**Cost of Presumptive Source Term Remedial Actions
Laboratory for Energy-Related Health Research,
University of California, Davis**

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EXECUTIVE SUMMARY

This report provides order-of-magnitude cost estimates for presumptive remedial actions being considered for five source term operable units at the Laboratory for Energy-Related Health Research, University of California, Davis. These cost estimates are intended for planning purposes only. They are not intended to be as accurate or as complete as estimates prepared for feasibility studies.

A summary of the presumptive general response actions and their estimated costs is provided in Table ES.1. The most economical presumptive remedial response action (besides the No Action Alternative) for all but the landfills (Operable Unit 5) appears to be removal (with or without segregation) and onsite disposal. The most economical response action for the landfills appears to be capping. The least economical alternative, at least for the landfills, appears to be removal and offsite disposal. If offsite disposal is necessary, the most economical response action appears to be removal and segregation (with or without treatment to reduce the waste volume) and then offsite disposal.

The cost of characterization relative to the cost of the remedial action is generally quite low and thus has little affect when comparing the costs of the presumptive remedial actions. However, in the case of the domestic septic tank soils (Operable Unit 4), the cost of characterization to support the No Action Alternative is on the same order as removal and disposal actions.

The estimated costs for the presumptive remedial actions evaluated in this study are most sensitive to uncertainties affecting the choice of onsite or offsite disposal, and the designation of waste to be disposed (radioactive, hazardous, or mixed waste). Other important uncertainties are those affecting the size of the area to be capped and the volume of waste requiring removal or in situ treatment. A summary of the primary cost-affecting assumptions for each operable unit and a qualitative estimate of the uncertainty associated with these assumptions is provided in Table ES.2.

Table ES.1 Estimated Costs for Various Presumptive Response Actions

GENERAL RESPONSE ACTION	NO ACTION	IN SITU TREAT- MENT	CAPPING	HOTSPOT REMOVAL & CAPPING		HOTSPOT REMOVAL, SEGREGATION & CAPPING		REMOVAL AND DISPOSAL		REMOVAL, TREATMENT, AND DISPOSAL		REMOVAL, SEGREGATION, AND DISPOSAL		REMOVAL, SEGREGATION, TREATMENT AND DISPOSAL	
				Onsite	Offsite	Onsite	Offsite	Onsite	Offsite	Onsite	Offsite	Onsite	Offsite	Onsite	Offsite
Operable Unit															
OU1				\$2,487	\$14,513			\$753	\$14,901			\$685	\$9,973	\$2,364	\$12,054
OU2	\$420	\$1,744						\$731	\$2,377	\$1,468	\$2,083				
OU3	\$46							\$1,147	\$17,278						
OU4	\$224	\$522						\$301	\$375						
OU5	\$545		\$2,683			\$7,628	\$8,768	\$10,005	\$22,696						
TOTALS	\$1,235	\$2,266	\$2,683	\$2,487	\$14,513	\$7,628	\$8,768	\$12,937	\$57,626	\$1,468	\$2,083	\$685	\$9,973	\$2,364	\$12,054

Notes:

- Presumptive general response actions were taken from the April 14, 1995 Informal Note from S. Golian (see Appendix A).
- Costs are in thousands of dollars.
- Shaded cells were not put forth as a presumptive general response action and thus were not evaluated in this study.
- Offsite disposal of hazardous waste was assumed to be to the Chemical Waste Management, Inc. facility near Kettleman City, CA, while low-level radioactive and radioactive mixed waste was assumed to be disposed to the Envirocare facility near Salt Lake City, UT. Category 3 low-level radioactive waste was assumed to be disposed to the Hanford Site near Richland, WA.

Table ES.2 Major Assumptions and Uncertainty

Operable Unit	Assumptions	Uncertainty
OU1 - Disposal Trenches	<ul style="list-style-type: none"> • Waste volume: 7,440 yd³. • Segregation and soil washing would reduce disposal volume by 37%. • Waste classification: RMW debris, RMW soil, LLW soil, and Category 3. 	<ul style="list-style-type: none"> • Moderate • Moderate to High • High
OU2 - ²²⁶ Ra & ⁹⁰ Sr Leach Fields	<ul style="list-style-type: none"> • Waste volume: 2,453 yd³. • Segregation and soil washing would reduce disposal volume by 67%. • Waste classification: LLW debris and LLW soil. 	<ul style="list-style-type: none"> • Low to Moderate • Moderate to High • Moderate
OU3 - Dog Pens	<ul style="list-style-type: none"> • Waste volume: 6,972 yd³. • Waste classification: RMW soil. 	<ul style="list-style-type: none"> • Moderate to High • High
OU4 - Domestic Septic Systems	<ul style="list-style-type: none"> • Waste volume: 552 yd³. • Waste classification: HW. 	<ul style="list-style-type: none"> • Moderate to High • High
OU5 - Landfills	<ul style="list-style-type: none"> • Waste volume: 64,377 yd³. • Selective (hotspot) removal and segregation would reduce disposal volume by 90%. • Waste classification: HW. 	<ul style="list-style-type: none"> • Moderate • High • High
<p>Category 3 = Category 3 low-level (radioactive) waste. HW = hazardous waste. LLW = low-level (radioactive) waste. RMW = radioactive mixed waste.</p>		

