in onsite landfills. Treatment options for these waste types are discussed in Subsection 4.6.

Demolition Debris and Sanitary Waste

Uncontaminated demolition debris and solid sanitary waste contribute a significant portion of projected waste volumes for all ASAP Alternatives. This type of material could potentially be emplaced in an onsite Subtitle D landfill such as the current or the new Rocky Flats sanitary landfills or could be a candidate material for emplacement in any onsite CAMU if it is considered remediation waste.

Facility Design

The landfill facility concept would be designed to accommodate wastes in bulk form only. The cell will be designed with a double composite liner and a composite final cover system. The liner and cover will comply with and exceed the RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 and 6 CCR 1007-2, Part 2. Because the intention is to meet and/or exceed RCRA Subtitle C requirements for this design, the CAMU and RCRA Subtitle C designs are similar. However the difference between these two options is that all waste placed in the RCRA Subtitle C cell would have to be treated to meet Land Disposal Restrictions, whereas this requirement is not applicable to the CAMU concept. Figures B-12 and B-13 show early conceptual drawings of the landfill facility. The landfill design is still evolving as new information is being developed. The final design will be explored further in ASAP Phase III.

The liner and leachate collection system used in the cell will consist of, from the bottom upward:

- A bottom (secondary) composite liner incorporating three feet of compacted clay and a geosynthetic clay liner (GCL) overlain by an 80-mil. High Density Polyethylene (HDPE) geomembrane
- A geonet leak detection system
- A top (primary) composite liner consisting of a GCL overlain by an 80-mil. HDPE geomembrane with a protective geotextile filter fabric
- A leachate collection system consisting of a one-foot gravel bottom or geonet side slopes overlain with geotextile filter fabric
- A one foot layer of common fill or select waste (initial layer of low-level mixed waste of select grading that will not damage liner) to protect the liners and leachate collection system

Each 100,000 yd^3 cell would be 440 feet long by 360 feet wide with berms 30 to 40 feet high. Support facilities for this design concept include a waste staging area, decontamination building, leachate collection tanks, and an evaporation pond.

Upon completion of operations, the cell would be covered with an earthen cap in compliance with RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 and 6 CCR 1007-2, Part 2. The cap shown in Appendix D, Environmental Restoration, is the final cover proposed for the alternatives.

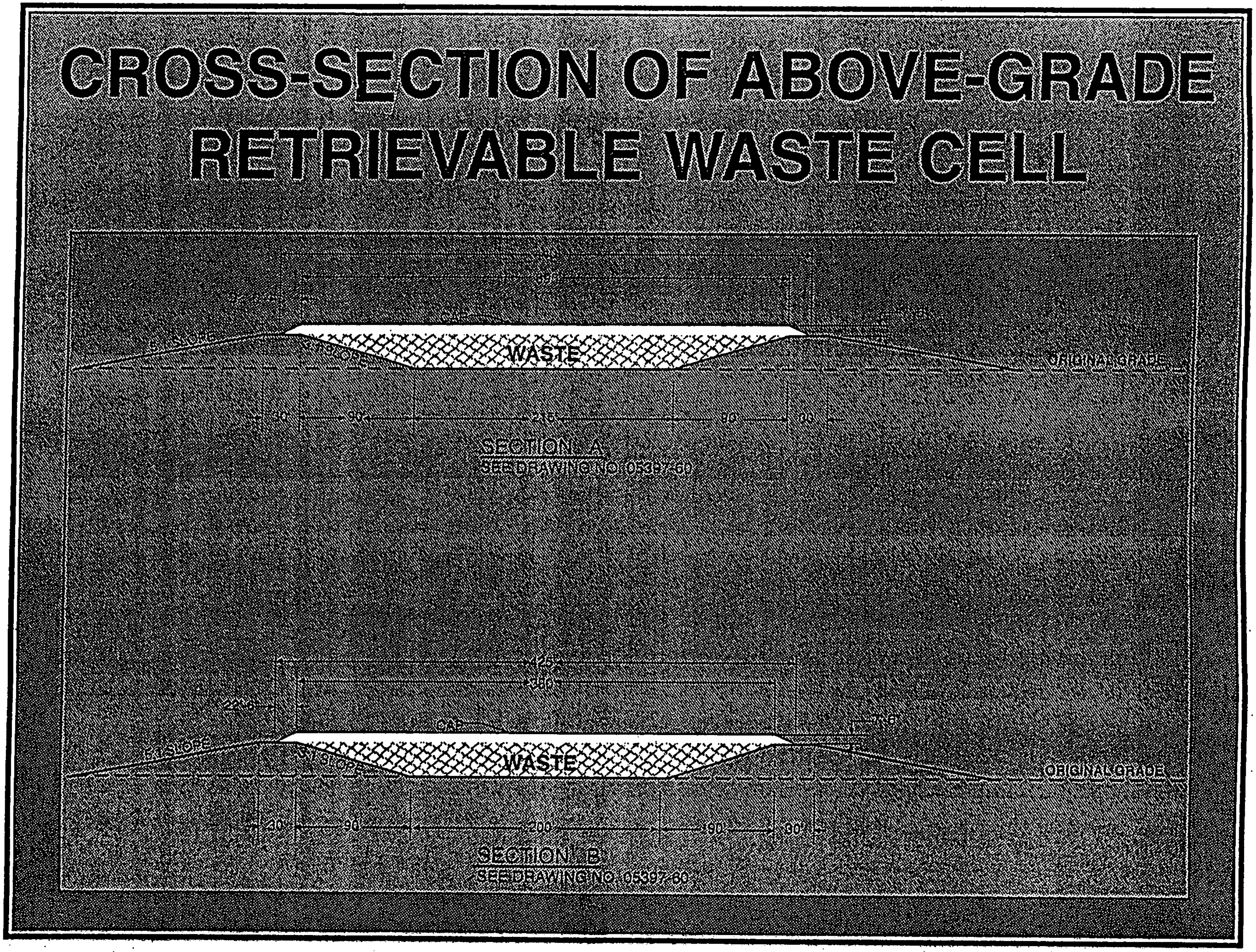

Figure B-12 Landfill Cross Section

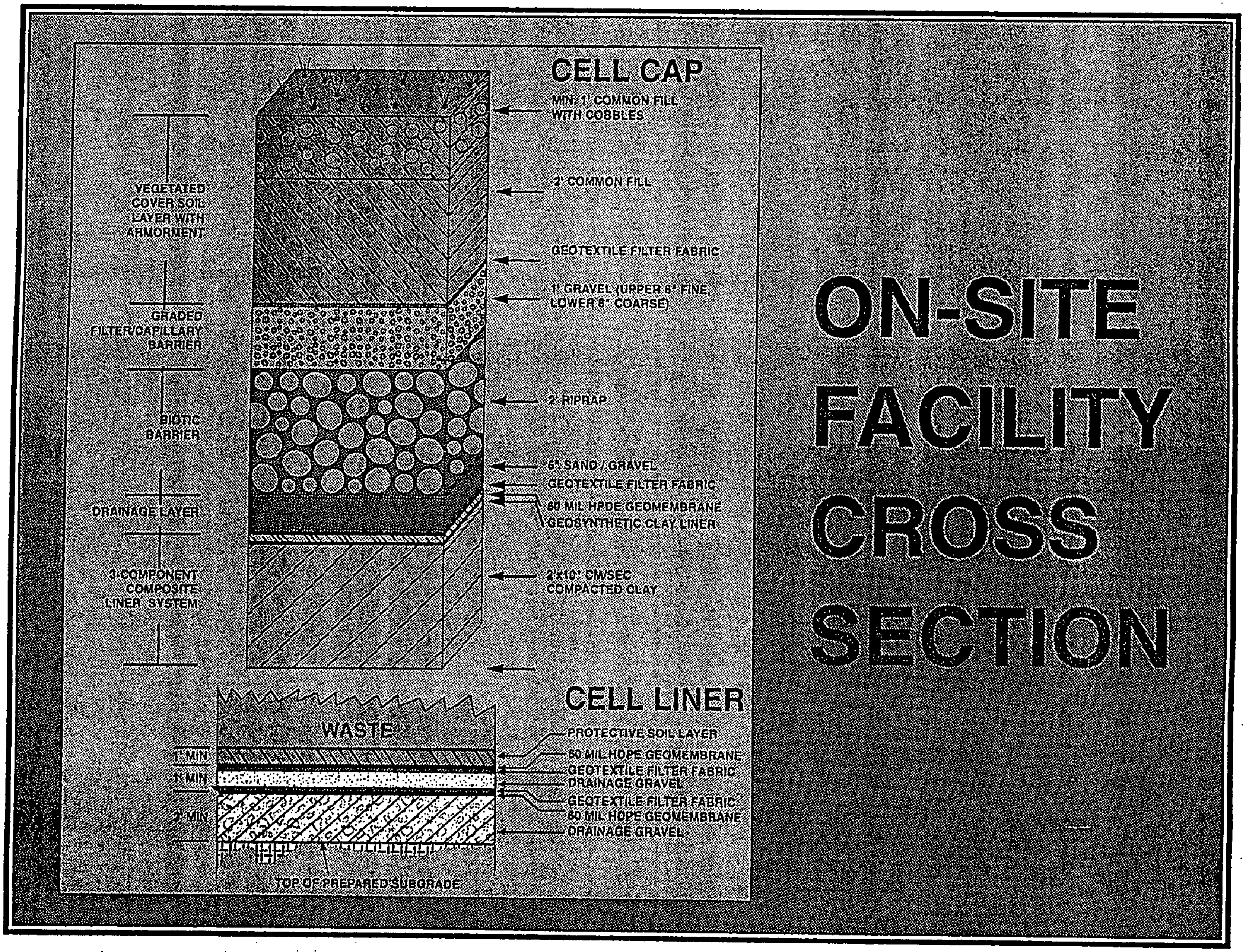

Figure B-13 Landfill Conceptual Design

Waste Monitoring and Retrievability Considerations

The liner system will include a leak detection and leachate collection system. During operations the facility will be monitored for leaks and the leachate would be collected, characterized, and treated as necessary. The leak detection system would allow for detection, collection, and removal of any liquid leaking through the primary liner.

During operations the waste will be mapped and gridded in the modules as it is placed for retrievability considerations. If any of the waste were required to be retrieved, the entire facility would likely have to be excavated and the wastes placed in a staging area for disposition. Upon completion of the cap installation, the facility will be monitored for leaks and necessary maintenance for a minimum of thirty years.

Waste Acceptance Criteria

The waste acceptance criteria for the Waste Management Facility are being developed at this time. They will be included in this plan as they are developed.

Effectiveness of Controls and Barriers

To meet the requirements for siting hazardous waste disposal sites as defined in 6 CCR 1007-2, Part 2, this facility must be designed to ensure that the waste will be isolated within the designated disposal area and away from natural environmental pathways that could expose the public for 1,000 years. There are several options available for controls and barriers for a waste management facility of this nature, and all must be considered to meet the 1,000 year protectiveness requirement. More detailed information is provided in Appendix D, Environmental Restoration.

Construction Schedule

The construction schedule is dependent upon the siting of this facility. For the purposes of this discussion the Solar Pond location was chosen for comparison. The anticipated start of construction would occur during the fourth quarter of Fiscal Year 1997. Construction would be completed during the second quarter of Fiscal Year 1998. Operations would then immediately follow after completion of systems operations testing. The construction schedule is shown in Figure B-14.

Construction Costs

The following is the planning estimate of the construction costs for this facility:

Construction Task	($K)
Design	$ 2,200
Permitting	300
Pre-Construction	400
Site Preparation	8,800
Construction of Cell	41,700
Cap	8,400
Contingency	19,900
TOTAL	$81,700

Landfill WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
1	OU 4 SUBTITLE C RCRA LANDFILL DESIGN CELL rev5	10/31/95	2/10/31	9205d
2	DESIGN	10/31/95	7/22/96	190d
3	Procure designer	10/31/95	1/30/96	66d
4	Confirm no competent fault	1/31/96	6/18/96	100d
5	Prepare conceptual design revision from existing document	1/31/96	2/27/96	20d
6	Review, revise, and approval conceptual design	2/28/96	3/26/96	20d
7	Prepare Title II design through 90%, using existing as basis	3/27/96	4/23/96	20d
8	Revelws and approvals of 90% design	4/24/96	5/21/96	20d
9	Complete Title II design	5/22/96	6/20/96	22d
10	Final reviews and approvals of Title II design	6/21/96	7/22/96	22d
11	PERMITTING AND AUTHORIZATION	10/31/95	1/28/97	326d
12	IAG Process/Decision Document	10/31/95	10/3/96	243d
13	Prepare draft Decision Document based on existing draft	10/31/95	11/27/95	20d
14	Review, prepare RS, revise, and obtain approvals on draft DD	11/28/95	1/26/96	44d
15	Prepare proposed Decision Document	1/29/96	2/23/96	20d
16	Review, revise, and obtain approvals to release proposed DD	2/26/96	4/25/96	44d
17	Perform public involvement, comment period, notices, mailings, h	4/26/96	7/25/96	65d
18	Prepare RS, revise DD, prepare final DD, receive approvals	7/26/96	10/3/96	50d
19	Prepare draft permit modification request	10/31/95	1/28/97	326d
20	Submit permit modification request	10/31/95	11/27/95	20d
21	Prepare draft permit modification (CDPHE)	4/24/96	11/5/96	140d
22	Comment on draft permit modification	11/6/96	12/3/96	20d
23	Complete permit modification and issue	12/4/96	1/28/97	40d
24	PROCUREMENT	2/28/96	3/13/97	272d
25	Prepare prequalification packages	2/28/96	4/23/96	40d
26	Respond to prequalification request	4/24/96	6/18/96	40d
27	Request proposals for construction	7/26/96	9/19/96	40d
28	Receive proposals	9/20/96	11/21/96	45d
29	Evaluate, select, obtain approvals for constractor	11/22/96	3/13/97	80d
30	PRECONSTRUCTION	5/22/96	7/31/97	312d

Timeline: 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

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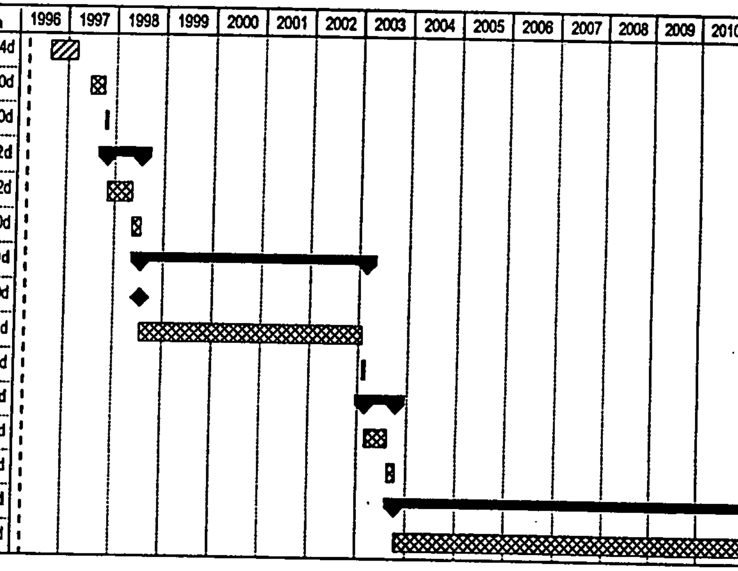
Figure B-14 Proposed Landfill Construction Schedule

Landfill WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
31	Procure workforce and prepare site for contractor	5/22/96	12/9/96	144d
32	Prepare contractor documents, perform training, etc.	3/14/97	7/3/97	80d
33	Perform contractor site preparation	7/4/97	7/31/97	20d
34	CONSTRUCTION	8/1/97	4/13/98	182d
35	Construct facility	8/1/97	2/2/98	132d
36	Perform operational testing and readiness	2/3/98	4/13/98	50d
37	OPERATION	4/13/98	11/18/02	1200d
38	Begin Operations	4/13/98	4/13/98	0d
39	Transfer waste to cell	4/14/98	10/21/02	1180d
40	Perform final quality tasks	10/22/02	11/18/02	20d
41	CAP	11/19/02	7/7/03	165d
42	Install cap	11/19/02	5/5/03	120d
43	Perform operational readiness on systems	5/6/03	7/7/03	45d
44	LONG-TERM CARE AND MONITORING	7/8/03	2/10/31	7200d
45	Perform long-term care and monitoring	7/8/03	2/10/31	7200d



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Noncritical | Milestone ◆ | Rolled Up ◇

Figure B-14 Proposed Landfill Construction Schedule (Cont.)

Operating Costs

The following is the planning estimate of the operating costs for this facility:

Operations Component	($K)
Containers	$ 400
Packaging	2,400
Treatment/Characterization	7,300
Transportation	600
Operations	9,000
Postclosure & Monitoring	13,900
Contingency	10,800
TOTAL	$44,400

Summary of Costs

	($K)
Construction Costs	$81,700
Operating Costs	44,400
Total Life-Cycle Costs	$126,100

4.4.6 Waste Vault

LLW/LLMW

For the purpose of comparison between alternative designs of waste management facilities, it was assumed that each design would be sized to accommodate 100,000 yds^3 of LLW, LLMW, and straight hazardous wastes. Discussions of possible facility designs presented below are based on preconceptual ideas developed by the Waste Management Facility team. Aspects of facility designs or descriptions may change as conceptual and Title II design phases are completed.

Specialty Wastes

Specialty waste, such as radioactive PCBs and asbestos will contribute a small volume toward potential emplacement in an onsite waste vault. Treatment options for these waste types are discussed in Subsection 4.6.

Facility Design

The Waste Vault facility would be designed to accommodate wastes packaged in cargo containers only. This facility would essentially be a self-supporting reinforced concrete shell approximately 560 feet long by 475 feet wide and 24 feet tall. The facility would consist of three reinforced concrete modules constructed one per year. The base of the structure would be an eighteen-inch-thick reinforced concrete slab supporting 12-inch-thick reinforced concrete walls and roof. Inside the facility would be three 30-foot-wide central corridors for routine monitoring and inspection. The wastes would be stored in approximately 5,000 cargo containers with a capacity of approximately 20 yds^3 each. A large forklift would be used to move the containers as necessary. Figure B-15 shows a conceptual drawing of the Waste Vault facility concept.