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1.0 INTRODUCTION

A Remedial Investigation/Feasibility Study (RI/FS) is in progress at the Laboratory for Energy-Related Health Research (LEHR) at the University of California, Davis. The purpose of the RI/FS is to gather sufficient information to support an informed risk management decision regarding the most appropriate remedial actions for impacted areas of the facility (DOE-Oakland 1994). In an effort to expedite remediation of the LEHR facility, the remedial project managers requested a more detailed evaluation of a selected (presumptive) set of remedial actions. In particular, they requested information on both characterization and remedial action costs.

The U.S. Department of Energy - Oakland Office requested the assistance of the Pacific Northwest National Laboratory^(a) to prepare order-of-magnitude cost estimates for presumptive remedial actions being considered for the five source term operable units. The cost estimates presented in this report include characterization costs, capital costs, and annual operation and maintenance (O&M) costs. These cost estimates are intended to aid planning and direction of future environmental remediation efforts. They should not be considered as accurate or as complete as estimates prepared under the normal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Feasibility Study process, and the presumptive set of remedial actions should not be considered a complete and final set of preferred remedial alternatives. Screening and development of these presumptive remedial actions does not follow the formal RI/FS guidance (EPA 1988).

This chapter contains discussions on the scope of this study, the approach taken, some of the general assumptions made, and a discussion of the report's organization.

1.1 SCOPE

The scope of this cost evaluation study is limited to Operable Units 1 through 5 (Figure 1.1). A list of the presumptive general response actions, technologies, and process options was taken from a memo by S. Golian (Appendix A), and is summarized in Table 1.1. These presumptive remedial actions are intended to represent a "best guess" set of remedial actions that address only the waste sites themselves. The remedial actions are not intended to address contamination that may extend for any appreciable distance into the vadose zone beneath the waste sites.

There are many unknowns and uncertainties regarding the nature and extent of contamination, the risks associated with this contamination, and the preliminary remediation goals. The presumptive remedial actions presented in this report were not selected relative to a formal set of remedial action objectives. Evaluation of the effectiveness of these presumptive remedial actions relative to their ability to meet a given set of Remedial Action Objectives and/or all reasonable and appropriate requirements is outside the scope of this study. Additional general response actions, remedial technologies, and process options will likely be screened and evaluated as additional RI/FS information becomes available.

(a) The Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle under Contract DE-AC06-76RLO 1830.

Figure 1.1. Location of Source Term Operable Units Within the LEHR Facility

Table 1.1. Presumptive General Response Actions

1.2 APPROACH

The approach used to develop these cost estimates was to assemble a somewhat detailed set of presumptive remedial actions based on the likely response actions outlined in the April 14, 1995, memo from S. Golian (Appendix A). Cost estimates for these more detailed remedial response scenarios (treatment trains) are intended to complement the bounding cost estimates presented in that memo by including refined waste volume estimates, refined and referenceable cost information, and costs of characterization necessary for each remedial action scenario. In addition, an evaluation was made on the relative sensitivity of the cost estimates to critical input parameters and their uncertainties.

This evaluation did not consider costs associated with the preparation of necessary RI/FS documentation (such as work plans, the RI Report, the Baseline Risk Assessment, Feasibility Study, Proposed Plan, Record of Decision) since these documentation costs are expected to be relatively independent of the presumptive remedial actions.

1.2.1 Characterization Activities

The scope of characterization activities assumed for each remedial response action was based on how the resulting data would affect remedial action decisions, implementation, and/or postclosure monitoring. The general approach was to base the characterization needs on those activities already identified in the latest RI/FS Work Plan (DOE-Oakland 1994). In general, more characterization data were assumed to be needed for the no action and hotspot removal actions than for the capping or complete removal actions. Where some form of remedial action was assumed, the characterization efforts were designed to be more representative of a Limited Field Investigation rather than a comprehensive Remedial Investigation. Critical characterization information considered included the following:

- chemical concentrations relative to remedial action levels, waste acceptance criteria, and safety levels
- information on natural attenuation rates
- waste plume geometry (and volume estimation)
- the long-term stability of the sites (particularly of the landfills relative to subsidence [presence of large voids, percentage of biodegradable])
- critical parameters that might affect treatment (e.g., particle size distribution, clay type, debris type, partitioning coefficients, action levels versus detection limits of field instrumentation)
- sampling and analytical costs versus bulk disposal
- air monitoring needs (operational exposure and offsite impacts from remedial actions)
- postclosure monitoring needs.

The costs for most characterization activities were based on existing site-specific information and vendor discussions. A discussion on the characterization technologies and cost basis for each is provided in Appendix D.

1.2.2 Presumptive Remedial Response Actions

The scope of these presumptive remedial response actions includes the consideration of institutional constraints as they might affect remedial action decisions, characterization needs, or cost. These included possible constraints associated with the construction and operation of an onsite landfill to take all the CERCLA-derived waste; the waste acceptance criteria and transportation requirements for offsite disposal; possible action-specific all reasonable and appropriate requirements; and degree of sampling acceptable to the general public in support of no action or hotspot removal actions.

The costs for remedial action activities were based primarily on the Environmental Estimating (ENVEST) portion of the Remedial Action Cost Estimating and Requirements (RACER) System developed by Delta Research Corporation, Niceville, Florida. The RACER System is being developed for the Air Force Civil Engineering Support Agency to estimate costs for RI/FS, Remedial Design, Remedial Action, and related site work and utilities. The RACER System is a parametric cost estimating system, which differs from traditional cost estimating methods (quantity take off) by allowing the user to input a minimum amount of information to create a cost estimate, with model default quantities based on similar project case histories and experienced engineering assumptions. Predefined and documented engineering relationships link the primary parameters to detailed engineering quantities. The quantities are priced using established cost databases (primarily the Corps of Engineers' Unit Price Book, which is updated annually). Supplementary cost information has been derived from vendor and contractor quotes. The RACER System models use the Interagency Cost Estimating Group Code of Accounts to assure compatibility with other agency efforts. Over 500 individuals have been trained to use the RACER System. The list of current users includes the U.S. Air Force, U.S. Army, U.S. Army Corps of Engineers, U.S. Navy, U.S. Department of Interior, U.S. Environmental Protection Agency (EPA), U.S. Bureau of Land Management, U.S. Department of Energy (DOE), other government agencies, and commercial and government contractors.

Costs for offsite disposal were based on vendor discussions. The cost basis for other remedial technologies (e.g., in situ stabilization/solidification and soil washing) was developed from a variety of references. A discussion on the design and cost basis for each of the remedial technologies is provided in Appendices B and C.

1.3 ASSUMPTIONS

Although much site information has been collected over the last few years, much remains unknown, particularly as it relates to clean-up levels and other institutional constraints. Thus, many assumptions were made either at the outset or during the course of the evaluation. The more general assumptions are given in Table 1.2, while those assumptions specific to each site and/or response action (such as waste volumes) are provided in the operable unit discussions in Section 2.0, and the cost estimates are provided in Appendices E through I. This evaluation did not consider costs associated with the preparation of necessary RI/FS documentation (such as work plans, the RI Report, the Baseline Risk Assessment, Feasibility Study, Proposed Plan, Record of Decision) because these documentation costs are expected to be relatively independent of the presumptive remedial actions.

Table 1.2. General Assumptions

There is ample room to construct and operate an onsite landfill to handle all of the CERCLA-derived waste from the LEHR facility.
A permit is not required for operation of an onsite landfill, and there are no restrictions concerning its acceptance of all CERCLA-derived LEHR waste.
The physical extent of remediation efforts for each site is assumed to be slightly larger (1 to 2 ft in each direction) than the physical boundaries of the waste site. Volumes were not based on preliminary remediation goals or remedial action objectives (these are yet to be established).
All decontamination and decommissioning activities (such as the dog pens) have been completed before any remedial actions.
All postclosure monitoring will be conducted on a sitewide basis and will consist of continuation of the groundwater monitoring program. These costs are assumed to be independent of the source term remediation efforts and, thus, are not included in the cost estimates.
No additional vadose zone or surface water monitoring is required for any of the source term remedial actions.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act. LEHR = Laboratory for Energy-Related Health Research.