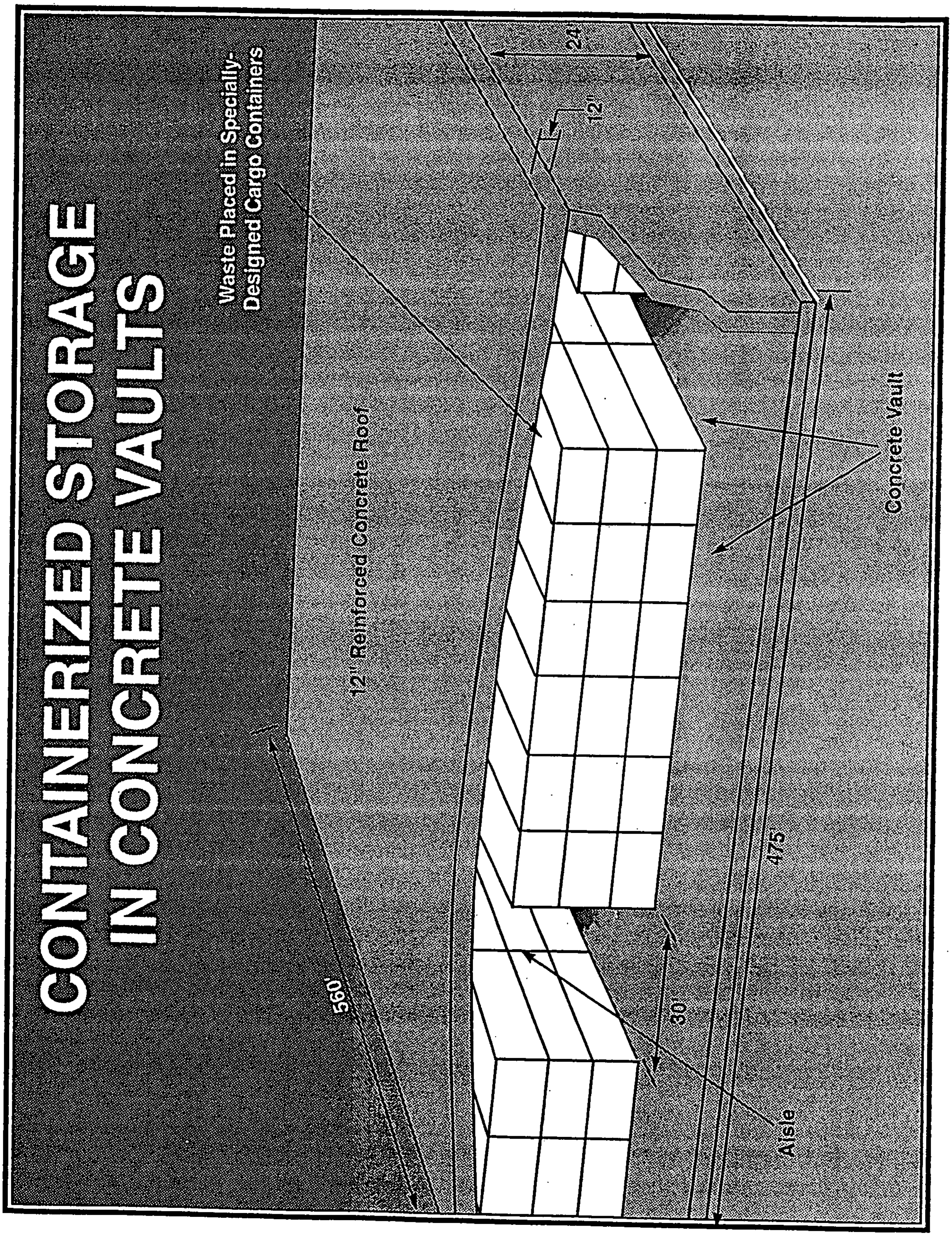

Figure B-15 Vault Conceptual Design

This facility would be visually monitored and inspected for leaks and necessary routine maintenance. This facility would likely not be covered with any type of cap system. Eventual final action on a cap or covering configuration must still be completed on the vault if this design option is implemented.

Waste Monitoring and Retrievability Considerations

This facility would not include a leak detection and leachate collection system, other than visual inspection for leaks. Leachate would not need to be collected due to the reinforced concrete roof.

During operations the waste will be mapped and gridded in the modules as it is placed for retrievability considerations. The concrete base will allow for ease of operations as well as ease of retrievability if needed. No damage to this facility would occur if any of the waste were required to be retrieved. Additionally, despite the large cost, if the waste is placed in a containerized form, retrievability is further enhanced as individual cargo containers can easily be retrieved.

Construction Schedule

The construction schedule is dependent upon the siting of this facility. For the purposes of this discussion the Solar Pond location was chosen for comparison. The anticipated start of construction on the first module would occur during the third quarter of Fiscal Year 1997, and construction would be completed during the first quarter of Fiscal Year 1998. Operations would then immediately follow after completion of systems operations testing. The construction schedule for the vault is shown in Figure B-16.

Construction Costs

The following is the planning estimate of the construction costs for the waste vault:

Construction Task	($K)
Design	$ 1,600
Permitting	300
Pre-Construction	400
Site Preparation	14,500
Construction of Cell	26,000
Cap	N/A
Contingency	14,400
TOTAL	$57,200

Operating Costs

The following is the planning estimate of the operations costs for the waste vault:

Operations Component	($K)
Containers	$ 52,800
Packaging	2,400
Treatment/Characterization	7,300

Vault WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
1	**OU 4 VAULT WITH CONTAINER STORAGE rev5**	10/31/95	4/26/30	8999d
2	**DESIGN**	10/31/95	10/14/96	250d
3	Procure designer	10/31/95	1/30/96	66d
4	Confirm no competent fault	1/31/96	6/18/96	100d
5	Prepare conceptual design	1/31/96	2/27/96	20d
6	Review, revise, and approval conceptual design	2/28/96	3/26/96	20d
7	Prepare Title II design through 90%	3/27/96	6/18/96	60d
8	Reveiws and approvals of 90% design	6/19/96	8/13/96	40d
9	Complete Title II design	8/14/96	9/12/96	22d
10	Final reviews and approvals of Title II design	9/13/96	10/14/96	22d
11	**PERMITTING AND AUTHORIZATION**	10/31/95	12/3/96	286d
12	**IAG Process/Decision Document**	10/31/95	10/3/96	243d
13	Prepare draft Decision Document based on existing draft	10/31/95	11/27/95	20d
14	Review, prepare RS, revise, and obtain approvals on draft DD	11/28/95	1/26/96	44d
15	Prepare proposed Decision Document	1/29/96	2/23/96	20d
16	Review, revise, and obtain approvals to release proposed DD	2/26/96	4/25/96	44d
17	Perform public involvement, comment period, notices, mailings, h	4/26/96	7/25/96	65d
18	Prepare RS, revise DD, prepare final DD, receive approvals	7/26/96	10/3/96	50d
19	**Prepare draft permit modification request**	10/31/95	12/3/96	286d
20	Submit permit modification request	10/31/95	11/27/95	20d
21	Prepare draft permit modification (CDPHE)	2/28/96	9/10/96	140d
22	Comment on draft permit modification	9/11/96	10/8/96	20d
23	Complete permit modification and issue	10/9/96	12/3/96	40d
24	**PROCUREMENT**	2/28/96	12/3/96	200d
25	Prepare prequalification packages	2/28/96	4/23/96	40d
26	Respond to prequalification request	4/24/96	6/18/96	40d
27	Request proposals for construction	6/19/96	8/13/96	40d
28	Receive proposals	8/14/96	10/8/96	40d
29	Evaluate, select, obtain approvals for constructor	10/9/96	12/3/96	40d
30	**PRECONSTRUCTION**	8/14/96	11/27/01	1380d

Timeline: 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

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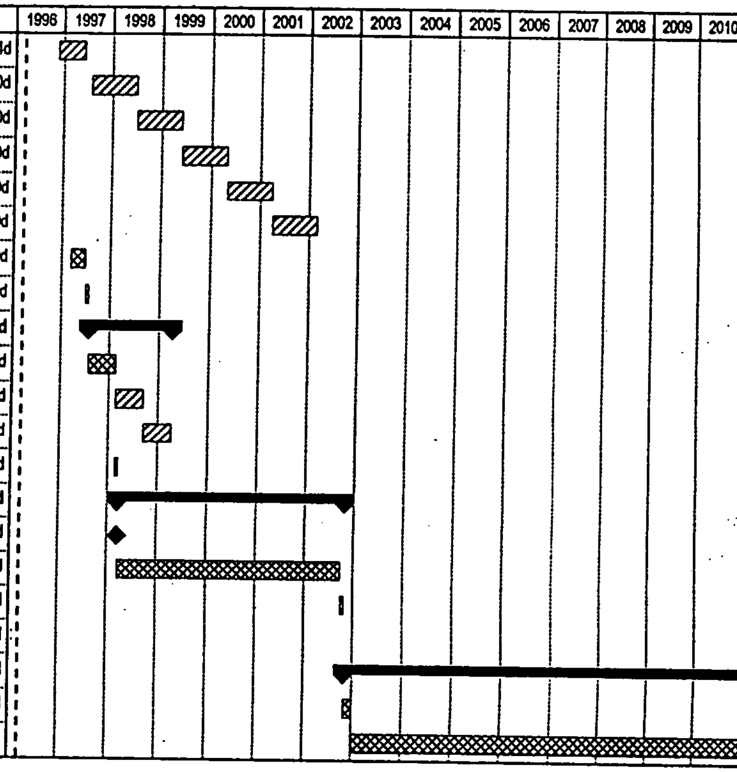
Figure B-16 Proposed Vault Schedule

Vault WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
31	Procure workforce and prepare site for contractor	8/14/96	3/3/97	144d
32	Perform long-lead procurement: containers for 1st year of operation	4/23/97	3/24/98	240d
33	Perform long-lead procurement: containers for 2nd year of operations	3/25/98	2/23/99	240d
34	Perform long-lead procurement: containers for 3rd year of operations	2/24/99	1/25/00	240d
35	Perform long-lead procurement: containers for 4th year of operations	1/26/00	12/26/00	240d
36	Perform long-lead procurement: containers for 5th year of operations	12/27/00	11/27/01	240d
37	Prepare contractor documents, perform training, etc.	12/4/96	3/25/97	80d
38	Perform contractor site preparation	3/26/97	4/22/97	20d
39	**CONSTRUCTION**	**4/23/97**	**1/4/99**	**444d**
40	Construct facility, 1st bay	4/23/97	11/14/97	148d
41	Construct facility, 2nd bay	11/17/97	6/10/98	148d
42	Construct facility, 3rd bay	6/11/98	1/4/99	148d
43	Perfrom operational testing and readiness	11/17/97	12/12/97	20d
44	**OPERATION**	**12/12/97**	**7/19/02**	**1200d**
45	Begin Operations	12/12/97	12/12/97	0d
46	Transfer waste to cell	12/15/97	6/21/02	1180d
47	Perform final quality tasks	6/24/02	7/19/02	20d
48	OU 4 VAULT WITH CONTAINER STORAGE rev3	10/31/95	10/31/95	1d
49	**LONG-TERM CARE**	**7/22/02**	**4/26/30**	**7245d**
50	Perform operational readiness on long-term systems	7/22/02	9/20/02	45d
51	Perform inspection and monitoring	9/23/02	4/26/30	7200d



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Noncritical ▨ Milestone ◆ Rolled Up ◇

Figure B-16 Proposed Vault Schedule (Cont.)

Transportation	600
Operations	4,900
Post Closure & Monitoring	13,000
Contingency	25,400
TOTAL	$104,800

It is important to note that the post closure and monitoring is for thirty years and does not include final disposition of the waste (e.g., transportation and disposal at offsite facility if required).

Summary of Costs

	($K)
Construction Costs	$57,200
Operating Costs	104,800
Total Life-Cycle Costs	$162,000

4.4.7 Concrete Slab

LLW/LLMW

For the purpose of comparison between alternative designs of waste management facilities, it was assumed that each design would be sized to accommodate 100,000 yds^3 of LLW, LLMW, and straight hazardous wastes. This quantity was derived from the approximate amount of ER waste expected to be generated in the top ten environmental remediation activities. Discussions of possible facility designs presented below are based on pre-conceptual ideas developed by the Waste Management Facility team. Aspects of facility designs or descriptions may change as conceptual and Title II design phases are completed.

Specialty Wastes

Specialty waste, such as radioactive PCBs and asbestos will contribute a small volume toward potential emplacement on an onsite concrete slab. The maximum projected volume of this type waste is 5 m^3.

Facility Design

The slab facility would be designed to accommodate wastes packaged in cargo containers only. This facility would be a reinforced concrete slab twelve inches thick placed on grade with a berm along the sides for secondary containment. The slab size would be 600 feet long by 520 feet wide (approximately 7.4 acres). On the facility would be three 30-foot-wide central corridors for routine monitoring and inspection. The wastes would be stored in approximately 5,000 cargo containers with a capacity of approximately 20 yds^3 each. A large forklift would be used to move the containers as necessary. Figure B-17 shows a conceptual drawing of the slab on grade facility concept.

This facility would be visually monitored and inspected for leaks and necessary maintenance. It was assumed that stormwater collected on the slab would be collected, characterized, and released without treatment.

This facility would likely not be covered with any type of cap system. Eventual final action must still be completed on the waste if this design option is implemented.

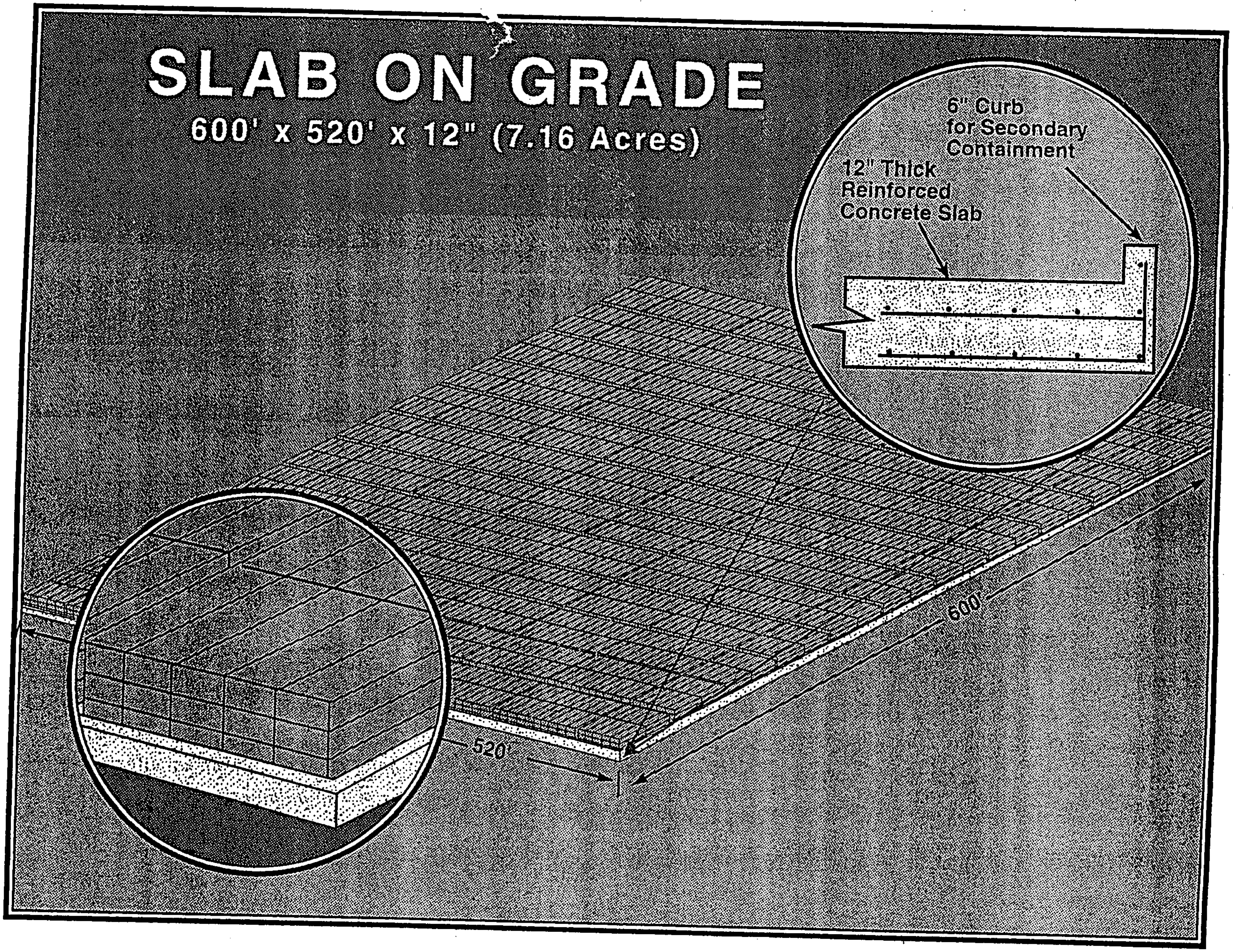


Figure B-17 Slab On Grade Conceptual Design

Waste Monitoring and Retrievability Considerations

This facility would not include a leak detection and leachate collection system, other than visual inspection for leaks. During operations the waste will be mapped and gridded on the slab as it is placed for retrievability considerations. The concrete base will allow for ease of operations as well as ease of retrievability if needed. No damage to this facility would occur if any of the waste were required to be retrieved.

Construction Schedule

The construction schedule is dependent upon the siting of this facility. For the purposes of this discussion the Solar Pond location was chosen for comparison. The anticipated start of construction for the first phase would be during the first quarter of Fiscal Year 1997, and construction would be completed during the second quarter of Fiscal Year 1997. Operations would then immediately follow after completion of systems operations testing. Construction scheduled for the concrete slab is shown in Figure B-18.

Construction Costs

The following is the planning estimate of the construction costs for the concrete slab:

Construction Task	($K)
Design	$ 300
Permitting	300
Pre-Construction	200
Site Preparation	11,000
Construction of Cell	3,800
Cap	N/A
Contingency	5,300
TOTAL	$20,900

Operating Costs

The following is the planning estimate of the operations costs for the concrete slab:

Operations Component	($K)
Containers	$ 52,800
Packaging	2,400
Treatment/Characterization	7,300
Transportation	600
Operations	5,500
Postclosure & Monitoring	10,400
Contingency	26,700
TOTAL	$105,700

It is important to note that the Postclosure and Monitoring is for thirty years and does not include final disposition of the waste.

Slab Storage WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
1	OU 4 SLAB WITH CONTAINERS rev5	10/31/95	6/7/29	8768d
2	DESIGN	10/31/95	3/18/96	100d
3	Confirm no competent fault	10/31/95	3/18/96	100d
4	Prepare conceptual design	10/31/95	11/13/95	10d
5	Review, revise, and approval conceptual design	11/14/95	12/11/95	20d
6	Prepare Title II design through 90%	12/12/95	12/25/95	10d
7	Revelws and approvals of 90% design	12/26/95	1/22/96	20d
8	Complete Title II design	1/23/96	2/5/96	10d
9	Final reviews and approvals of Title II design	2/6/96	3/6/96	22d
10	PERMITTING AND AUTHORIZATION	10/31/95	9/23/96	235d
11	IAG Process/Decision Document	10/31/95	9/23/96	235d
12	Prepare draft Decision Document based on existing draft	10/31/95	11/27/95	20d
13	Review, prepare RS, revise, and obtain approvals on draft DD	11/28/95	1/22/96	40d
14	Prepare proposed Decision Document	1/23/96	2/19/96	20d
15	Review, revise, and obtain approvals to release proposed DD	2/20/96	4/15/96	40d
16	Perform public involvement, comment period, notices, mailings, h	4/16/96	7/15/96	65d
17	Prepare RS, revise DD, prepare final DD, receive approvals	7/16/96	9/23/96	50d
18	Prepare draft permit modification request (Subpart I)	10/31/95	5/27/96	150d
19	Submit permit modification request	10/31/95	11/27/95	20d
20	Prepare draft permit modification (CDPHE)	12/26/95	3/4/96	50d
21	Comment on draft permit modification	3/5/96	4/1/96	20d
22	Complete permit modification and issue	4/2/96	5/27/96	40d
23	PROCUREMENT	12/26/95	6/10/96	120d
24	Request proposals for construction	12/26/95	2/19/96	40d
25	Receive proposals	2/20/96	4/15/96	40d
26	Evaluate, select, obtain approvals for constractor	4/16/96	6/10/96	40d
27	PRECONSTRUCTION	1/23/96	5/7/01	1380d
28	Procure workforce and prepare site for contractor	1/23/96	8/9/96	144d
29	Perform long-lead procurement: containers for 1st year of operations	10/1/96	9/1/97	240d
30	Perform long-lead procurement: containers for 2nd year of operations	9/2/97	8/3/98	240d

Timeline: 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

RMRS
Waste Management Facility
KCL 11/30/95

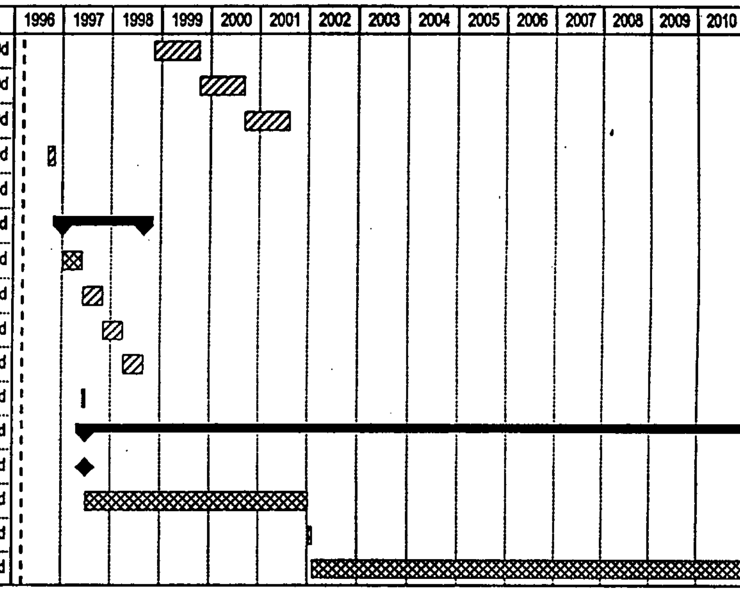
Critical — Progress — Summary
Noncritical — Milestone ◆ — Rolled Up ◇

Figure B-18 Proposed Slab On Grade Schedule

Slab Storage WMF at Solar Ponds

conceptual schedule start-date 10/31/95

ID	Name	Estimated Start	Estimated Finish	Duration
31	Perform long-lead procurement: containers for 3rd year of operations	8/4/98	7/5/99	240d
32	Perform long-lead procurement: containers for 4th year of operations	7/6/99	6/5/00	240d
33	Perform long-lead procurement: containers for 5th year of operations	6/6/00	5/7/01	240d
34	Prepare contractor documents, perform training, etc.	6/11/96	8/5/96	40d
35	Perform contractor site preparation	9/24/96	9/30/96	5d
36	CONSTRUCTION	10/1/96	5/27/98	432d
37	Construct facility, phase 1	10/1/96	2/27/97	108d
38	Construct facility, phase 2	2/28/97	7/29/97	108d
39	Construct facility, phase 3	7/30/97	12/26/97	108d
40	Construct facility, phase 4	12/29/97	5/27/98	108d
41	Perform operational testing and readiness for initial storage campaign	2/28/97	3/27/97	20d
42	OPERATION	3/27/97	6/7/29	8400d
43	Begin Operations	3/27/97	3/27/97	0d
44	Transfer waste to storage	3/28/97	10/4/01	1180d
45	Perform final quality tasks	10/5/01	11/1/01	20d
46	Inspect and maintain	11/2/01	6/7/29	7200d



RMRS
Waste Management Facility
KCL 11/30/95

Critical | Progress | Summary
Noncritical | Milestone ◆ | Rolled Up ◇

Figure B-18 Proposed Slab On Grade Schedule (Cont.)

Summary of Costs

	($K)
Construction Costs	$20,900
Operating Cost	105,700
Total Life-Cycle Costs	$126,600

4.5 Offsite Disposal

Several options for offsite disposal of Rocky Flats waste are discussed in this section. A listing of these options follows:

- Federal Repositories
  - Waste Isolation Pilot Plant (WIPP)
  - Nevada Test Site (NTS)
  - Hanford Site
  - Other potential sites

- Commercial Disposal Sites
  - Envirocare
  - U.S. Ecology
  - Barnwell
  - Commercial landfills for solid sanitary waste

These options are not specifically identified in the evaluation of the various alternatives but are included here to show potential choices for consideration in ASAP Phase III.

4.5.1 Federal Repositories

All wastes generated at Rocky Flats must eventually be disposed in an approved facility.

Waste Isolation Pilot Plant (WIPP)

WIPP is DOE's planned destination for TRU and TRM wastes; DOE expects WIPP to open in April 1998. For planning purposes, although the WAC for this facility are not yet finalized, this analysis assumes that no major revisions or modifications to the present WAC will occur. This analysis also assumes that WIPP will operate under a RCRA no-migration variance, thus eliminating the need for LDR treatment. Stakeholder and regulatory concerns have not been resolved, and some doubt remains as to when or if the facility will be available.

The waste generation rate is primarily dependent upon implementation of the preferred ASAP alternative which will determine the Site's course of action. For example, in Alternative 1, Unrestricted, the TRU/TRM inventory is largest based on quantities generated from residue processing activities, while in Alternative 4, Mothball, TRU/TRM waste inventory is smallest based on decreased generation from demolition activities. The finalized alternative will provide information on the usable state of the Site after final closure, funding level and schedule, and building decommissioning schedules. These factors and the residue processing path to meet WIPP WAC or long-term storage criteria will significantly impact the amount of waste generated and storage and disposal capacities.

TRU/TRM wastes could be retained onsite in retrofitted storage facilities (e.g., Buildings 371, 460, 707) until they can be transferred to a new centralized TRU/TRM waste storage facility.

Use of existing facilities for temporary storage allows for timely relocation of TRU/TRM wastes from buildings being dismantled and avoids delays associated with construction lead times and line-item funding cycles. The duration of onsite storage is dependent upon the opening of WIPP and the availability of TRUPACT II transport vehicles.

Several factors will limit the offsite disposal rate to WIPP:

- Disposal certification capacity
- Availability of TRUPACT II vehicles and containers
- Plutonium content

All containers destined for WIPP require disposal certification, which includes real-time radiography (RTR), waste assay, and headspace-gas analysis. In addition, solid samples must be collected and analyzed from a representative number of containers. Based on current funding and logistical issues such as drum movement and availability of staging areas, the disposal certification rate will be 200 drums (42 m^3) per year. An increased disposal certification capacity is required to eliminate any TRU/TRM waste storage deficiencies and ensure that efficient certified TRU/TRM waste is available for shipment to WIPP.

The availability of TRUPACT II vehicles to transport the TRU/TRM waste to WIPP is critical to the offsite disposal shipping rate. One truck destined for WIPP can transport three TRUPACT II containers. Each container can hold 14 drums of TRU/TRM waste. Therefore, each TRUPACT II vehicle could potentially carry 42 drums (8.82 m^3) of TRU/TRM waste to WIPP, assuming maximum shipping capacity per truckload. However, TRUPACT II containers are restricted to 200 grams of plutonium per drum and a total of 325 grams per container. Since existing residues contain significant quantities of plutonium, these restrictions will almost certainly reduce the total number of drums per vehicle.

The estimated annual WIPP acceptance rate and the anticipated maximum TRU/TRM waste shipping volumes available to the Site are shown in Table B-6.

Table B-6
Acceptance And Shipping Rates

FISCAL YEAR	WIPP ANNUAL ACCEPTANCE (m^3)	ROCKY FLATS ANNUAL SHIPMENTS (m^3)*
1998	441	141
1999	1764	882
2000	1764	882
2001	4410	1764
2002	4410	1764
2003	7497	1764
2004	7497	1764
2005	7497	1764
2006	7497	1764
2007	7497	1764
2008	7497	1138
TOTAL		15391

* This capacity is based on physical limitations at Rocky Flats as well as commitments at WIPP for receipt of other DOE Sites' waste.

The maximum volume of 15,391 m³ of TRU/TRM waste would be disposed at WIPP by the end of FY 08 based upon these shipping capacities. This aggressive shipping schedule assumes TRUPACT II vehicle availability to accommodate all indicated shipments. It was assumed that all truckloads would be at maximum shipping capacity. This also assumes that the IDC and content code mix of TRU/TRM waste is appropriate and available for transport for each shipment to ensure maximum shipping capacity.

Several actions could increase shipping capacity if necessary:

- Increase the transport gram limit on the TRUPACT II container to ensure that maximum shipping capacity is utilized with each shipment.

- Increase the drum disposal certification rate to equal or exceed the maximum shipping rate.

- Construct additional TRUPACT II vehicles to facilitate the timely offsite disposal of TRU/TRM waste (The number required would be calculated based on Site needs and other DOE Site commitments to ship to WIPP).

Load preparation and all associated costs are extensively covered in Subsection 4.11. The time and cost associated with load preparation must be addressed to ensure certified TRU/TRM waste availability for shipment to WIPP.

Transportation of TRU/TRM waste to WIPP for disposal presents a significant risk of accidents. Transportation risk was based on the National Safety Council statistic that one accident can be anticipated every 500,000 miles. Based on shipping the maximum TRU/TRM waste volume to WIPP and an approximate distance of 700 miles from Rocky Flats to WIPP, three accidents would be anticipated for the offsite disposal of TRU/TRM waste. The number of accidents would increase significantly if additional shipments to WIPP are required because the maximum shipping capacity of the TRUPACT II vehicle is not utilized.

Transportation and disposal costs for WIPP are $40,000 per m³ of TRU/TRM waste or $8000 per drum based on current estimates. This cost includes shipment in the TRUPACT II container and internment costs at WIPP. These costs would be incurred by WIPP.

Nevada Test Site (NTS)

Currently, LLW is designated for shipment to NTS because it is the primary waste repository for Rocky Flats. All LLW shipments to NTS have stopped; shipments should resume by March 1996. Ten LLW streams have been authorized for shipment. Two new waste streams (HEPA filters and sewage sludge) have been requested for authorization, and approval is expected by March 1996.

NTS has been operating to NVO-325, Revision 1, since June 1992 and Revision 2 is anticipated in FY97. NVO-325 is the Waste Acceptance Criteria for NTS. Appropriate changes to the Site Low-Level Waste Management Program to address this revision will be required to ensure that LLW generated at Rocky Flats can be certified to meet acceptance criteria for offsite disposal. A limit on the amount of waste that NTS will accept on an annual basis is pending, and the amount of LLW allocated to Rocky Flats for disposal is uncertain at this time.

Currently, Rocky Flats is working with NTS on the LLMW permit authorization, and the acceptance approval is anticipated in September 1998. Stakeholder and regulator issues are of major concern and significant risk exists on the viability of this option. Changes to the

Site Low-Level Waste Management Program will be required prior to offsite disposal of LLMW. The changes will ensure that LLMW generated at Rocky Flats is certified to meet the waste acceptance criteria at NTS.

Non-ER LLW is currently shipped to Hanford and NTS. LLW sewage sludge was shipped to Hanford through 1995; in the future, it will be shipped to NTS. Non-ER LLMW is required to meet LDR requirements prior to disposal and is destined for Envirocare, NTS, or onsite disposal.

Rocky Flats currently stages and ships LLW out of Building 664. The Site has the capability to ship waste directly from the Centralized Waste Storage Facility (CWSF) (Building 906) and 750 and 904 Pads. This provides the Site with additional shipping capacity when NTS begins accepting LLMW.

Load preparation and all associated costs are extensively covered in Subsection 4.11. The time and cost associated with load preparation must be addressed to ensure certified LLW/LLMW availability for offsite shipment to approved waste facilities.

Transportation of LLW/LLMW to NTS for disposal presents a significant risk of accidents. The transportation risk was based on the National Safety Council statistic that one accident can be anticipated every 500,000 miles. Based upon shipping the maximum total LLW/LLMW volume to the NTS and a distance of 700 miles from the Site to NTS, 130 accidents would be anticipated for the offsite disposal of all LLW/LLMW at NTS. Assuming the minimum total LLW/LLMW volume to the NTS, 10 accidents would be anticipated for the offsite disposal. However, not all LLW/LLMW is destined for NTS; therefore the number of anticipated accidents would increase or decrease based on the final destination for the waste. Envirocare, other DOE facilities, and other commercial facilities are under consideration for offsite disposal of LLW/LLMW.

Transportation and disposal costs for LLW/LLMW are estimated at \$2800 per m^3 or \$588 per drum. This cost includes shipment in the appropriate container and internment costs at the approved offsite facility. These costs would be incurred by Rocky Flats.

Hanford

Hanford will accept only low-level asbestos waste after 1995. Currently, 46 m^3 of asbestos-containing material are stored in Building 666 and several other locations at Rocky Flats. Of this total, 31 m^3 of asbestos-containing material are contaminated with low-level radioactive materials. Nonradioactive asbestos-containing material is shipped to approved disposal facilities. Radioactive asbestos-containing material is shipped for disposal in a landfill at DOE's Hanford Facility. However, with the decommissioning process, additional low-level asbestos-containing waste would be generated and require offsite disposal.

Hanford will accept limited quantities of LLMW from sites which are currently approved and shipping LLW to Hanford. The LLMW would go into storage and become Hanford waste. The LLMW does not currently need to meet LDR requirements, but in the future this would become a requirement. The LLMW streams and quantities would require DOE and audit/approval from Hanford.

Load preparation and all associated costs are extensively covered in Subsection 4.11. The time and cost associated with load preparation must be addressed to ensure certified LLW/LLMW availability for offsite shipment to approved waste facilities.

Transportation and disposal costs for LLW/LLMW are estimated at \$2800 per cubic meter or \$588 per drum. This cost includes shipment in the appropriate containers and internment costs at the approved offsite facility. These costs would be incurred by Rocky Flats. If Hanford would be authorized to accept Rocky Flats LLMW and the waste is correctly characterized, a one-time payment of approximately $5000 per cubic meter for LLMW is anticipated. The discussions with Hanford regarding the acceptance of LLMW are in the initial contact stages. This option will continue to be pursued but for the purpose of this report, Hanford is not considered a disposal site for Rocky Flats LLMW.

Other Candidate Repositories

Other federal sites (i.e., Oak Ridge, Tennessee; Savannah River Site, South Carolina; and Los Alamos National Laboratory, New Mexico) are future repository possibilities for offsite disposal. At this time, however, these sites are not considered disposal sites for Rocky Flats LLW/LLMW. Preliminary contacts have been made to initiate discussions with other sites on the feasibility of this option. Extensive review and evaluation would be required by DOE and the other federal sites. Siting and permitting would be required to follow state and federal regulations and include the appropriate level of public involvement.

4.5.2 Commercial Disposal Sites

Disposal of Rocky Flats waste at commercial facilities is potentially viable for all waste categories except TRU/TRM waste. Specific alternatives for commercial disposal of the other waste categories are discussed in the following sections. Information is provided on all candidate sites and eligible waste categories/streams.

Candidate Waste Streams

LLW/LLMW have historically been disposed at other DOE sites; however, approval has been granted by DOE,HQ in several cases, to allow disposal of DOE-site generated LLW/LLMW at commercial facilities. Disposal of these waste categories at commercial facilities may be a viable option for some radioactive waste; however, many of these facilities have restrictions on radioactive contamination levels (from 1 nCi/g to 10 nCi/g of alpha emitting radionuclides) that would affect a significant portion of the Site's LLW/LLMW category.

Nonradioactive PCB and asbestos waste has been routinely disposed at commercial facilities, and this practice will continue. Several facilities have been used and will continue on a competitive bidding basis.

Hazardous waste as defined by RCRA is currently routinely disposed through commercial treatment, storage, and disposal facilities (TSDFs), and this method will continue as the primary means of disposal. Numerous facilities are available to industry for TSDF services for nonradioactive hazardous waste.

Uncontaminated demolition debris and solid sanitary waste are candidates to be disposed at offsite commercial landfills. Several studies have been performed to evaluate the use of commercial facilities for disposal of the Site's solid sanitary waste. Results show that this option is technically and economically feasible; however, concerns were noted for liability issues if contamination (specifically, radioactive contamination) were to be found in a facility utilized by Rocky Flats.

Candidate Sites

Because PCB, asbestos, and RCRA hazardous wastes are currently disposed at offsite commercial facilities, no effort was applied to developing a specific list of potential facilities. Disposal of these wastes will continue as is currently done.

Candidate sites for disposal of Rocky Flats LLW/LLMW include: (1) Envirocare of Utah, (2) U.S. Ecology at Hanford, and (3) Barnwell in South Carolina. Additional sites in Utah and Texas are undergoing the approval/permitting process and may become viable candidates in the future. Envirocare is currently receiving limited Rocky Flats LLMW and is being evaluated as a potential site for LLW disposal. Envirocare has recently reduced their limit for alpha radionuclides to 1 nCi/g or less from 10 nCi/g which severely limits the quantities of Rocky Flats LLW/LLMW that may be acceptable. The U.S. Ecology and Barnwell facilities are licensed for LLW only and have not been actively pursued because of more favorable options.

Commercial landfills for solid sanitary waste (including uncontaminated construction debris) are available in the general geographic area of the Site. Landfills are located in Jefferson County, Adams County, and other more remote locations in eastern Colorado. Preliminary discussions have occurred with these facilities, and offsite disposal of solid sanitary waste and construction debris is a viable option.

Comparative Cost Information

Costs associated with disposal of Rocky Flats waste at commercial facilities are comparable among currently known candidate sites. Transportation costs are based on weight and distance, and actual disposal fees vary from site to site as shown below. Costs for waste characterization and other preparation are expected to be similar for all commercial sites; these costs are expected to be less than those for disposal at DOE sites.

Facility	Waste Category	Unit Cost ($/m^3)
Envirocare	LLW	300
Envirocare	LLMW	1580
U.S. Ecology	LLW	1900
BFI Jefferson County	San/Const. Debris	23

Comparative Risk Information

Risks associated with offsite commercial disposal of Rocky Flats waste fall into two major categories: (1) transportation risks and (2) liability risks. Transportation risks are based on the expected accidents and potential radiological contamination of the environment. Both are based on the vehicle miles required to transport waste to the disposal site. Liability risks are associated with potential future cleanup actions that could result at disposal sites in which DOE and/or the Site contractor are held liable for financing all or part. Risk analysis is covered in Subsection 4.11.

4.6 Treatment Options

Waste treatment is an integral component of the overall life cycle of a waste beginning with the point of generation through to the final disposition of the waste. Many wastes, as generated, do not require any kind of treatment. There are, however, a variety of wastes that will require treatment prior to disposition. Treatment is performed for several reasons: (1) volume reduction to make the waste easier and less expensive to store and dispose, (2) stabilization to make the waste safer, easier and less expensive to store, transport, and dispose, and (3) to meet the myriad requirements imposed by local and federal regulators and disposal facilities.

The first two criteria listed above are typically viewed as issues involved with making better business decisions, i.e., determining the most effective, cost efficient method of conducting business. The last criterion, although it has a basis in sound business principles, is aimed more directly at protection of human health and the environment, with economics as a secondary consideration. Additionally, while decisions regarding the first two criteria can be evaluated on a cost/benefit basis, decisions related to the last criterion are based on strict compliance with established criteria.

Waste treatment options discussed below include:
- Summary of Requirements
- Onsite Treatment Options
- Offsite Treatment Options

Within each "Treatment Option" section, there is a further analysis of options based on:
- TRU/TRM Wastes
- LLW/LLMW
- Hazardous/Other Regulated Wastes

These topics are further analyzed based on risk considerations, available technologies and cost and schedule estimates. Within the TRU/TRM waste category, "minimal" treatment and "full" treatment options are explored. Within the LLW/LLMW category, "no treatment," "minimal treatment" and "full treatment" options are analyzed.

Some of the options discussed in this section are not specifically included as part of the eight alternatives evaluated in ASAP Phase II. They are included here to show the types of treatment options and technologies analyzed and to provide a more complete range of choices for consideration in ASAP Phase III.

4.6.1 Requirements

Requirements for treatment of radioactive wastes are discussed under the auspices of federally established agencies and requirements. In the case of commercial radioactive wastes, the Nuclear Regulatory Commission (NRC) is the primary authority in establishing the requirements under which such waste must be managed. NRC requirements are documented in the Code of Federal Regulations. Through the Low-level Radioactive Waste Policy Act and Amendments, much of the NRC's authority has been or can be delegated to individual States and Compacts; thus the responsibility for establishing radioactive waste management criteria falls with these entities. In the case of radioactive wastes generated in support of the federal nuclear weapons programs, DOE is the primary authority in establishing the requirements under which such waste must be managed. DOE's requirements have historically been documented in DOE Orders, and more recently, are being codified through publication in the Code of Federal Regulations.

If radioactive wastes are mixed with other chemical components that would ordinarily cause the waste to be a hazardous waste as defined by the Environmental Protection Agency (this combination is referred to as a "mixed waste" or "radioactive mixed waste"), an additional regulatory framework is added to the management of this waste type. Such requirements were established, and are described under RCRA. The primary authority in establishing requirements for management of hazardous waste component of mixed waste is the EPA. Although EPA is the primary authority, such authority can be, and has been delegated to the State of Colorado and is enforced by CDPHE.

Rocky Flats also has an inventory of PCB-contaminated waste and asbestos waste. Special case wastes, such as these, are managed according to the requirements established under the TSCA. The primary authority for establishing these requirements is also EPA.

An additional set of requirements is imposed by the DOT which regulates the interstate transportation aspects of movement of radioactive wastes and mixed waste from one location to another.