1.4 REPORT ORGANIZATION

This report gives the presumptive remedial response actions for each of the operable units (Section 2.0). Section 3.0 contains the results and discussion; Section 4.0 contains the references cited herein. Appendixes A through D give the background information used to determine the characterization and remedial action costs, and Appendixes E through I present the cost sheets prepared for each operable unit.

2.0 PRESUMPTIVE REMEDIAL RESPONSE ACTIONS

The presumptive remedial response actions examined in this study were taken from the April 14, 1995, memo from S. Golian (Appendix A) and include the following:

- no action
- in situ treatment
- capping
- hotspot removal (with onsite and offsite disposal) and capping
- hotspot removal with segregation (and onsite and offsite disposal) and capping
- removal and disposal (onsite and offsite)
- removal, treatment, and disposal (onsite and offsite)
- removal, segregation, and disposal (onsite and offsite)
- removal, segregation, treatment, and disposal (onsite and offsite).

However, not every remedial response action was evaluated for every source term or component within each operable unit. Table 1.1 summarizes the remedial actions presumed to be most likely for each operable unit, as defined in the April 14, 1995, memo from S. Golian (Appendix A). The characterization needs required to support these remedial actions were developed from the RI/FS Work Plan (DOE-Oakland 1994). A brief discussion on the background and presumptive remedial actions evaluated for each source term operable unit follows.

2.1 OPERABLE UNIT 1

Operable Unit 1 (OU1), as defined by the LEHR core project team, contains three source areas: the Disposal Trenches, the DOE Disposal Box, and the 49 Waste Holes (Appendix A). The Disposal Trenches were further subdivided into the Southwest Trenches, a possible area of surface contamination caused by human intrusion, and the Solid Waste Trenches for evaluation of presumptive remedial actions (Appendix A). However, for the purposes of this study, the area of human intrusion is assumed to be remediated in concert with the southwest trenches; a separate evaluation was not performed.

2.1.1 Background

Disposal Trenches. The disposal trenches are generally located along the southern boundary of the LEHR site and adjacent to Landfill Unit #2. Low levels of chloroform and ^{226}Ra have been detected at the Southwest Trenches. Reportedly, there are three trenches, numbered 15 through 17. Trenches 15 and 16 combined are approximately 120 ft in length and oriented in a north-south direction. Trench 17 alone is of similar length and orientation. The depth of the trenches is assumed to be 8 ft to 10 ft.

Chloroform is expected to be found in the Solid Waste Trenches adjacent to Landfill Unit #2. Containers with pesticides were also found. These trenches are numbered 1 through 14. Typical dimensions are 2-ft wide, length ranging from 33 ft to 270 ft, and depth of 8 ft to 10 ft.

DOE Disposal Box. A metal box is expected to be found at this source area. The box is estimated to measure approximately 30 ft by 15 ft according to site maps and is assumed to be 8 ft to 10 ft deep. Radioactive and possibly radioactive mixed waste is expected to be in the box. The extent of contamination in the adjacent soils is unknown.

49 Waste Holes. The waste holes are unlined holes or pits dug into the soil. Waste was then placed in the holes and backfilled. Waste materials, including 17 radionuclides, 8 of which are long-lived isotopes, and tritium are expected to be found at the 49 Waste Holes. Documents indicate that 1.7 Ci (total) of radionuclides was released. One wipe sample revealed alpha contamination. Records also show that bottles containing chemicals were disposed in the waste holes. The waste hole dimensions are approximately 4 ft by 4 ft by 8 ft to 10 ft.

2.1.2 Presumptive Remedial Actions

Table 1.1 shows the presumptive remedial actions evaluated for each of the OU1 source areas. These presumptive remedial actions were taken the April 14, 1995, memo from S. Golian (Appendix A), which presents the general rationale for the selection of these presumptive remedial actions. The presumptive remedial actions evaluated for the OU1 source areas included the following:

- hotspot removal (with onsite and offsite disposal) and capping
- removal and disposal (onsite and offsite)
- removal, segregation, and disposal (onsite and offsite)
- removal, segregation, treatment, and disposal (onsite and offsite).

Hotspot Removal and Capping Response Action. Hotspot removal and capping involves the excavation and removal of hotspots. The hotspot excavations would be backfilled with clean soils before capping the entire source area. The cap would consist of eight layers, combine natural and synthetic materials, and meet Resource Conservation and Recovery Act (RCRA) standards. Contaminated debris and soils would be disposed onsite or offsite, without segregation or treatment.