Finally, based on location-specific hydrology, geology, and climate, as well as technical capabilities and limitations, offsite treatment, storage, and disposal facilities may establish specific requirements for receipt and disposition of wastes at their facilities. Such requirements are typically outlined in site specific WAC. Typical requirements established in WAC include limits on radionuclide constituents and radioactivity concentrations, limitations on free liquids and dispersible particulates, limitations on reactive and dangerous constituents, and others.

For radioactive wastes, the primary consideration in evaluating treatment options is based on the desire to minimize the potential for migration of the radioactive constituents from the waste while in storage or in its final resting place. The basic requirements; are established through evaluation of individual storage and disposal WAC documents. For example, NTS has received low-level waste from Rocky Flats for disposal. The NTS WAC prohibits the presence of free liquids and dispersible particulates. As a result, wastes destined for disposal at NTS that contain free liquids or particulates must be treated to eliminate the offending characteristics prior to disposal at NTS. The WIPP has similar requirements; therefore, transuranic waste must also be treated to eliminate the prohibited characteristics.

In the case of radioactive mixed wastes, in addition to the desire to minimize potential migration of radionuclides, there is an added incentive to minimize the potential for migration of chemical components. For mixed waste, facility WAC documents typically specify that the wastes must comply with the requirements of RCRA. More specifically, statutory and regulatory requirements have been established, referred to as LDR requirements or standards, that describe quantitative standards by which hazardous wastes (and through extension, radioactive mixed wastes) must be treated prior to ultimate landfill disposition. The intent of the LDR standards is to reduce the toxicity and likelihood of migration of waste from land disposal facilities. Such intent includes a ban on disposal of bulk or noncontainerized liquids, and a set of minimum technological requirements for landfills. The purpose of the LDR standards is to minimize factors that may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness. An additional purpose is to minimize factors that may pose a substantial present or potential hazard to human health or the environment. Evaluation of treatment options that incorporate these principles is based on several qualitative and quantitative factors listed below:

QUALITATIVE CONSIDERATIONS	QUANTITATIVE CONSIDERATIONS
Toxicity, persistence, mobility and degradability in nature	Quantity of hazardous constituents
Potential for accumulation in tissue	Concentration of hazardous constituents
Flammability, corrosiveness and other hazardous characteristics	Physical, chemical or infectious characteristics
Presence of constituents identified as carcinogens, mutagens, or teratogens	

In summary, the treatment options evaluated and discussed below must consider health and safety protection factors as well as technical and economic factors. Frequently, the health and safety factors analysis (i.e., verbatim regulatory compliance) may be at odds with what is technically or economically practical and prudent. As a result, the options identified below attempt to consider a variety of solutions to the waste treatment problem. The underlying goal of waste treatment is to ensure short- and long-term protection of human health and the environment. Depending on the degree of protection required and the time frames under which such protection is desired, economics may drive the solution. With sufficient time and funding allocations, there is no doubt that the highest ultimate degree of protection can be provided through waste treatment. Given current technical limitations and funding realities, it is still possible to provide a high degree of protection through waste treatment, while at the same time addressing other high risk priorities such as residue stabilization and SNM consolidation.

4.6.2 Onsite Treatment

Existing waste treatment facilities at Rocky Flats were designed to treat various waste forms for safe storage, transport, and disposal. Most of the existing technologies focus on volume reduction of liquid and solid waste forms and stabilization of other wastes so that they can be placed in storage or disposed in accordance with onsite and offsite WAC. Existing site capacity can be divided into two categories: (1) facilities that currently treat liquid wastes and (2) solid waste processing facilities that may aid pretreatment or post-treatment of waste forms. These two categories are discussed further as part of the LLW/LLMW Treatment Options section.

For wastes that cannot be treated utilizing existing liquid or solid treatment capacity, additional capacity must be developed and installed. Most recent efforts have focused on development of new mixed waste treatment capacity. Historically, Rocky Flats has determined that onsite treatment was the preferred approach based on the nature of radioactive and mixed waste, and based on a general lack of radioactive waste treatment sources anywhere within the commercial or government sectors. In recent years, however, offsite sources have evolved with the potential to treat and/or dispose of radioactive waste. As a result, treatment options have considered onsite as well as offsite treatment. Offsite treatment options are discussed below in Subsection 4.6.3.

Onsite Treatment of *Transuranic (TRU) and Transuranic Mixed (TRM) Waste*

There are two objectives presented in this section for the treatment and management of TRU and TRM wastes. The objectives were selected to facilitate the designation of an optimal treatment strategy for TRU/TRM wastes which fits with the Site priorities under the ASAP. The two objectives examined in this section are:

1. Minimal treatment of TRU/TRM wastes for onsite safe storage for a period of 20 to 30 years.

2. Full treatment of TRU/TRM wastes to meet WAC established by WIPP in Carlsbad, New Mexico.

Treatment Options

Option 1: Minimal Treatment

This treatment option is based upon the premise that the Site has neither the existing treatment capacity to treat the noncompliant TRU/TRM wastes to meet WIPP WAC nor the necessary resources to store, transport, or dispose of the additional TRU/TRM waste drums created from future missions at RFETS. In the future, these resources or technologies may become available to the Site at a reasonable cost for implementation. However, the resources necessary to treat the noncompliance TRU/TRM wastes to meet WIPP WAC are cost prohibitive.

The inventory of TRU/TRM wastes can be grouped into three subpopulations for purposes of evaluating treatment options. The subpopulations are grouped according to the following criteria:

- Characteristic Wastes - These wastes have been identified through process knowledge or analytical data to exhibit the hazardous characteristics of either ignitability, corrosivity, or reactivity. The treatment options proposed for these wastes mitigate these characteristics for long-term safe storage onsite.

- Fluid Wastes - This subpopulation of wastes consists of process residual wastes suspected of containing liquids or fluids which should be immobilized to minimize the potential mobility or leachability of these wastes prior to long-term storage onsite.

- Stable Wastes - This subpopulation of wastes consists of glass, lead, metal, structural materials, plastics, soil, and debris. This subpopulation also includes the small inventory of classified shapes and molds generated during weapons production at the Site. This material appears to be in a stable storage configuration and is assumed not to require treatment prior to long-term storage onsite.

Treatment Option Assumptions

The following assumptions accompany the development of unit treatment costs described in this section:

- Residue processing operations include all necessary post-processing of secondary TRU/TRM waste streams, including packaging, to meet WIPP WAC. The treatment costs associated with the secondary TRU/TRM wastes from residue operations are excluded from this section.

- Residue processing operations include liquid stabilization of all deactivation TRU/TRM wastes drained from tanks, piping, and appurtenances within the Protected Area plutonium processing buildings. These materials will be processed to meet WIPP WAC and placed long-term storage. The treatment costs associated with the secondary TRU/TRM wastes from residue liquid stabilization operations are excluded from this section.

- No TRU/TRM waste streams will be generated from any future remediation activities conducted at the Site.

Risk Considerations

The following risk considerations have been evaluated during this feasibility study:

- A formal risk assessment of the toxicity characteristics of hazardous and radiological contaminants in the current TRU/TRM waste inventory or future projected generation waste streams should be evaluated. The waste stream groupings presented in this section were discerned by a preliminary evaluation of the chemical and physical characteristics of the wastes.

- Gas generation risks are minimized by the installation of container filters on all TRU/TRM waste containers.

- Loss of contaminant control should have minimal impact to the safe storage configuration of the TRU/TRM wastes under the minimal treatment alternative. This risk is minimized by the integrity of the container and the structural and containment capabilities inherent in the waste storage facility.

- Risk of package corrosion is mitigated by the proposal to pretreat all acid-contaminated or corrosive waste streams prior to placement in long-term storage.

- Risk associated with reactivity from unoxidized pyrophoric metals is minimized by the pretreatment of the TRU/TRM waste forms which, through the application of process knowledge, may be suspect for representing this risk.

Available Technologies

The treatment option proposed for minimal treatment of the current inventory proposes the use of a small scale immobilization (neutralization/cementation) system and oxidation system for minimizing the hazardous components of the characteristic wastes and fluid waste groups. Several of the TRU/TRM waste streams are known to contain some portion of liquids or acid-contaminated solids which must be neutralized and immobilized to mitigate possible safety risks. The second technology application to be implemented for several small volume process residuals (i.e., Mg oxide crucibles, molten salts, sand, slag and crucibles) is oxidation.
Some of the TRU wastes contain classified materials including classified shapes, tooling, and scrap materials. Although these materials will require no specific treatment prior to long-term storage, it will be necessary to maintain segregation of these wastes from the remaining TRU/TRM waste inventory while in long term storage. These wastes will continue to be managed as classified secret restricted data materials and will be stored in a controlled vault in the TRU Waste Storage Facility.

Cost and Schedule

Much of the TRU/TRM wastes generated during future decommissioning, demolition, residue processing, and routine operations is expected to be categorized as meeting the criteria for the Stable Waste group. These wastes are expected to include structural metals, glass, plastics, soil, and debris, which after periodic assay and RTR processing, could be stored without further treatment in long-term storage. A portion of the routine operations TRU/TRM wastes, presently estimated at no more than 20 percent of the total, are likely candidates for treatment in the pilot scale immobilization and oxidation systems previously described for the current inventory. Cost information associated with treatment of inventory and projected generation TRU/TRM wastes is summarized in Subsection 4.11.

Option 2: Full Treatment of TRU/TRM Wastes to Meet WIPP WAC

This option involves treatment of current and future generation to achieve full WIPP WAC compliance to guarantee availability for shipment as resources allow.

Table B-7 lists all current Rocky Flats TRM wastes alphabetically and includes the waste form group description, the IDCs which are collected under the waste group description, and the proposed treatment by IDC for those waste form group subpopulations which do not meet WIPP WAC and TRAMPAC requirements.

- Risk Considerations of Option 2

  Risk considerations include those previously described under Option 1 minimal treatment. The main purpose for considering this option revolves around the ability to ship to WIPP as soon as possible, as opposed to long-term storage.

- Available Technologies

Based on current waste characterization information and current WIPP WAC, an analysis concluded that four treatment or processing methods are required to prepare the uncertifiable portions of Rocky Flats TRU and TRM waste for disposal at WIPP. These methods will most likely involve some form of repackaging, immobilization, neutralization, and oxidation. Most of the wastes requiring neutralization and oxidation will also require immobilization or repackaging.

Table B-7 presents the specific processing or treatment methods required for the uncertifiable portion of each TRM waste stream as well as the proposed treatment methods which address a specific requirement of WIPP WAC or TRAMPAC that is not satisfied by the waste streams in their present form. A description of treatment methods and corresponding WIPP WAC or TRAMPAC requirements is provided in the following subsections. Approximately forty-three percent of the TRM waste volume and fifty-four percent of the TRU waste volume at Rocky Flats currently meet WIPP WAC and TRAMPAC.

- Test and Possible Repackage

Analytical testing will be required for a considerable portion of Rocky Flats TRU and TRM (typical) waste (approximately 40 percent). There is some question as to whether these containers of waste will meet the gas-generation requirements of TRAMPAC. Testing is currently being conducted to establish that these requirements will be met.

- Immobilization/Stabilization

To meet the particulate content and free liquid requirements of WIPP WAC, immobilization is necessary for some waste streams. Particulate waste materials must be immobilized if greater than 1 weight percent of the waste matrix in each package is in the form of particles less than 10 microns in diameter or if greater than 15 weight percent is in the form of particles less than 200 microns in diameter. Free liquids may not be present in payload containers. Approximately 14 percent of inventoried TRM waste and 6 percent of inventoried TRU waste requires immobilization.

- Neutralization and Oxidation

Neutralization and oxidation are necessary to treat wastes that exhibit RCRA characteristics. TRU-contaminated corrosive, reactive, and ignitable materials must be treated to remove the hazardous characteristic. Additionally, WIPP WAC have limits on the amount of PCBs allowed in each container. A total of 15 percent of inventoried TRU and TRM waste requires neutralization and 8 percent requires oxidation. The waste forms requiring these treatments will require additional treatment (immobilization or repackaging) prior to shipment to WIPP.

Two options are being considered for TRU and TRM wastes requiring treatment. The first option being considered assumes that the wastes will be treated by a proposed capital project TRM waste treatment system. This treatment system will consist of the following treatment methods: repackaging, neutralization, oxidation, and immobilization. This treatment system is specifically designed to prepare a final waste form to meet WAC and TRAMPAC for shipment to WIPP in accordance with DOE and DOT requirements. A possible side effect of this treatment is that the waste forms may be LDR compliant. The waste forms currently planned for treatment in the TRM treatment system are listed below. In many cases, only a portion of a listed waste form will require treatment.

Table B-7
TRM Waste Treatment Summary

Waste Form	Treatment Necessary for WAC or TRAMPAC Compliance	Proposed Treatment for LDR Compliance
Aqueous Sludge	Possibly Repackage for TRAMPAC	Deactivation
	Possibly Repackage for TRAMPAC	Neutralization
	Possibly Repackage for TRAMPAC	Immobilization
	Repackage for TRAMPAC	
	Neutralization, Repackage for TRAMPAC	
	Neutralization, Oxidation, Repackage for TRAMPAC	
Cemented Filters	Neutralize for WAC	Organic Destruction
Combustibles	Repackage for TRAMPAC	Organic Destruction
	Repackage for TRAMPAC	Immobilization
	Repackage for TRAMPAC	
	Possibly Repackage for TRAMPAC	
	Possibly Repackage for TRAMPAC	
	Repackage for TRAMPAC	
	Oxidation, Repackage for TRAMPAC	
	Repackage for TRAMPAC	
	Repackage for TRAMPAC	
Excess Chemicals	Neutralization, Oxidation, Immobilization	Organic Destruction
Filters and Media	Neutralization, Immobilization	Organic Destruction
	Neutralization, Immobilization	Immobilization
	Repackage for TRAMPAC	
	Oxidation, Repackage for TRAMPAC	
	No Treatment Necessary	
	Repackage for TRAMPAC	
Firebrick	Repackage for TRAMPAC	Organic Destruction
	Immobilize for WAC	Immobilization
Glass	No Treatment Necessary	Organic Destruction
	No Treatment Necessary	Immobilization
	Possibly Repackage for TRAMPAC	

Table B-7
TRM Waste Treatment Summary (cont)

Waste Form	Treatment Necessary for WAC or TRAMPAC Compliance	Proposed Treatment for LDR Compliance
Ground Glass	Immobilization	Organic Destruction
	Immobilization	Immobilization
Heavy Metal (Non-SS)	Repackage for TRAMPAC	Immobilization
Incinerator Ash	Immobilize for WAC	Organic Destruction
	Immobilize for WAC	Immobilization
Insulation	No Treatment Necessary	Organic Destruction Immobilization
Lead	No Treatment Necessary	Immobilization
Leaded Gloves	Oxidation, Repackage for TRAMPAC	Immobilization
Leaded Gloves - Acid Contaminated	Neutralize for WAC	Immobilization
Metal	Neutralization, Repackage for TRAMPAC	Organic Destruction Immobilization
Mg Oxide Crucibles	Oxidation, Repackage for TRAMPAC, Immobilization	Organic Destruction
Misc Pu Recovery By-Products	Oxidation, Repackage for TRAMPAC	Immobilization
	Oxidation, Repackage for TRAMPAC	Immobilization
	Neutralization, Oxidation, Repackage for TRAMPAC	
	Oxidation, Repackage for TRAMPAC	
Misc. Liquids	Neutralization, Immobilization	Organic Destruction
	Neutralization, Immobilization	
Organics - Discard Level	Immobilization	Organic Destruction
Particulate Sludge	Neutralization, Immobilization	Organic Destruction
	Neutralization, Immobilization	Immobilization
	Immobilize for WAC	
	Possibly Immobilize	
PCB Solids - Combustibles	Repackage for TRAMPAC, Oxidation	Organic Destruction

Table B-7
TRM Waste Treatment Summary (cont)

Waste Form	Treatment Necessary for WAC or TRAMPAC Compliance	Proposed Treatment for LDR Compliance
Sand, Slag, and Crucible	Oxidation, Immobilization	Organic Destruction
	Oxidation, Immobilization	Immobilization
	Immobilize for WAC	
Soil and Cleanup Debris	Repackage for TRAMPAC	Organic Destruction Immobilization
Solidified Organics	Repackage for TRAMPAC	Organic Destruction Immobilization
Solidified Process Solids	No Treatment Necessary	Immobilization
Supercompacted Combustibles	No Treatment Necessary	Organic Destruction Immobilization
Used Absorbents	No Treatment Necessary	Organic Destruction
Wastewater	Neutralization, Immobilization	Water Treatment
Wet Slurry	Neutralization, Immobilization	Immobilization
Misc. Liquids	Neutralization, Immobilization	Organic Destruction
	Neutralization, Immobilization	
Organics - Discard Level	Immobilization	Organic Destruction
Particulate Sludge	Neutralization, Immobilization	Organic Destruction
	Neutralization, Immobilization	Immobilization
	Immobilize for WAC	
	Possibly Immobilize	
PCB Solids - Combustibles	Repackage for TRAMPAC, Oxidation	Organic Destruction
Sand, Slag, and Crucible	Oxidation, Immobilization	Organic Destruction
	Oxidation, Immobilization	Immobilization
	Immobilize for WAC	
Soil and Cleanup Debris	Repackage for TRAMPAC	Organic Destruction Immobilization

Table B-7
TRM Waste Treatment Summary (continued)

Waste Form	Treatment Necessary for WAC or TRAMPAC Compliance	Proposed Treatment for LDR Compliance
Solidified Organics	Repackage for TRAMPAC	Organic Destruction Immobilization
Solidified Process Solids	No Treatment Necessary	Immobilization
Supercompacted Combustibles	No Treatment Necessary	Organic Destruction Immobilization
Used Absorbents	No Treatment Necessary	Organic Destruction
Wastewater	Neutralization, Immobilization	Water Treatment
Wet Slurry	Neutralization, Immobilization	Immobilization

REPACKAGING

Aqueous Sludge
Combustibles
Filters and Media
Firebrick
Glass
Heavy Metal
Leaded Gloves
Metal
Mg Oxide Crucibles
Misc. Pu Recovery By-Products
PCB Solids - Combustibles
Soil and Cleanup Debris
Solidified Organics

NEUTRALIZATION

Aqueous Sludge
Cemented Filters
Excess Chemicals
Filters and Media
Leaded Gloves - Acid Contaminated Metal
Misc. Pu Recovery By-Products
Misc. Liquids
Particulate Sludge
Wet Slurry
Filters and Media
Leaded Gloves
Mg Oxide Crucibles
Misc. Pu Recovery By-Products
PCB Solids - Combustibles
Sand, Slag, and Crucible

OXIDATION

Aqueous Sludge
Combustibles
Excess Chemicals

IMMOBILIZATION

Excess Chemicals
Filters and Media
Firebrick
Ground Glass
Incinerator Ash
Mg Oxide Crucibles
Misc. Liquid
Organics - Discard Level
Particulate Sludge
Sand, Slag, and Crucible
Wet Slurry

The second option being considered is the potential for treatment of some or all TRM wastes in the conceptual waste treatment systems identified in the Rocky Flats Proposed Site Treatment Plan for LLMW. Although exploration of this option has only recently been initiated, early evaluations indicate that several TRM wastes can be treated in the LLMW systems. The results of this preliminary evaluation are summarized in Table B-8.

Although many of the matrices and chemical constituents of TRM waste match those of their LLMW equivalents, the elevated levels of radioactivity in TRM waste present unique challenges to treatment system design. Specific issues, such as criticality concerns,

Table B-8
Candidate TRM Waste Forms For LLMW Systems

TRM	LLMW System*	Required Treatment
Cemented Filter	3	Neutralization
Filters and Media	3	Neutralization/Immobilization
Leaded Gloves - Acid Contaminated	3	Neutralization
Firebrick	2/4B or 3	Immobilization
Incinerator Ash	2/4B or 3	Immobilization
Particulate Sludge	3	Immobilization
Sand, Slag, and Crucible	2/4B or 3	Immobilization
Wet Slurry	2/4B or 3	Immobilization

* See Rocky Flats Proposed Site Treatment Plan for descriptions

worker exposure concerns, and increased source term concerns (with subsequent potential for increased environmental consequences) have a much greater effect on system design when compared with LLMW. Consequently, additional evaluation must be performed to verify the acceptability of the LLMW systems for treatment of TRM waste.

- Cost and Schedule

Estimates for development of the TRM waste treatment system have been prepared in the past to support compliance efforts under the Site Treatment Plan (STP). The costs for the TRM waste treatment are provided in Subsection 4.11. The schedule for the TRM waste treatment system is provided in Table B-9.

Table B-9
Preliminary - TRU/TRM Waste Treatment System Schedule

ACTIVITY TITLE	START	STOP
Conceptual Design	02-Oct-95	13-Feb-97
RCRA Permit	09-Nov-95	02-Mar-98
Work Specific Permit	03-Mar-98	28-Feb-02
Title I Design	15-Feb-96	17-Feb-97
Title II Design	04-Mar-97	02-Mar-98
Construction	03-Mar-98	06-Mar-00
System Start-Up	01-Sep-99	20-Jun-01
Operational Readiness Review	01-Feb-00	01-Jul-02
Systems Operations	02-Jul-02	02-Jul-08

NOTE:

1. Based on 10/2/95 start
2. Based upon 1000 m3/yr. production capacity

LLW/LLMW Onsite Existing Treatment Options

Existing capability for LLW/LLMW treatment at the Site can be categorized into liquid waste capacity and solid waste capacity. These are summarized as follows:

<u>Liquid Waste Processing Capacity</u>

Wastewater and aqueous process wastes are transferred to Building 374 via a system of piping or container transfers: The type of treatment used for each waste form depends on the chemical constituents and amount of residual radioactivity in the waste form to be treated. Aqueous waste is treated in Building 374 with three different processes. Waste forms contaminated with higher levels of radioactivity are treated in a precipitation process, the resultant sludge is solidified, and the clarified water is sent to the evaporator for further treatment. Waste forms contaminated with lower levels of radioactivity are treated in the evaporation process, and the resultant salts are immobilized with cement, which produces the Saltcrete waste form. Acidic wastewater is neutralized and filtered. The resultant sludge is immobilized with cement, and the clarified water is sent to the evaporator.

<u>Solid Waste Processing Capabilities</u>

Several solid waste processing facilities have been used in the past and may be used for waste processing in the future. These facilities are designed to treat waste to accomplish waste volume reduction, packaging of large waste, and repackaging of waste that does not comply with WAC. Such capabilities include (1) the Size Reduction Vault, Building 776, (2) the Waste Balers, Building 776 (neither baler is currently RCRA permitted, and restart of these operations is uncertain), (3) the Advanced Size Reduction Facility, Building 776, and (4) the Supercompaction and Repackaging Facility, Building 776.

For the remainder of LLW/LLMW that can not be treated by existing processing capacity, additional capacity must be developed and installed.

Treatment Requirements

Not all LLW generated at the Site requires treatment. Only the LLW that do not meet disposal facility WAC are treated prior to shipment. Those include LLW contaminated with PCBs, asbestos, or those with a physical form that cannot be shipped without treatment (e.g., they contain free liquids or excessive dispersible fines). Treatment for free liquids consists of evaporation or addition of a suitable absorbent. Dispersable fines can be treated through an immobilization technology (e.g., cementation). The immobilization technologies are described in greater detail later. Treatment for PCBs and asbestos are described by the Toxic Substances Control Act. Specifically, PCBs must be treated by incineration. Since Rocky Flats does not have an operating incinerator, any LLW with PCBs will have to be treated offsite.

LLMW, however, must be treated to meet regulatory standards discussed in Subsection 4.6.1. The type of treatment required depends on the physical characteristics of the waste and the type(s) of regulated hazardous constituents in the waste.

Treatment Options

Option 1: No Treatment to Meet LDR Standards

This option was evaluated from the point of view of being able to save significant expenditures and based on the assumption that existing inventory and future generation currently does, and will continue, to pose minimal risk as stored and generated. Pursuit of this option would also operate under the assumption that existing and future generation wastes would exist in a long-term stable form and that engineered barriers and site characteristics would provide for long-term protection of human health and the environment. Additionally, the current statutory and regulatory framework requires treatment for radioactive mixed wastes and prohibits indefinite storage of mixed waste. As such, a final assumption involved in this analysis is that a modification of the current regulatory framework could be obtained.

Based on initial screening of the existing inventory, it has been determined that a variety of wastes currently exist in a chemical or physical form not amenable to direct disposal. The factors influencing this analysis are discussed in further detail under Option 2. Additionally, there are short-term compliance issues and liabilities with potentially significant consequences associated with the lack of mixed waste treatment.

There are some opportunities to combine wastes with different physical properties (e.g., liquids with solids) to eliminate the liquid component; however, the technical issues (physical and chemical waste form) coupled with the regulatory issues, create a difficult set of circumstances to overcome. Therefore, this alternative is not viable at present.

While this alternative is the least expensive of all treatment options, it also provides the lowest relative degree of protection, and the highest level of difficulty to ultimately implement.

Option 2: Minimal Treatment of LLMW to LDR

Minimal treatment is defined as treating to LDR requirements, only those high-risk wastes that represent a significant health hazard to the public if disposed untreated. Based on this definition, Table B-10 shows a breakdown of wastes currently in inventory by risk category. A similar distribution of wastes is assumed for future generation. Three options will be considered: (1) treating only the high-risk wastes; (2) treating the high and medium-high risk wastes; and (3) treating the high, medium-high, and medium-risk wastes.

Table B-10
LLM Waste Inventory By Risk Category

WASTE FORM	PHYSICAL FORM	VOLUME (m3)	RISK CATEGORY	Percentage of Total	Treatment Technology
Acids	liquid	8.23	High		poly micro
Analytical Lab Solutions	liquid	4.44	High		cement
Beryllium Fines	particulate	3.15	High		poly macro
Cyanides	liquid	0.44	High		UV dest
Excess Chem. - Non-Lab	liquid	1.68	High		offsite
Excess Chem. - Non-Lab. w/ Hg	liquid	3	High		offsite
Excess Chem. - Organometallic	liquid	23.92	High		CCO
FBI Oil	liquid	41.63	High		CCO
Misc. Liquids	liquid	1.94	High		CCO
Organics - Disc. Level	liquid	48.22	High		CCO
Paints	liquid	1.15	High		CCO
Particulate Sludge	semi-solid	87.6	High		SCDE & macro
PCB Liquids	liquid	39.01	High		CCO
Roaster Oxide	particulate	66.36	High		LDR comp
Silver Nitrate	liquid	1.05	High		AGNO3 Dest
Solar Pond Sludge	semi-solid	1086	High		cement
Solar Pond Water	liquid	293.1	High		existing
Used Absorbent	absorbed liquid	0.29	High		SCDE & Macro
Wastewater	liquid	169.8	High		existing
Wet Slurry	semi-solid	56.2	High		cement
		1937.21	**High Total**	**14.29%**	
Glass	solid	2.52	Low		poly macro
Glovebox Parts with Lead	solid	0.42	Low		poly macro
Heavy Metal	solid	1.13	Low		poly macro
Lead	solid	34.69	Low		poly macro
Leaded Gloves	solid	3.57	Low		poly macro
Leaded Gloves - Acid Cont.	solid	0.21	Low		poly macro
Miscellaneous Pu Recovery Byproducts	solid	0.21	Low		poly macro
Turnings	solid	0.42	Low		poly macro
		43.17	**Low Total**	**0.32%**	
Cemented Composite Chips	solid	95.4	Medium		SCDE
Cemented Filters	solid	12.39	Medium		SCDE
Excess Chem. - Non-Lab	solid	0.32	Medium		offsite
Excess Chem. - Non-Lab. w/ Hg	solid	1.92	Medium		offsite
Excess Chem. - Organometallic	solid	16.54	Medium		offsite
Filters and Media	solid	2.52	Medium		SCDE & macro
Ground Glass	solid	10.29	Medium		poly micro
Nitrate Salts	solid	0	Medium		poly micro
PCB Solids - Combustibles	solid	10.81	Medium		CCO
PCB Solids - Metal	solid	0.52	Medium		offsite
Pondcrete	solid/semi-solid	5708.07	Medium		cement
Saltcrete	solid/semi-solid	3451.45	Medium		poly micro
		9310.23	**Medium Total**	**68.67%**	
Combustibles	solid	1226.94	Medium High		SCDE & macro
Incinerator Ash	solid/particulate	10.92	Medium High		poly micro
Insulation	solid	2.94	Medium High		SCDE & macro
Metal	solid	163.13	Medium High		SCDE & macro
Soil and Cleanup Debris	solid	406.05	Medium High		SCDE & macro
Solidified Bypass Sludge	solid/ semi-solid	457.38	Medium High		cement
Solidified Organics	solid/semi-solid	0.42	Medium High		CCO
		2267.78	**Medium High Total**	**16.73%**	
		13558.39	**Grand Total**	**100.00%**	

"HIGH" Risk based on mobile, leachable, degradable physical/chemical form
"MEDIUM HIGH" Risk based on toxicity of chemical constituents; multiple constituents
"MEDIUM" Risk based on toxicity of chemical constituents; single constituents
"LOW" Risk based on relative inertness of matrix and constituents

Key to treatment technology abbreviations in Table B-10

AGNO3 dest: silver nitrate destruction
CCO: catalytic chemical oxidation
Cement: cementation
LTTD: low temperature thermal desorption
poly macro: polymer macroencapsulation
poly micro: polymer microencapsulation
SCDE: supercritical carbon dioxide extraction

Notes to Table B-10:

Whenever a surface organic contaminant removal technology is used (SCDE, LTTD), the original matrix after treatment will require some form of immobilization (cement, polymer encapsulation) to stabilize leachable metals. When the CCO process is used, the secondary waste generated from the destruction technology will require immobilization (cement or polymer encapsulation)

For the surface organic contaminant removal technologies, both LTTD and SCDE have shown favorable results for waste forms tested to date. In FY96, comparative testing is scheduled to determine if one of the technologies is more versatile or has advantages for treating the Rocky Flats' wastes.

Risk Considerations

As mentioned above in the Requirements Subsection 4.6.1, the main considerations in evaluation of treatment options are based on a variety of qualitative and quantitative factors. Complete application of these factors in a quantitative manner on existing inventory and future generation requires a significantly greater detail regarding characterization information on current inventory, a much better understanding of the predictions surrounding future generated waste, and significantly increased levels of time and funding for performing quantitative risk assessments.

The existing inventory was evaluated based on physical form (solid, liquid, semisolid, particulate, and absorbed liquid) and chemical characteristic (chemical constituents, concentrations,and toxicity. HIGH risk wastes were declared so based on the presence of mobile, leachable, and/or degradable physical and chemical forms. LOW risk wastes are categorized based on the general inertness of the physical matrix and chemical constituents. The balance of the wastes were to be categorized into a MEDIUM risk; however, review of available data indicated a finer degree of categorization could be performed. Therefore, a MEDIUM HIGH risk waste category was established which lists wastes that are less mobile and degradable in the environment, but still contain multiple high risk chemical constituents that possess some toxicity characteristic in the environment. MEDIUM risk wastes are similarly based on the potential for exhibiting certain toxicity characteristics, but contain only singular high-risk chemical constituents or multiple low-risk chemical constituents.

The relevance of this discussion becomes apparent in the evaluation of the Minimal Treatment Alternative below. Whereas full LDR treatment may provide the highest degree of protection from an environmental and human health and safety view, it also requires the largest expenditure of funds to accomplish. In comparison, the Minimal Treatment alternative provides an alternative in which the highest risk wastes can be treated to provide a significant margin of environmental safety while treatment of the lower risk wastes can be deferred (as funding becomes available) or eliminated (as regulatory changes occur). The details of this alternative are presented below.

- Available Technologies

Treatability groups for the LLMW inventory were developed on the basis of three waste characteristics: radiological properties, bulk physical/chemical matrix, and hazardous RCRA-regulated contaminants. Within each waste type there may be subpopulations having different regulated contaminants. Based on available characterization data, each subpopulation was examined and assigned to a treatment technology based on BDAT treatments and the test data resulting from Rocky Flats technology development efforts associated with each subpopulation's EPA codes. Each unique combination of treatment technologies has been defined as a treatability group.

Technologies needed to treat the Site's HIGH risk wastes are described in the following sections. The HIGH risk wastes will require technologies for immobilization, organic destruction and/or organic removal technologies to address solvent contaminants. Brief descriptions of the technologies available now at the Site that can treat these wastes follow. Additional details of the technologies can be found in the Site Treatment Plan.

Waste immobilization is the primary treatment envisioned for many of the HIGH risk wastes. In addition, it is required as the final component for other treatment technologies to meet both LDR standards and disposal site WAC. In other words, the intermediate waste forms or by-product wastes produced by oxidation, surface organic contaminant removal, and other technologies may require immobilization before final disposal. The immobilization technologies currently under consideration for those wastes are described briefly below.

- <u>Cementation</u> is the most widely used immobilization technology. In this process, Portland or other cements, water, and waste are mixed and cast into various containers to harden. The strength and leach resistance of the final waste form vary widely depending on the final composition and numerous processing variables.

- <u>Polymer Solidification</u> is divided into microencapsulation or macroencapsulation. With microencapsulation, dried waste is mixed and extruded with the polymer using a commercially available polymer extruder. Macroencapsulation uses either thermoplastic or thermosetting polymers. In the first case, thermoplastic polymer is extruded around and over debris type wastes confined in a basket inside a drum. With thermosetting (epoxy type) polymers, the epoxy is mixed separately from the waste and poured around and over debris type wastes confined in a basket inside a drum. In all cases, the final product is a solid waste form that is highly leach resistant.

The LDR components of some LLMW forms can be treated by thermal processes. In response to significant public concern with thermal treatment, nonthermal treatments are being developed as alternatives. These are nonthermal (<350°C) treatment technologies that destroy hazardous constituents by oxidation using chemical oxidizing agents, hydroxyl ions, or free radicals. The metals and radionuclides are passed through into a secondary waste that must be subsequently immobilized. For the HIGH risk wastes, only catalytic chemical oxidation (CCO) is being considered for onsite treatment.

- <u>Catalytic Chemical Oxidation (CCO)</u>, also referred to as the DETOX™ process, is an effective treatment for both solid and liquid combustible wastes. By using both an iron catalyst and co-catalysts, combined with a strong acid solution, slightly elevated operating temperatures (200°C), and moderate pressure, wastes are chemically degraded. Wet chemical oxidation tolerates varying waste forms and material size and can dissolve and concentrate most metals.

Separation technologies treat mixed waste by removal of the hazardous component to a concentration below the treatment standard. The hazardous contaminant is either collected for management as a hazardous waste or for destruction. Separation technologies being considered for treatment of the HIGH risk wastes include low-temperature thermal desorption and supercritical carbon dioxide (CO_2) extraction.

- Supercritical Carbon Dioxide Extraction is based on the powerful dissolving qualities of gases heated above and compressed beyond their critical temperature and pressure. In this state, CO_2 exists as a single fluid phase, with the low viscosity of a gas and the solvent properties of a liquid. These two qualities permit the supercritical fluid to pass easily through waste materials, dissolving and extracting large amounts of organic compounds in the process.

The Site already has considerable capacity for pilot scale testing of mixed wastes. The technologies currently available at the Site include: a pilot-scale polymer extruder for microencapsulating wastes; full-scale (55-gallon drum) macroencapsulation capability using thermoset polymers; a pilot-scale polymer extruder for macroencapsulating debris type wastes with thermoplastic polymers; a supercritical carbon dioxide extraction system; small-scale cyanide destruction, mercury stripping, microwave vitrification, and UV oxidation systems; and pilot-scale cementation capability. In addition, designs for a pilot-scale catalytic chemical oxidation system are complete.

Considering the small volume of HIGH risk wastes in inventory requiring treatment, large-scale treatment systems as described for the capital projects in the Site Treatment Plan are not necessary to process the wastes listed. Instead, existing technologies currently being tested under treatability study exemptions and RD&D permits could be utilized to treat all of the HIGH risk wastes. In addition, a portion of the HIGH risk wastes may be consumed during the TSE and RD&D testing and made LDR compliant. If this option is chosen, the costs of designing, procuring, and installing larger capital project treatment systems could be avoided.

If treating the additional wastes in the MEDIUM-HIGH and MEDIUM risk categories is required, the same alternative as described above for treating the HIGH risk wastes will apply. The same technologies will be required and the volume of waste to be treated is still small enough that construction of the capital treatment systems will not be required. However, the cost and the time required to treat the inventory will increase as the inventory increases.

Cost and Schedule

For this option, the estimated costs required to treat the HIGH risk LLMW are shown in Subsection 4.11. These costs were based on the following assumptions:

An onsite disposal and storage facility will have similar WAC to that in place for other existing DOE disposal facilities (e.g., <100 nCi/g for LLMW, no free liquids.)

The wastes in the risk category in Table B-7 above currently identified for offsite treatment will be treated onsite utilizing available treatment systems or a small catalytic chemical oxidation system where organic destruction is required.

Saltcrete that is LDR compliant according to the most recent characterization data will be shipped to Envirocare. Only the subpopulation that is not LDR compliant (estimated to be 14 percent or 483.2 m^3) will require treatment.

Nitrate salts generated during the ASAP period will be treated as they are generated in Building 374.

The estimated volumes of waste expected to be generated in each of the ASAP alternatives are not broken down by risk type; therefore, the quantity of HIGH risk waste expected to be generated is not available. If the conservative estimate discussed earlier in Risk Considerations is used, then the volume of HIGH risk waste generated during the ASAP will be approximately 15 percent (conservatively) of the total LLMW generated. If the Medium High Risk waste is added, this percentage increases to about 30 percent.

Option 3: Full Treatment of LLMW to LDR

The Site Treatment Plan outlines the path for full compliance with LDR for all LLMW generated or stored at the Site, regardless of risk category. Cost estimates to treat the entire LLMW inventory were developed for the STP and all of the capital project treatment systems identified in the STP will be required to address the volumes of LLMW generated in the ASAP. The major factor influencing the cost for this option will be the amount of LLMW generated from D&D, ER, and other sources at the Site during execution of the ASAP.

- Risk Considerations

The evaluation of full LDR treatment is based on the assumption that the LDR treatment standards have, as a basis, an element of risk assessment associated with them. This is the path that becomes mandatory absent any change to existing statutory and regulatory treatment requirements.

The *intent* of the LDR regulations is to minimize risk posed by disposal of untreated waste; the regulations attempt to achieve this intent using actual quantitative treatment standards based on a concept called BDAT, which includes an overall review to ensure that such standards adequately protect human health and the environment. The relevance in this is that the current treatment standards are based on concentrations that are currently achievable with conventional technologies. As a result, they may be more restrictive than is absolutely necessary for adequate protection. This acknowledgment was made by EPA in promulgation of the "First Third" rule. It is this "Best Demonstrated Available" technology basis for determining treatment standards that also caused the recognition that there were perhaps other alternatives equally as protective of human health and the environment. Such recognition is made at a national level through the allowance of national and case-by-case capacity extensions (to the effective date for treatment standard implementation), treatability variances, and no migration variances.

In the case of national and case-by-case capacity extensions, there frequently is recognition that the best technologies may not be available in the short term. In the case of treatability variances, petitioners may apply for equivalency demonstrations in which a proposed alternative treatment process is unable to meet the established treatment standards, but can be demonstrated to provide an equivalent degree of risk minimization as the treatment standards do. Finally, in the case of no migration variances, there is recognition that environmental factors of the disposal facility can also minimize potential of migration of wastes and thus can provide the same degree of protection as treatment would.

Implementation of this option involves the highest cost of the three options discussed, but provides the greatest relative degree of protection based on maximum removal and/or destruction of hazardous constituents. It is also the easiest to implement based on limited regulatory and political impediments.

- Available Technologies

The technologies required to treat the entire inventory of LLW/LLMW generated during the ASAP alternative selected include those described in Option 2 (Minimal Treatment to LDR) and those additional technologies described below.

Low-Temperature Thermal Desorption technologies consist of processes that vaporize volatile and semivolatile organics from various substrates. The processes are planned and designed to avoid combustion of the contaminants in the primary unit. After desorption, the volatilized organics may be subsequently treated in an afterburner or condensed for reuse or destruction.

Ultraviolet (UV) Oxidation uses hydrogen peroxide as an oxidizing agent and UV radiation to break down the hydrogen peroxide to reagents that chemically convert organic materials into carbon dioxide and water. This technology operates at near-ambient conditions and generates a minimal amount of secondary waste but operates at a lower destruction rate than other technologies.

Alkaline Chlorination, or Electrochemical Chlorination, will be used for treatment of cyanides. Alkaline chlorination employs strong chemical oxidizers at ambient or slightly elevated temperatures to destroy organic liquids. An electrolytic cell is used to destroy cyanide plating bath solutions. The cell uses an electrochemical chlorination reaction to reduce the cyanide concentration in the solution to levels that will allow final treatment of the solution by the Building 374 liquid waste treatment facility.

Mercury Stripping will use thermal desorption at approximately 300°C and mercury capture media (such as granulated carbon) to strip mercury from waste such as fluorescent light bulbs. (The EPA is expected to promulgate a Final Rule in CY95 regarding the treatment of fluorescent bulbs.)

Microwave Melters incorporate inorganic and metallic constituents in a glass matrix using microwave energy to melt the waste. Dry wastes and glass frit are semi-continuously fed into the drum, which is attached to a microwave generator. The drum becomes the resonant cavity, and temperatures between 1,000°C and 1,200°C are generated. Decomposition gases and moisture are driven off, and metallic and inorganic substances are trapped in the glass matrix. When the drum is removed from the chamber, the waste is in a form appropriate for shipment and disposal.

The size of the treatment systems required will have to be adjusted to meet the ASAP schedules and available budget. Essentially, the treatment systems described in the Site Treatment Plan have been established as the baseline. The LLMW Miscellaneous Waste Forms Immobilization Treatment System includes the following technologies: neutralization, polymer micro- and macroencapsulation, cementation, chemical precipitation, cyanide destruction, and electrochemical stripping. The LLMW Surface Organic Contaminant Removal/Lead Decontamination System includes the following technologies: low temperature thermal desorption, supercritical CO_2 extraction, mercury stripping, catalytic chemical oxidation, and chemical wash/cyanide stripping. The LLMW Building 374/774 Treatment System uses microwave solidification. The LLMW Pondcrete/Pond Sludge Remix Treatment System will use immobilization technologies, most likely cementation. A more detailed description of the treatment systems can be found in the Site Treatment Plan.

- Cost and Schedule

Cost estimates for treatment are provided in Subsection 4.11. An average cost for treatment is used based on the cost estimates developed for the STP capital treatment systems previously mentioned. This treatment cost is $10,000/m^3$ of waste and is a conservative estimate that includes amortization of the costs of a capital project treatment system over the expected life cycle of the system.

In Land Disposal Restrictions for Newly Listed Wastes and Hazardous Debris, 40 CFR Section 268.45 (Debris Rule), EPA promulgated treatment, certification, notification, and disposal requirements for waste that meets the EPA definition of hazardous debris. To qualify as debris, a waste form must (among other things) be a RCRA-defined solid waste, be in a solid physical form, meet minimum particle-size criteria, and not be either a process residual or an intact container. Wastes that already require specific treatment standards are also excluded from treatment under the Debris Rule.

EPA developed treatment standards for hazardous debris in the form of technology-specific treatment requirements for two primary reasons: (1) to handle the difficulty in analytically characterizing debris waste and (2) to remain consistent with the change to performance-based treatment standards from concentration-based standards. In addition, certain restrictions on contaminants and performance standards were developed to ensure that the most effective technology is used to treat debris waste forms. The following treatment strategies are specified Debris Rule technologies:

- Physical extraction
- Chemical extraction
- Thermal extraction
- Biological destruction
- Chemical destruction
- Thermal destruction
- Immobilization

There are significant advantages for a generator of hazardous debris to use the technology-specific standards defined in the Debris Rule. First, it provides a mechanism for dealing with nonhomogeneous wastes by simplifying most of the analytical characterization requirements. The waste must still be characterized to ensure its classification as debris. Second, the rule provides for disposal of certain treated debris waste forms in a RCRA Subtitle D landfill. Therefore, wastes that have been treated with an extraction or destruction technology and do not exhibit a characteristic are no longer considered hazardous waste and may be disposed as nonhazardous. For treatment using immobilization technologies, the treated debris waste form must still be managed as a hazardous waste because immobilization does not remove listed hazardous contaminants. However, debris waste forms immobilized in this manner would then be considered LDR compliant but must still be disposed in a RCRA Subtitle C facility.

The Debris Rule has the potential to impact overall LDR compliance for a variety of waste forms at Rocky Flats. After conducting preliminary assessment of the applicability of the Debris Rule to Rocky Flats waste forms, the following LLMW may qualify as hazardous debris:

- Beryllium Fines
- Cemented Filters
- Combustibles
- Filters and Media
- Glass
- Glovebox Parts with Lead
- Ground Glass
- Heavy Metal (Non-SS)
- Insulation
- Leaded Gloves
- Leaded Gloves – Acid Contaminated
- Metal
- Polychlorinated Biphenyl (PCB) Combustibles
- PCB Non-Combustibles
- Soil and Cleanup Debris

Initial estimates suggest that approximately 20 percent of Rocky Flats currently stored LLMW (excluding Pondcrete, Saltcrete, and Solar Pond Water) may qualify as hazardous debris. Debris Rule strategies will be pursued for all candidate wastes.

Hazardous/Other Regulated Waste Treatment

Although onsite treatment is an available option, there is sufficient capacity available through offsite commercial treatment, storage, and disposal firms at a competitive price to eliminate onsite treatment as a topic of discussion. Unlike treatment of radioactive and radioactive mixed waste, treatment of hazardous and other regulated wastes does not require significant adaptation of existing processes, and frequently, the wastes can be reused or treated for beneficial resource recovery, thereby eliminating additional burdens placed on the environment, and resulting in significant cost savings over onsite treatment.

4.6.3 Offsite Treatment

Rocky Flats has conducted an extensive evaluation to identify treatment capability at other DOE facilities or commercial facilities with potential capacity for Rocky Flats wastes. The actual use of an offsite facility depends on a variety of factors, including facility availability for Rocky Flats waste, transportation, the conclusions of a NEPA assessment, and others. Rocky Flats recognizes that commitments for use of offsite facilities must be identified to ensure that adequate plans are available for mixed wastes intended for offsite treatment and to ensure that State equity issues can be adequately resolved prior to commitment of resources.

The actual use of an offsite facility depends on a variety of factors, including facility availability for Rocky Flats waste, transportation, the conclusions of a NEPA assessment, and others. Commitments for use of offsite facilities must be identified to ensure that adequate plans are available for mixed wastes intended for offsite treatment. The types of commitments required for offsite treatment of Rocky Flats mixed waste are as follows:

- Pretreatment characterization
- Identify packaging/shipping/WAC requirements
- Negotiate agreements with Site
- Obtain NEPA documentation
- Receive approval to ship
- Repackage waste to meet transportation and WAC requirements
- Ship to offsite treatment facility
- Receipt characterization
- Treatment operations
- Post-treatment characterization
- Return treated waste to originating site
- Transport to disposal site

Existing information and data on potential TSD facilities for Rocky Flats wastes are supplemented by onsite facility assessments; interviews with facility engineers, management, operators, and regulatory specialists; and the collection of all relevant facility documentation (e.g., WAC), facility permits, and packaging and transportation requirements. This evaluation also identifies applicable DOT, state, and DOE regulations affecting TSD, packaging, and transportation for management at offsite TSD facilities.

Specific technical and regulatory considerations under evaluation include the following:

1. Whether the waste is in a suitable form for shipping, or whether it can be converted into a shippable form with present plant processes to comply with DOE and DOT requirements
2. Whether the waste meets WAC for the offsite facility
3. Whether the facility can treat, store, or dispose Rocky Flats waste in a manner consistent with DOE orders
4. Whether the treatment capacity is adequate for Rocky Flats wastes
5. Whether the facility's RCRA permit allows, or can be modified for, acceptance of Rocky Flats waste forms
6. Whether the TSD facility's RCRA waste codes match the LLMW RCRA waste codes
7. Whether there are other regulatory criteria that would preclude transportation of Rocky Flats waste to a selected TSD facility
8. Whether other state and federal permits allow TSD of Rocky Flats waste forms
9. Whether state agency or governor issued orders, rules, or memoranda preclude TSD of a candidate Rocky Flats waste form at a facility within that state
10. Whether managers of sites identified as technical matches agree that technical capability exists to treat Rocky Flats waste forms

Based on the desire to minimize overall impacts of the waste management process on the future activities described elsewhere within this document, it may become prudent to consider the offsite shipment of treated waste for disposal (to minimize the need for additional storage facilities), and to consider offsite shipment of waste for treatment prior to disposal (to minimize the need for additional storage facilities and to minimize the expenditure for funds for onsite treatment to minimize risk). As a result, offsite treatment options are described below.

- TRU/TRM Treatment Offsite

  Based on national policy issues, lack of capacity for treatment, transportation concerns, and cost issues associated with transport to treatment, transport back to Rocky Flats for storage, and eventual transport to WIPP, the offsite treatment of TRU/TRM waste is currently not evaluated as an option.

- LLW/LLMW Treatment Offsite

  Rocky Flats has conducted an extensive evaluation to identify treatment capability at other DOE facilities as well as commercial facilities with potential applicability to Rocky Flats mixed wastes. These assessments have identified facilities throughout the DOE complex and the commercial sector with some potential for treating Rocky Flats LLMW.

  - Inventory

    The STP configuration proposed a treatment baseline with eight LLMW forms assigned for offsite treatment. These waste forms are listed in Table B-11.

- Risk

In addition to the risk considerations described earlier under the onsite treatment option, there are added concerns regarding the interstate transport of radioactive and mixed wastes to out-of-state entities.

- Available Technologies

Since publication of the STP in April 1995, activities oriented towards evaluating other offsite TSD alternatives for Rocky Flats mixed waste treatment have found that other treatment options within the DOE complex have potentially become more viable. A synopsis of these evaluations is presented below.

Table B-11

LLMW For Offsite Treatment

Waste Form	MWR#	OPTION
Excess Chemicals - Non-Lab Packs	RF-W086	Advanced Mixed Waste Treatment Facility (AWMTF) - Thermal (Idaho National Engineering Lab)
Excess Chemicals - Non-Lab Packs w/Mercury	RF-W085	AWMTF
Excess Chemicals - Organometallic Lab Packs	RF-W083	AWMTF
FBI Oil	RF-W015	Diversified Scientific Services, Inc. (DSSI) - Thermal (Kingston, Tennessee)
Miscellaneous Liquids	RF-W049	AWMTF
Organics - Discard Level	RF-W046	DSSI - Thermal
Paints	RF-W027	AWMTF
PCB Liquids	RF-W017	AWMTF

Consolidated Incineration Facility

The Consolidated Incineration Facility (CIF) at the Savannah River Site (SRS) was originally considered and rejected as an option for treatment of LLMW from Rocky Flats based upon a radioactivity limit of 10 nCi/g of waste. This limit, though, has recently been raised to 58 nCi/g of waste with a limit of 50 nCi/g of waste for alpha contamination. This presents an improved potential opportunity for treatment of LLMW from Rocky Flats.

Rocky Flats is examining the technical feasibility of such treatment at SRS by comparing known waste characteristics for Rocky Flats waste with the WAC for the CIF.

TSCA Incinerator

The TSCA incinerator at the Oak Ridge Reservation (ORR) was originally rejected as an option for treatment of Rocky Flats polychlorinated biphenyl (PCB)-contaminated LLMW based upon preliminary information that the incinerator would be fully occupied treating waste from ORR. More recently, the treatment capacity for the TSCA incinerator has become available for treatment of PCB-contaminated waste from other DOE sites. Rocky Flats is currently conducting an informal feasibility study to examine the possibility of treating PCB liquids at the TSCA incinerator.

Poly-macroencapsulation Treatment Unit

Preliminary evaluations have begun to determine the technical feasibility of shipping LLMW forms to the poly-macroencapsulation unit planned by Envirocare of Utah, Inc. (Envirocare). Lead, as well as waste forms categorized as debris, could be candidates for treatment by this unit. The treatment unit will be located at Envirocare's disposal facility in Clive, Utah.

The costs and schedule for offsite treatment of LLMW are presented in Table B-12.

Table B-12
LLMW Offsite Treatment Costs And Schedule

OFFSITE FACILITY COSTS & SCHEDULE	COSTS	Start	End
DSSI	$3,738,000		
Pretreatment Characterization (DSSI)		3-Apr-96	2-Jan-03
Shipment Offsite (DSSI)		1-Oct-98	27-Sep-02
Offsite Treatment (DSSI)		30-Mar-99	28-Mar-03
AMWTF	$10,182,000		
Pretreatment Characterization (AMWTF)		4-Mar-01	1-Apr-03
Shipment Offsite (AMWTF)		2-Apr-03	30-Apr-04
Offsite Treatment (AMWTF)		30-Jun-03	30-Jun-04
Total Cost	$13,920,000		

Notes:
1. Based upon October 1, 1995 start of program.
2. Based upon FY95 constrained funding projections.
3. AMWTF schedule based upon Oct. 16, 1995 agreement between State of Idaho, DOE, and the Dept. of Navy to construct and operate the AMWTP.

- Hazardous/Other Regulated Waste Treatment

Rocky Flats generates and stores nonradioactive hazardous waste regulated under RCRA and the Colorado Hazardous Waste Regulations and nonradioactive waste contaminated with PCBs or asbestos regulated by TSCA. Hazardous and TSCA waste management requirements are based on the Rocky Flats Hazardous Waste Requirements Manual, and generators of hazardous waste are responsible for appropriate management of that waste in accordance with the Hazardous Waste Requirements Manual.

- Risk Considerations

Since all of the nonradioactive hazardous and TSCA wastes are shipped offsite for treatment, the primary risk considerations are associated with proper storage onsite prior to shipment and risks associated with transporting the waste offsite for treatment. The risks associated with these wastes in the various ASAP alternatives depend on the volume of waste generated during execution of the ASAP alternative ultimately implemented.

- Available Technologies or Facilities

Since Rocky Flats sends all of the nonradioactive hazardous and TSCA waste offsite for treatment, the technologies used for treatment are those used by the commercial facilities to meet the regulatory requirements for treatment. Rocky Flats has contracts with two commercial facilities for treating this waste, Rollins Environmental Services and Chemical Waste Management.

These facilities charge a wide range of prices for treating this hazardous waste depending on the chemical and physical characteristics of the waste as well as the regulated constituents. The price ranges are from $30.00 to $2,200 per drum for waste stored in drums and from $178.00 per m³ for bulk wastes to $15.00 per gallon ($3,958 per m³) for small quantity, high hazard wastes.

4.7 Summary of Constraints and Standards

Waste management practices at Rocky Flats are governed and/or influenced by a number of factors. These factors are discussed below and are organized into three categories as follows: (1) regulatory issues, (2) logistics issues, and (3) liability issues.

4.7.1 Regulatory Issues

Resource Conservation and Recovery Act (RCRA)

RCRA is integral to the overall concept of ASAP because of the waste storage and disposal options being proposed. Regulations promulgated under RCRA set forth management standards for generators and transporters of hazardous wastes, and prescribes an operating permit program for owners and operators of treatment, storage, and disposal facilities (40 CFR 260-280).

The Site is exploring the use of existing facilities to store waste. These facilities may need to be permitted under RCRA for hazardous waste and mixed waste storage.

Disposal options being considered include establishing a Corrective Action Management Unit (CAMU, 40 CFR 264, Subpart S) or a disposal facility under Subtitle C regulations. Each option would need to be permitted under the RCRA program. A CAMU offers an expedited disposal facility for solid waste related to remediation activities. The commensurate restrictions are that only remediation waste can be disposed of in the cell. However, a disposal facility constructed and permitted under Subtitle C would require a more involved permitting process but would allow for disposal of any RCRA regulated waste. In addition, various treatment options are being considered as they relate to LDR waste.

Clean Water Act (CWA)

A key provision of the CWA is the National Pollutant Discharge Elimination System (NPDES) which provides a system for regulating both direct and indirect discharges of pollutants into United States waters. The CWA employs standards for effluent discharges which are implemented and enforced through the NPDES permit program which is tailored to meet the Site's operating conditions. The monitoring that will be conducted is discussed in Appendix D, Environmental Restoration.

Clean Air Act (CAA)

The most significant impact of the ASAP will be the need to provide an increased number of radiological emissions assessments to satisfy Rad-NESHAP monitoring and documentation requirements (including possible permitting). Accelerated processing rates and demolition activities resulting in decommissioning and removal of contaminated gloveboxes and ducts, excavation of contaminated soils, or demolition of buildings may require that the radiological emissions from the process be estimated, the dose to the public calculated, and the appropriate actions be taken with CDPHE (and EPA) to ensure that the process is adequately documented. Additional effluent monitoring may be required for some buildings that do not presently have monitoring capability, or which do not meet required EPA monitoring protocols. Additionally, the shrinking of the Buffer Zone could impact the existing dose assessments, depending on the use of the released land, and could increase effluent monitoring requirements over some period of the ASAP activities. Monitoring is analyzed in more detail in Appendix D.

An alternative to effluent monitoring may be appropriate in areas that are subject to rapid changes in their physical configuration, and which may not be amenable to effluent air monitoring. For these circumstances, ambient air monitoring could be proposed to demonstrate compliance with the Rad-NESHAP standard with concurrence from CDPHE and EPA. If successfully negotiated, this strategy would require some changes in the ambient air program, including restart of some perimeter samplers and startup of a laboratory analysis program to analyze americium and uranium isotopes in addition to the present plutonium analyses. Tritium monitoring may also be required, but this radionuclide may not be detectable at the levels that could be anticipated.

National Environmental Policy Act (NEPA)

NEPA will be considered for the various combinations of waste storage and disposal proposed for ASAP. The Site-Wide Environmental Impact Statement (SWEIS) to be published in mid-1997 is currently bounding the various alternatives under the ASAP for analysis. The record of decision (ROD) will define the Site's preferred action(s). Actions that need to take place prior to the ROD can be treated as interim actions to the SWEIS being prepared if the proposed action meets the following conditions:

(a) is justified independently of the program
(b) is itself accompanied by an adequate NEPA document, and
(c) will not prejudice the ultimate decision on the program.

Ecological Considerations

Numerous federal statutes, laws, and executive orders govern the protection and management of ecological resources across the Site. Key aspects in the ecological areas are the consideration of threatened and endangered species and their habitats, potential impacts to floodplains and wetlands, and assessed injuries to the environment from remedial actions under CERCLA. The more important laws governing the Site include:

- Endangered Species Act
- Migratory Bird Treaty Act
- Natural Resources Damage Assessment
- Golden Eagle Protection Act
- Executive Orders 11990, 11988, and 10 CFR 1022 (Wetland and Floodplain Protection)

Atomic Energy Act

The Atomic Energy Act, as amended, is the principal authority for the management of the nuclear industry. In conjunction with the DOE Organization Act of 1977, it authorizes DOE to undertake activities necessary for the defense nuclear industry. This includes management standards for safely handling nuclear materials and authority to protect defense-related nuclear materials. The Price-Anderson Act amendments, Public Law No. 100-408, 102 Stat. 1066 (1988), renewed DOE's authority to indemnify contractors to civil and criminal penalties for violating applicable nuclear safety requirements. Under authority of the Atomic Energy Act, DOE creates requirements and recommended practices in the Code of

Federal Regulations and DOE orders, respectively. These DOE orders incorporate established national and industrial standards. Since the Site generates and stores types of radioactive wastes that are governed by these DOE orders, ASAP activities are directly affected.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

CERCLA, which was enacted in 1980 and is also referred to as Superfund, and its major amendments (the Superfund Amendments and Reauthorization Act [SARA]) provide funding and enforcement authority for the cleanup and restoration of inactive or abandoned hazardous substance sites and for responses to releases of hazardous substances to the environment. Under regulations promulgated by EPA, sites contaminated by past activities must be investigated and remediation plans developed and implemented. The intent of these actions is to minimize the release of hazardous substances, pollutants, or contaminants, thereby protecting human health and the environment. Remedial activities associated with ASAP are governed by CERCLA requirements. CERCLA requirements are addressed in phases designed to investigate, remediate, and complete the restoration of contaminated sites. CERCLA activities at Rocky Flats are generally applied through the Federal Facility Compliance Agreement and Consent Order, commonly referred to as the Interagency Agreement (IAG). The IAG defines specific requirements and schedules for assessing and remediating site contamination.

The IAG establishes the roles and responsibilities of EPA and the State with respect to the oversight of RCRA and CERCLA activities and programs at the Site as they apply to environmental remediation and restoration activities. The agreement clarifies responsibilities among DOE and the two regulatory agencies, spells out procedures, and establishes time lines for completion of various activities for the study and cleanup of past contamination at the Site. Negotiations for a new Rocky Flats Cleanup Agreement are under way and will govern future ASAP activities.

Federal Facility Compliance Act

The Federal Facility Compliance Act (FFC Act) waives sovereign immunity and subjects the DOE to the imposition of civil fines as penalties for violation of RCRA or state hazardous waste requirements. The requirements of the FFC Act include the following: (1) paying charges for reasonable, nondiscriminatory fees and services assessed in connection with federal, state, or local solid or hazardous waste regulatory programs, (2) providing the states and the EPA with an inventory of mixed waste and related treatment capacity and technology, and (3) planning for waste treatment to meet land disposal restrictions.

Mixed Residue Settlement Agreement and Compliance Order on Consent

This compliance order requires the Site to implement a Mixed Residue Reduction Program which prescribes requirements to process and manage certain mixed residue waste for eventual shipment and disposal. Mixed residues are process byproducts that contain actinides (including plutonium) in concentrations that were previously saved for recovery and are contaminated with hazardous wastes. The form that these wastes assume from residue processing activities has a profound impact on the management of these materials in terms of storage requirements and associated facilities, and shipment to offsite repositories.

Hazardous Materials Transportation Uniform Safety Act of 1990 (HMTUSA)

The HMTUSA provides authority and responsibility for the DOT to establish requirements for the identification, packaging, marking, labeling, and transportation by all modes, of hazardous and radioactive materials and wastes. Those requirements establish limitations on the characteristics and quantity of radioactive material that can be transported within and outside of the borders of the State of Colorado. These limitations will naturally influence the offsite disposition of radioactive and mixed wastes generated as part of any ASAP alternative.

4.7.2 Logistical Issues

Contaminant Migration Controls

Cleanup and construction activities on the scale envisioned for some of the ASAP alternatives will require effective control mechanisms to prevent contaminants from exiting the Site or being released to previously uncontaminated Site areas. Protective measures will need to be instituted for source term containment both during remediation and construction activities and afterward, should an onsite emplacement alternative be implemented. The effectiveness of these measures will be a significant influencing factor governing public acceptability and regulatory agency concurrence or approval. The principal pathways for contaminant release are air, surface water, and groundwater. Air emissions will be influential in alternatives with extensive excavation activities and in building demolition actions. Surface water considerations will affect above-ground waste emplacement options whereas groundwater consideration will be key for subsurface emplacement structures. These issues are discussed more fully in Appendix D, Environmental Restoration.

Infrastructure Support for Waste Management

Onsite emplacement alternatives will require some degree of ongoing infrastructure support in the form of electrical power, water, sewage, fire protection, and access control. The level of support and its duration varies among the alternatives. Above-ground storage buildings will require more support than subsurface structures because of greater onsite personnel needs and maintenance of building safety systems. Activities such housekeeping, filter system changeouts, instrument calibrations, RCRA inspections, and routine building maintenance will need to be conducted.

Coordination of Remedial Cleanups and Economic Conversion Considerations

For some alternatives, conflicts between IHSS cleanup and retaining buildings for other uses need to be resolved. Many existing buildings which have potential beneficial uses to private industry or the government are located on or immediately adjacent to contaminated areas. Tradeoffs between leaving contamination in place in order to keep a building or forfeiting the building to alternative economic use in order to remove contaminated soil and substrate will need to be evaluated on a case-by-case basis.

4.7.3 Liability Issues

Several liability concerns may be encountered with some specific alternatives.

Liability Concerns Associated with Transferring Ownership of Formerly Contaminated Land to Non-DOE Ownership

DOE must comply with §120(h) of CERCLA. This section requires that if DOE executes a contract for sale or transfer of real property that was contaminated, the Secretary of Energy must include information in the contract about the hazardous substances and the nature of the release, as well as a description of the remedial action taken and a covenant warranting that the remediation completed will protect human health and the environment. Basically, with the exception of ongoing remedial maintenance (e.g., ground water monitoring), DOE must complete its remediation and clean up the property before it can transfer land under this section. If someone later claims an injury as a result of residual contamination or failure of the remedy, then that person could sue DOE or its management contractor for damages.

Liability Concerns Associated with Allowing Public Access

An owner or operator of real property owes differing standards of care to different types of visitors to the property. For example, the owner and operator owe a higher standard of care to an invitee than to a trespasser. If the Site opens its doors and actively encourages public activity, that will create additional duties toward anyone injured on the Site or exposed to hazardous substances quite different from when the Site was fenced and public access was considered criminal. Obviously, if a visitor becomes injured as a result of exposure, and in some cases, as a result of other injury, the Site owner and operator may be liable for damages.

Liability Concerns Associated with Using Commercial Disposal Facilities for DOE Wastes

Ordinarily, one who ships hazardous or other materials to a commercial disposal facility is protected by insurance or the terms of the delivery contract from additional liability, assuming information about the type of materials shipped is accurate. However, the courts have made clear that, if the owner and operator of a commercial disposal facility cannot be held responsible for subsequent damages, i.e., in the nature of a release of hazardous substances under CERCLA, due to bankruptcy or some other reasons, then the shippers may be responsible for the damages resulting from releases of contaminants from what they shipped. Since under CERCLA there is joint and several liability, if the Site were to ship waste to a commercial disposal facility where the facility ultimately failed and the owner and operator could not longer be held accountable, then the Site could potentially be liable for all damages caused as a result of such release, if other potentially responsible parties could not be found.

4.8 Land Use Implications

4.8.1 Habitat Protection Considerations

The elimination of contaminants to allow for free-release of the entire Site would provide approximately 6,500 acres to alternative use. One of the future land-use options under consideration is using the area as an ecological or wildlife preserve. This extensive level of cleanup would need to be tempered to prevent jeopardizing one of the major benefits of allowing the Site to remain as a natural wildlife preserve. Breeding populations of many native plant and animal species exist in the Site buffer zone because of the absence of livestock grazing and urban development. Extensive excavation work to remove contaminants, especially in wetland and riparian areas along drainages could destroy fragile habitat necessary for some of these relatively rare species.

4.8.2 Subsurface Waste Emplacement

Alternatives that leave waste materials buried onsite restrict development in these areas. Major construction requiring excavation or drilling would be precluded. This restricts future development in areas covered by a cap and those locales containing entombed buildings.

4.8.3 Surface Waste Storage Buildings

Waste storage buildings may impose restrictions on the free-release of buffer zone lands because of distance-to-receptors considerations when calculating potential radiation dose to the public under ambient or accident conditions. Building Safety Analysis Reports (SARs) contain established plutonium gram loading limits for buildings based on effective dose equivalent estimates at the site boundary. Current estimates are based on boundary conditions encompassing the 6,500 acre reservation. The quantity of plutonium stored in waste buildings may preclude shrinking the buffer zone and hence, making these lands freely accessible by the general public for recreational, residential, and/or industrial use.

4.8.4 Mineral Rights

Mining rights to subsurface minerals on Site lands are owned by private interests (e.g., Western Aggregate, McKay Ranch), not by DOE. Consideration of alternatives that include surface or underground structures which may compromise access to subsurface resources (mainly aggregate) must address these rights. Compensation to private rights owners may be a cost factor that needs to be better defined as part of the cost evaluation.

4.9 Barriers/Uncertainties

4.9.1 Limitations on the Plutonium Content of Buildings

Maximum Credible Accident Considerations

Current practice limits the amount of plutonium contained in nonhardened (lacking reinforced concrete), non-HEPA-filtered buildings to less than 10 kilograms (kg). This limitation stems from a 1986 informal agreement between the State of Colorado and the Site related to maximum credible accident alternatives. Results of more recent analyses show that no significant risk to the public results from increasing the gram loading above 10 kg when waste containers are configured within certain specified criteria (e.g., metal containers used, less than 290 drums per 1,000 ft^2 of floor space, less than 10.5 kg of plutonium on average for any given 1,000 drums).

A request for an interim authorization agreement allowing waste storage in quantities containing more than 10 kg of plutonium total within nonhardened, non-HEPA-filtered buildings is being prepared. DOE approval for this change is required before implementation.

Another issue potentially affecting the amount of wastes stored in buildings is the factor used to estimate the release fraction that would occur in the event of an accident. The release fraction is an estimate of the proportion of radioactive material that would escape containment during an accident. It is significant because it influences the estimated amount of plutonium contributing to potential radiation dose effects to the public. The factor currently used for maximum credible accident alternatives is 0.01. DOE is evaluating whether to raise the release fraction factor to 0.5 based on results of a recently completed study performed by Battelle. If the 0.5 factor is adopted, this will significantly reduce the amount of plutonium in wastes that can be stored in buildings.

The significance of the limitation on plutonium content of buildings is in sizing storage facilities and the construction costs associated with whether they must be hardened and contain HEPA filtration systems. This consideration is especially important for storing TRU wastes. If the 10 kg building limit is imposed, the cost differential between constructing a hardened versus a nonhardened building is approximately \$10,500 per m^3 of waste stored.

Clean Air Act

Another factor affecting the costs for storing radioactive wastes and the amount of material that can be stored in a building is the Clean Air Act. Provisions of the federal Clean Air Act regulation, 40 CFR 61 Subpart H, require monitoring and permitting when the amount of radioactive material exceeds certain levels. The action level varies depending upon the type of radioactive material and the distance from potential receptors (i.e., the public). The Clean Air Act requires continuous air effluent monitoring and inventory control when estimated uncontrolled air emissions result in calculated radiation dose values of 0.1 mrem/year or greater. Uncontrolled means that no filtration efficiencies can be used in calculating the potential emissions. Table B-13 shows the amount of plutonium, enriched uranium, and depleted uranium that could potentially result in an uncontrolled dose of 0.1 mrem/year under normal operating alternatives. These results show that when wastes contain between 40 to 60 kg total within a building, then monitoring is required. Buildings that are not designed to control and contain air flow through a monitored exhaust stack cannot contain more than 40 to 60 kg of plutonium. Thus, the Clean Air Act limits the storage efficiency of existing butler-type buildings and would require more expensive construction of new buildings to contain wastes with total plutonium amounts that exceed the action level.

4.9.2 Corrective Action Management Unit

The site is seeking approval from CDPHE to locate a new CAMU-type landfill onsite. Utilization of a CAMU offers many advantages to the Site for the emplacement of wastes in landfill cells. It allows for consolidation of remediation wastes (i.e., wastes from environmental cleanup activities) from multiple locations and provides relief from LDR requirements. Negotiations are underway between the Site and CDPHE to gain approval for an onsite CAMU and to determine provisions for its use. Construction of a CAMU is dependent upon the outcome of these negotiations.

A related issue to the siting of a CAMU is the definition of remediation wastes. If demolition debris is included as remediation waste along with soils and sludges from environmental restoration activities, direct deposit of contaminated building demolition debris into the landfill for burial would be allowed.

4.9.3 Onsite Landfill Waste Acceptance Criteria

Effort is underway to develop waste acceptance criteria for an onsite landfill. The desired specific activity level for low-level waste emplacement in the landfill is not to exceed 100 nCi/g. This level is comparable to other federal waste repositories (e.g., Nevada Test Site, Hanford). It is considerably higher than that used by commercial disposal sites which is typically less than 10 nCi/g (see Table B-14). Envirocare has recently reduced its acceptance level to less than 1 nCi/g. It is important that the higher specific activity level (i.e., 100 nCi/g) be used in order to accept the full spectrum of waste at Rocky Flats. If 10 nCi/g is established as the WAC, then approximately 75 percent of the Site's low-level wastes would not be eligible for emplacement (based on current inventory).

In addition, measuring specific activity levels at less than 10 nCi/g to verify that the waste in a drum did not exceed that amount would not be possible with currently available instrumentation. A value of 10 nCi/g translates to approximately 24 mg of plutonium. This cannot be measured on a drum-by-drum basis and would necessitate emptying the drum contents, measuring individual waste packages, and computing a total prior to repacking and sealing the drum. Thus, the characterization costs associated with verifying that less than 10 nCi/g was present would be prohibitively expensive.

4.9.4 TRU/TRM Storage Building Considerations

The packaging criteria used for wastes from residue processing will have a significant effect on TRU/TRM storage alternatives, namely whether or not an existing facility can be used or if a new building is required, whether it is a hardened structure or a butler-type building. Differences in packaging criteria influence the total volume of containers that need to be stored (not necessarily to volume of waste, per se) and the degree of protection offered by the container against breech and subsequent release of material. If the waste drums themselves are packaged to meet WIPP WAC, the number of drums from residue processing could be as high as 30,000. If the waste is packaged in bags to meet WIPP WAC and

Table B-13
Approximate Mass of Radionuclide Required to Reach 0.1 mrem/yr (Uncontrolled) EDE Monitoring Threshold (kilograms)

	Modeling Variables (in meters)			Weapons Grade Plutonium		Enriched Uranium		Depleted Uranium	
	Distance to Receptor	Stack Height	Stack Diameter	Particulate Solid	Solid	Particulate Solid	Solid	Particulate Solid	Solid
Bldg 374	4,648 m	13.11 m	1.10 m	6.33E-02	63.29	227.41	2.27E+05	4.24E+04	4.24E+07
Bldg 440	4,343 m	7.62 m	1.83 m	5.71E-02	57.14	205.32	2.05E+05	3.82E+04	3.82E+07
Bldg 444	4,458 m	4.19 m	2.14 m	6.02E-02	60.24	216.45	2.16E+05	4.03E+04	4.03E+07
Bldg 460	4,496 m	8.54 m	1.51 m	5.99E-02	59.88	215.15	2.15E+05	4.01E+04	4.01E+07
Bldg 551	4,343 m	10.00 m	0.50 m	5.71E-02	57.14	205.32	2.05E+05	3.82E+04	3.82E+07
Bldg 865	3,924 m	4.65 m	1.55 m	4.95E-02	49.50	177.87	1.78E+05	3.31E+04	3.31E+07
Bldg 881	3,886 m	16.46 m	2.44 m	4.98E-02	49.75	178.76	1.79E+05	3.33E+04	3.33E+07
Bldg 883	3,962 m	11.49 m	1.77 m	5.00E-02	50.00	179.65	1.80E+05	3.35E+04	3.35E+07
Bldg 906	3,658 m	2.80 m	0.61 m	4.52E-02	45.25	162.58	1.63E+05	3.03E+04	3.03E+07
Bldg 991	3,734 m	3.99 m	1.31 m	4.61E-02	46.08	165.58	1.66E+05	3.08E+04	3.08E+07
IDM Bldg	3,467 m	2.80 m	0.61 m	4.17E-02	41.67	149.71	1.50E+05	2.79E+04	2.79E+07

Note: For the determination of a monitoring requirement, no credit may be assumed for any reduction in emissions due to filtration.

It is assumed that the radioactive component of waste stored in drums is best represented as solid during storage and particulate solid during waste repackaging.

Table B-14
Disposal Site Options

Disposal Site	Waste Type	Disposal Costs dollars/ft3	Total Source Term Allowed for Site/Cell	Specific Activity per Container nCi/gm	Status/Special Considerations
NTS (DOE)	LLW LLMW	12.70 TBD		≤ 100	Rocky Flats currently has approval to ship low level waste (LLW) to NTS. NTS is the designated waste repository for Rocky Flats. Waste disposal at any other site requires authorization from DOE, HQ. Scheduled to accept LLMW for disposal in 1997.
Hanford (DOE) Washington	LLW, Cat. 1	42.13		≤ 10	Rocky Flats currently has approval to dispose of unlimited quantities of asbestos-contaminated LLW at Hanford. The Site also has approval to dispose of 7,000 ft^3 of LLW sewage sludge at Hanford, of which ~5,000 ft^3 has already been shipped.
	LLW, Cat. 3	95.68		> 10 and ≤ 100	Hanford will accept limited quantities of LLMW from sites which are currently approved and shipping LLW to Hanford. LLMW goes into storage and becomes Hanford waste. LLMW does not currently need to meet Land Disposal Restrictions (LDR), but in the future, this will be a requirement. The $140/$ft^3$ is a one-time payment as long as the generator has characterized the waste correctly.
	LLMW	140.68		≤ 100	LLMW and additional waste stream and/or quantities would require authorization from DOE, HQ and audit/approval from Hanford.
Oakridge (DOE) Tennessee	LLW	125.00			Specific activity limits are based on performance assessment and are radionuclide specific. The facility is above grade. Wastes are placed in concrete vaults and later covered with an engineered cap.
Savannah River (DOE) South Carolina	LLW		N/A	0.091 Ci/package	Specific activity is based on performance assessment and is radionuclide specific. The 0.091 Ci/package limit is for Pu-239. SRS has below ground disposal and below ground vault structures. A MW facility is planned but not final.
Envirocare Utah	LLW	variable		< 1	Envirocare accepts waste in bulk with at least one dimension less than ten inches. Envirocare recently received authorization to dispose of oversized debris, which is solidified waste with all dimensions greater than ten inches. Rocky Flats is currently working several projects with Envirocare. They include Operable Unit (OU) 1 - Hot Spot Remediation Waste, and OU 2 - Filter Sludge and Saltcrete.
	LLMW, soil	41.84		< 1	Envirocare is currently building a LLMW treatment facility. Rocky Flats is currently working with Envirocare to determine estimates for treatment of several Rocky Flats' LLMW streams.
	LLMW, debris	60.49		< 1	An exemption to DOE Order 5820.2A for disposal of LLMW as commercial sites is currently in place. Disposal of straight LLW would require an additional exemption. LLMW treatment/disposal costs are unknown but can be accomplished pending results of generator. Funded treatment study performed by Envirocare. Specific activity limits are radionuclide specific. < 1 limit is for Pu-239.

Table B-14
Disposal Site Options

Disposal Site	Waste Type	Disposal Costs dollars/ft³	Total Source Term Allowed for Site/Cell	Specific Activity per Container nCi/gm	Status/Special Considerations
U.S. Ecology Hanford Washington	LLW	51.00		≤ 10	Plutonium (Pu) is limited to 300 grams above ground awaiting burial. This site can accept Rocky Mountain Compact waste, but it must be approved by the Governor of Washington, who would like to close this site.
	LLMW	N/A		N/A	Would require DOE authorization and an exemption to DOE Order 5820.2A allowing disposal of LLW at a commercial site. Rocky Flats is not currently pursuing this site for waste disposal.
U.S. Ecology Ward Valley California	LLW				This site is currently seeking approval. Requires a land transfer from the Department of Interior. If approved, will require approximately twelve months to build. California has the right to reject DOE waste. No other information is available at this time.
	LLMW	N/A		N/A	Would require DOE authorization and an exemption to DOE Order 5820.2A allowing disposal of waste at a commercial site. Rocky Flats is not currently pursuing this site for waste disposal.
U.S. Ecology Butte Nebraska	LLW				This site is currently seeking approval. License approval may take another 24 months. If approved will take another 24 months to build. Disposal will occur in above ground vaults. Disposal costs will probably be $500 to $1,000/ft³. No additional information is available at this time.
	LLMW	N/A		N/A	Would require DOE authorization and an exemption to DOE Order 5820.2A allowing disposal of waste at a commercial site. Rock Flats is not currently pursuing this site for waste disposal.
U.S. Ecology Beatty Site Nevada	LLW				No longer accepts radioactive waste as of December 21, 1992. Currently accepts straight hazardous waste. Has criteria where extremely low levels of radioactive contamination are exempted (pCi/gm). Under this criteria, they have accepted waste streams such as sewage sludge from nuclear power plants.
	LLMW	N/A		N/A	Would require DOE authorization and an exemption to DOE Order 5820.2A allowing disposal of waste at a commercial site. Rock Flats is not currently pursuing this site for waste disposal.
Chem-Nuclear Systems Barnwell South Carolina	LLW, Class A		N/A	≤ 10 Ci/m³	Could be compact issues regarding disposal of waste at this site. Would require DOE, HQ authorization and an exemption to DOE Order 5820.2A allowing disposal of LLW at a commercial site. Rocky Flats is not currently pursuing this site for waste disposal.
	LLW, Class C	N/A		≤ 100 Ci/m³	
	LLMW			N/A	
Los Alamos National Lab New Mexico	LLW	$25/ft³	N/A	≤ 100 nCi/g	Based on geology/climate location, there are no packaging restrictions.
	LLW w/PCB, asbestos, biological				

multiple bags placed in drums, the drums themselves may not meet the WAC but the storage volume requirement is reduced to as few as 8,500 drums. An additional packaging concept being explored is storing wastes in sealed pipes and placing pipes in drums. If the pipe component packaging approach is used, then as much as 1,000 g of plutonium may be stored in a single drum and the projected number of drums to be stored drops to around 2,800. This wide range of drums to be stored markedly affects the size and type of storage building needed for TRU/TRM waste. Additionally, with the increased protection afforded by the pipe component against container rupturing, the waste potentially could be stored in a nonhardened building (i.e., Butler-type) and still meet public safety requirements.

Other factors influencing building storage requirements for TRU/TRM waste is the shipping start date and the rate at which waste can be shipped to WIPP. The projected date for WIPP to open is April 1998. Work at the Site continues to ensure that sufficient quantities of wastes are certified and available so as to not impede shipments. Current constraints on shipments include limitations on the plutonium gram loading of the TRUPACT II vessels to 325 g and a requirement that all wastes in a vessel consist of the same waste category. DOE is evaluating ways to expand the TRUPACT II shipping envelope by increasing the gram loading/vessel to as much as 2,800 g and allowing wastes from different waste categories to be transported together. Should these new transport requirements become approved, waste shipping to WIPP could be significantly expedited. This would result in a much reduced TRU/TRM waste storage area needed on the Site to handle this waste.

4.9.5 LDR Treatment Considerations

Significant uncertainty exists in developing reasonable cost estimates for LLMW waste with LDR treatment requirements. Unit cost estimates for potential treatment technologies vary considerably depending on the technology used, ranging from $1,000/m³ to $20,000/m³. Contributing to the high uncertainty is the fact that many technologies are untested and unproven on a commercial production scale or are sensitive to economies of scale regarding throughput. The uncertainties are further exacerbated by the lack of detailed characterization data for projected LLMW waste generation volumes, especially for materials resulting from environmental restoration activities. The projected amounts of LLMW remediation wastes not meeting LDR requirements range from 25 percent to 75 percent of the total.

These uncertainties, taken together, result in an enormous range of potential cost estimates for treating LDR wastes. Preliminary estimates show that LDR treatment estimates can vary from $308 million to $18,495 million for the projected waste volumes from Alternative 1, Unrestricted. Unit cost treatment values ranged from $3,500/m³ under Alternatives 1, 3d, and 3e to $10,000/m³ for the remainder of the alternatives. It is also assumed that 25 percent of the remediation wastes from environmental restoration activities will require treatment under Alternative 1, 50 percent will require treatment under Alternatives 3a and 3b, and 15 percent will require treatment under the remainder of Alternatives. These assumptions result in an extremely high treatment cost, especially for alternatives involving large amounts of environmental restoration waste materials (e.g., Alternative 1, Unrestricted).

Some of the alternatives evaluated in ASAP Phase II consider limiting treatment to high-risk LDR noncompliant wastes. Low and moderate risk LDR wastes would either not be treated or treatment would be deferred until further evaluated to demonstrate that the risks posed by disposal of the waste meet the intent of public protection requirements. This course of action may be technically acceptable for LDR wastes which do not present an appreciable risk to the public (e.g., pondcrete); however, exemption from the regulations will be required. The probability of and mechanism for obtaining the required exemptions is unknown at this time and will be further explored in ASAP Phase III.

4.9.6 Construction Cost Estimates

Some uncertainty exists in the estimated construction costs for waste management facilities due to the preliminary nature of the information used as the basis for these estimates. An example of this uncertainty is the current estimate which shows a RCRA Subtitle C landfill costing significantly more than a concrete-lined cell. This apparent discrepancy will be further evaluated and construction cost estimates refined as appropriate.

4.9.7 Landfill Siting Criteria

The cost estimate for constructing the landfill in Alternative 3e, Entombment and Landfill, is high because it is an above-ground structure (i.e., about 35 feet above grade). The high landfill cost is due, in part, to the large quantities of fill that would need to be imported to cover waste materials placed in cells and to eventually cap the facility. Fill material would most likely be imported from the aggregate operations west of the Industrial Area. The proposed location of the landfill is in the vicinity of the solar evaporation ponds where depth to groundwater is about 10 feet which necessitates above-ground construction. Siting the landfill in the solar pond area reflects stakeholder preference for locating the facility in an area of known contamination as opposed to locating it in an undisturbed, uncontaminated location in the buffer zone.

Relocation of the landfill to west of the Industrial Area would reduce construction costs because a below-grade structure could be built requiring less fill material. There would be technical advantages as well because of more favorable hydrologic conditions. The tradeoff between siting the landfill in or outside of the Industrial Area will be explored further in ASAP Phase III.

4.9.8 Waste Categories by Source

Process wastes are generated by nuclear and nonnuclear manufacturing, stabilization, and maintenance processes. They are typically metals, plastics, glass, spent chemicals, and a wide variety of other materials generated from processing operations. Demolition wastes arise from deactivation, decontamination, decommissioning, and demolition activities. These wastes consist of excessed equipment (e.g., scrap metal, concrete, piping, and plenums). Materials with recycle and/or salvage value are not included in this category. Remediation wastes are typically environmental media such as soils, sludges, and liquids that are generated as a result of cleanup actions to eliminate source terms and to decrease the potential for migration of radioactive and chemical hazards.

The origin of the waste, in some cases, may determine the regulatory influences that affect how the waste is managed. For example, while process wastes and remediation wastes are both subject to regulation by CDPHE and/or EPA, they may be subject to different requirements. Specifically, process wastes that are considered hazardous under State of Colorado hazardous waste laws may be required to be disposed of in landfills that meet the definition of RCRA Subtitle C. Similar remediation wastes can be disposed of in a landfill meeting the definition of a CAMU and are subject to different requirements: i.e., need not meet LDR nor minimum technology requirements.

The prevailing statute governing management of backlog process wastes and future waste generation needs to be determined (i.e., RCRA or CERCLA). It could be argued that wastes currently present and those generated in the future be managed as CERCLA waste because the Site is no longer an active production facility and the work activities being conducted are related to environmental cleanup. Regardless of which statute prevails, wastes will be managed in a safe and compliant manner in accordance with potential risk.

4.10 Alternatives Contributed by Stakeholders and Regulators

During the course of the ASAP Phase II process, alternative suggestions were contributed by stakeholders and regulators, either formally as published proposals or informally at public meetings, by facsimile, electronic mail, and telephone conversations. Brief summaries of these alternative suggestions are presented below.

4.10.1 Build Additional TRUPACT II Vehicles Instead of a New TRU/TRM Building

In lieu of constructing a new facility to temporarily store TRU/TRM wastes, it was suggested that additional transport vehicles (i.e., TRUPACT IIs) be built to store waste.

At present, 15 TRUPACT II vehicles are available to transport waste. The projected future fleet size is 53. The cost associated with constructing each new vehicle is about $1 million which includes the three TRUPACT vessels and the trailer. The waste transport capacity of a TRUPACT II vehicle varies depending on the containers transported (e.g., drums, standard waste boxes, or 10-drum overpacks). For purposes of discussion, it is assumed that drums will be used for transport.

Each vehicle can transport 42 drums (i.e., 14 drums per vessel, 3 vessels per trailer) or the equivalent of about 9 m^3. The projected TRU/TRM waste volume to be generated is about 6,200 m^3 or slightly less than 30,000 drum equivalents. The number of TRUPACT II vehicles needed to store 30,000 drums is about 700. However, shipping should be occurring concurrently; thus, the maximum amount of waste requiring storage is about 1,800 m^3. A rough approximation for the number of transport vehicles to store this amount of waste and support the shipping schedule is about 200. Therefore, the cost associated with this suggested alternative is about $200 million which is more than the projected costs of building a new storage facility.

4.10.2 Offsite Disposal in Boulder County

It is suggested that the Site consider constructing an offsite storage and disposal facility on private property located near Eldorado Canyon State Park in Boulder County, Colorado. Three options are included in the proposal:

(1) A facility designed to store 1.5 million yd^3 (1.2 million m^3) of containerized and bulk LLW/LLMW. The wastes would be placed in a natural ravine. The walls and floor of the ravine would be sealed. The design includes a concrete, roller-compacted, monolithic, gravity drain/shield to contain the wastes. A cement plant would be built to support construction of the facility. Long-term surface runoff and drainage monitoring would be provided by an automatic swamp/pump/holding tank system.

(2) A facility designed to dispose of 2.5 million yd^3 (1.9 million m^3) of LLW/LLMW in a 3.2 million yd^3 (2.5 million m^3) cement monofill. Waste placed in this facility would not be easily retrieved. The configuration of the facility is similar to that described above for option (1). The facility would be capped with soil and revegetated.

(3) A facility consisting of a subterranean building constructed within the ravine designed for 1.2 million yd^3 (0.9 million m^3) of LLW/LLMW and 10,000 yd^3 (7,650 m^3) of TRU waste and SNM. A waste management research facility is included in this option. The ravine walls and floor would be sealed. Void spaces between the building walls and ravine walls would be backfilled with sand and gravel. Provisions would be provided for security to protect the SNM (e.g., secured access silos and guard towers). The facility would be capped with soil and revegetated.

Construction and operating cost estimates were not included in the proposal, so direct cost comparisons with other alternatives is not possible. An advantage that this alternative has over other offsite disposal alternatives is the reduced transportation costs and risks. A 20-mile railroad haul is envisioned, which is considerably less than that for repositories located in Utah, Nevada, or other federal or commercial disposal sites.

4.10.3 Vitrified Waste Logs Stored in Granite or Marble Blocks

This alternative suggests vitrifying the waste in glass logs which, in turn, are placed in holes bored in granite blocks. The logs would be sealed in place with granite plugs. A number of other materials could be used in place of granite to hold the waste logs: e.g., marble. The blocks could be arranged in a variety of configurations ranging from planar to a pyramid-like structure. Preliminary cost estimates indicate that implementation of this method of storage is far more expensive than the other alternatives (e.g., more conventional buildings, concrete-lined cell).

4.10.4 Clean Up to Background and Ship All Waste Materials Offsite

A variation of Alternative 1, Unrestricted, is to clean up both onsite and offsite contamination to background instead of to residential release standards. Numerous stakeholders and regulators have asked that this alternative be considered. For the Background Alternative, the individual hazardous substance sites (IHSSs) would be remediated to background levels and the volume of waste generated would be approximately 1.6 million m^3 or approximately 30 percent greater than the volume of waste generated in the residential alternative. This waste would be shipped for offsite disposal. This volume is small in comparison to the amount of waste that would be generated from remediation of wind-blown plutonium contamination both onsite and offsite. Estimates of this waste material range between 10.2 million m^3 and 30 million m^3 depending on the extent of the area remediated (see Appendix D, Environmental Restoration, for details). Thus, the total volume of material that would need to be remediated ranges from 11.8 million m^3 to 31.6 million m^3. A detailed cost analysis was not attempted because of uncertainties of volumes needing treatment and private property value compensation.

4.11 Analysis and Results

Information on the various waste management options related to the eight ASAP alternatives has been developed and presented throughout this Appendix, to allow an overall evaluation to be performed. This section provides an overall comparison to support selection of a recommended path forward for ASAP. The criteria used are cost and risk. Tables are provided in the following sections to allow direct comparison of each alternative for the evaluation criteria.

4.11.1 Cost Analysis

Overall cost is one of the primary criteria for evaluation of the ASAP Alternatives. This section provides the appropriate cost data for each of the ASAP Alternatives to allow the necessary evaluation and comparison. Information is provided on unit costs for waste management activities; those costs are then used to calculate overall waste management costs.

Comparative Costs For Options

Costs associated with the various waste management options are primarily influenced by projected waste volumes, onsite versus offsite disposal, interim and long-term storage needs, and decisions on the level of treatment to meet LDR or WAC requirements. A comparison of total waste management costs by Alternative is presented in Table B-15. The comparisons are made based on the general waste management functions of storage, treatment, and disposal with specific waste management options for each alternative used to develop the costs. Costs were calculated by using the unit cost for operations for each of the waste management cost elements and anticipated facility design/construction costs.

Table B-15
Waste Management Cost Comparison
(in millions-M)

COST ELEMENT/ALTERNATIVE	1. Unrestricted	3a. Phased Shipment	3b. Priority Shipment	3c. Excavation	3d. Leveled Buildings	3e. Entombment and Landfill	4. Mothball
ONSITE STORAGE							
•LLW/LLMW							
Facility Construction	$284	$126	$90	N/A	N/A	N/A	N/A
Operation	$3,894	$1,262	$680	$21	$21	$21	$18
•TRU/TRM							
Facility Construction	$47	$22	N/A	$22	$22	$22	$12
Operation	$8	$11	$8	$11	$11	$11	$11
TREATMENT							
•LLW/LLMW	$1,078	$469	$469	$383	$383	$383	$166
•TRU/TRM	$12	$14	$12	$14	$14	$14	$13
ONSITE DISPOSAL							
•LLW/LLMW							
Facility Construction	N/A	N/A	N/A	$200	$200	$400	$80
Operation	N/A	N/A	N/A	$168	$168	$162	$74
OFFSITE DISPOSAL							
•LLW/LLMW	$5,974	$938	$938	N/A	N/A	N/A	N/A
•TRU/TRM	$357	$358	$357	$358	$358	$358	$310
•Hazardous	$300	$39	$39	$39	$39	$39	$31
•Uncontaminated	$4	$4	$4	$4	$3	$3	$1
TOTALS	$11,958	$3,243	$2,597	$1,220	$1,219	$1,413	$716
Minimum LLMW Treatment Range							
Volume (m3)[1]	308,249	67,249	67,249	67,249	67,249	67,249	29,236
Cost ($M)[2]	$308	$67	$67	$67	$67	$67	$29
Maximum LLMW Treatment Range							
Volume (m3)[1]	924,746	201,746	201,746	201,746	201,746	201,746	87,709
Cost ($M)[2]	$18,495	$4,035	$4,035	$4,035	$4,035	$4,035	$1,754

Notes:
1. Minimum and maximum volumes are assumed to be 25% and 75% of the total projected waste volumes respectively
2. Minimum and maximum costs for treatment are assumed to be $1,000 and $20,000 per cubic meter respectively

Overall costs for each of the alternatives show, as expected, that the maximum cost is Alternative 1, Unrestricted, and the minimum cost is Alternative 4, Mothball. These minimum and maximum alternatives are primarily caused by the projected waste volumes which must be managed. Costs for the other alternatives are much closer when compared to each other and the variations are caused by the specific waste management options chosen, such as treatment requirements, emplacement onsite or disposal offsite, and interim onsite storage requirements.

Waste Management Unit Costs

Unit costs for waste management were prepared to compare the relative life-cycle waste management costs for each of the alternatives under consideration. The unit costs were developed from the FY96 waste management budget and FY95 actual costs; as such, they are representative of the way in which wastes are currently managed at the Site. Unit waste management costs are stated in terms of 1996 dollars and may increase or decrease in the future due to inflation or cost-reduction initiatives. These unit costs are truly variable costs, and are tied directly to the amount of waste that is physically handled at the Site and the amount of time required to manage that waste. The fixed operations and programmatic support costs required to maintain a certain level or readiness for the waste management program are not included here. These would be expressed as an additional annual support cost for as long as the program would be expected to operate at the Site, but would be relatively constant (year for year) between each ASAP alternative.

The unit costs for Site waste management are shown in Table B-16. The costs are divided among three main elements: waste storage, characterization, and disposal. Waste storage costs reflect the recurring annual costs of inspecting the condition of the wastes and facilities and of operating and maintaining storage facilities based on the amount of waste physically stored at the Site in each year. A conversion factor, based on an average storage efficiency per square foot of floor space, was used to derive the storage operations and maintenance costs on a volume basis.

Table B-16
Waste Management Unit Costs

Cost Element	Low-Level Waste	Low-Level Mixed Waste	TRU Waste	TRU Mixed	Haz	TSCA	San	Notes
Storage:								
Physical Inspections	$55/m³/yr		$178/m³/yr					
RCRA Inspections		$96/m³/yr		$178/m³/yr	$96/m³/yr			
LLW/LLMW Storage O&M	$207/m³/yr	$207/m³/yr						Assumes storage efficiency of 0.092 m³/ft² floor space
TRU/TRM Waste O&M			$400/m³/yr	$400/m³/yr				Assumes storage efficiency of 0.092 m³/ft² floor space
TSCA Inspections						$142/m³/yr		
TSCA Storage O&M						$200/m³/yr		Assumes storage efficiency of 0.092 m³/ft² floor space
RCRA Storage O&M					$207/m³/yr			Assumes storage efficiency of 0.092 m³/ft² floor space
Characterization:								
TRU/TRM Operational Drum Characterization			$12,430/m³	$12,430/m³				Head-space gas sampling and analysis only
RCRA LDR Characterization		$11,500/sample						Per sample, includes sample collection, and chain-of-custody
Non-Destructive Assay	$6,539/m³	$6,539/m³	$6,539/m³	$6,539/m³				
Real-Time Radiography	$729/m³	$729/m³	$729/m³	$729/m³				RTR not required for Envirocare
Disposal								
Disposal Fees (Offsite)	$445/m³	$2,193/m³	$40,000/m³	$40,000/m³	$3,586/m³	$770/m³	$23/m³	LLW-NTS @ FY96 rates; LLMW-Envirocare, no vol. discount; TRU/TRM disposal costs are planned as part of the WIPP budget, not as part of the Rocky Flats budget.
Prepare, Inspect, Certify, and Stage Load	$1,404/m³	$337/m³	TBD	TBD				LLW-NTS; LLMW-Envirocare typical saltcrete shipment
Transportation	$35-50/m³	$288/m³	TBD	TBD				LLW rate (drums/full crates); LLMW - typical saltcrete shipment
Disposal Fees (Onsite)	$668/m³	$668/m³					$43/m³	Based on $100,000 yd³ ER soils
Transportation (Onsite)	$8/m³	$8/m³						

Waste characterization costs are given for operational drum characterization for TRU and TRM wastes to satisfy the WIPP WAC; characterization for RCRA LDR; radiologic assay of containers; and container radiography. All costs are based on the volume of waste characterized with the exception of the RCRA LDR analysis. This is given as a cost per sample since the sample may be used to represent a discrete population of waste; the size of the population will vary according to the statistical characteristics of the waste.

Disposal costs are all volume-based representing the time and effort to select, physically prepare, inspect, certify, and stage a waste load; transport the load to the disposal site; and included relevant fees charged by the disposal facilities. Transportation costs for offsite disposal of LLW/LLMW are based on truck transport; rail transport could result in an estimated 25 percent reduction in these costs. The disposal fees for onsite disposal are from the report *Draft Evaluation of Onsite vs. Offsite Management Options for RFETS*. These are representative of disposing of 100,000 cubic yards of environmental remediation wastes in an onsite Corrective Action Management Unit (CAMU) cell.