Characterization activities associated with this response action include geophysical, soil-gas, and radiological surveys; soil borings; and chemical sampling and analysis. The surveys would be used to delineate the hotspots, with borings, sampling, and analysis as confirmation. Stockpiled wastes will be characterized for disposal. Backhoe exploration and physical testing proposed in the RI/FS Work Plan (DOE-Oakland 1994) are considered unnecessary.

Southwest Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwest Trenches is estimated to be 470 yd³. Approximately 50% of this volume is assumed to be excavated during hotspot removal.

Solid Waste Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2,790 yd³. Approximately 50% of this volume is assumed to be excavated during hotspot removal.

49 Waste Holes. The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3,860 yd³. Approximately 50% of this volume is assumed to be excavated during hotspot removal.

Removal and Disposal Response Action. Removal and disposal involves the excavation, removal, and disposal of buried waste materials and contaminated soils, without segregation or treatment. The excavations would be backfilled with clean soils. Contaminated debris and soils would be disposed onsite or offsite.

Characterization activities associated with this response action include geophysical, soil-gas, and radiological surveys and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the RI/FS Work Plan (DOE-Oakland 1994) are considered unnecessary.

Southwest Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwest Trenches is estimated to be 470 yd³. This response action assumes 100% of this volume is to be excavated.

Solid Waste Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2,790 yd³. This response action assumes 100% of this volume is to be excavated.

DOE Disposal Box. The total volume to be excavated, including the box and adjacent soils, is estimated to be 320 yd³. This assumes the sides of the excavation are sloped 1:1 (run:rise) to prevent cave in. This response action assumes 100% of this volume is to be disposed.

49 Waste Holes. The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3,860 yd³. This response action assumes 100% of this volume is to be excavated.

Removal, Segregation, and Disposal Response Action. This response action is similar to the removal and disposal response action except that the contaminated soils would be segregated from the waste materials before onsite or offsite disposal. No treatment would be performed on the segregated soils. The excavations would be backfilled with clean soils.

Characterization activities associated with this response action include geophysical, soil-gas, and radiological surveys and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the RI/FS Work Plan (DOE-Oakland 1994) are considered unnecessary.

Southwest Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwest Trenches is estimated to be 470 yd³. This response action assumes 100% of this volume is to be excavated.

Solid Waste Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2,790 yd³. This response action assumes 100% of this volume is to be excavated.

49 Waste Holes. The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3,860 yd³. This response action assumes 100% of this volume is to be excavated.

Removal, Segregation, Treatment, and Disposal Response Action. This response action involves the excavation, removal, segregation, treatment, and disposal of buried waste materials and contaminated soils. The contaminated soils would be segregated from the waste materials for treatment. Treatment would involve soil washing to concentrate contaminants into smaller volumes through classification techniques and/or dissolution/desorption. The excavations would be backfilled with clean soil.

Characterization activities associated with this response action include geophysical, soil-gas, and radiological surveys and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the RI/FS Work Plan (DOE-Oakland 1994) are considered unnecessary.

Southwest Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwest Trenches is estimated to be 470 yd³. This response action assumes 100% of this volume is to be excavated.

Solid Waste Trenches. The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2,790 yd³. This response action assumes 100% of this volume is to be excavated.

49 Waste Holes. The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3,860 yd³. This response action assumes 100% of this volume is to be excavated.

2.2 OPERABLE UNIT 2

Operable Unit 2 (OU2) consists of the ²²⁶Ra and ⁹⁰Sr treatment tanks and leach systems. The purpose of these systems was to treat radioactive waste before discharge to leach fields. The April 14, 1995, memo from S. Golian (Appendix A) divides this operable unit into three components: structures, soils, and cobbles. However, in this study, the soils and cobbles are evaluated together as a single component.

2.2.1 Background

The ²²⁶Ra treatment tanks consist of a series of buried settling tanks located between the Imhoff and Animal Hospital-2 Buildings. The ²²⁶Ra leach system is made up of a seepage trench, three dry wells, a distribution box, and associated distribution pipelines. The ²²⁶Ra treatment system received low-level radioactive fecal matter and waste water from Animal Hospital-2.

The ^{90}Sr treatment system, located beneath and adjacent to the Imhoff Building, is composed of the Imhoff treatment tanks and two leach fields. The older, original leach field, abandoned when the Imhoff Building was constructed, is located partly under the east end of the Imhoff Building, while the more recently used leach field is located east of the Imhoff Building. The Imhoff tank system is buried beneath the Imhoff Building, and several techniques were used for treating the waste. The ^{90}Sr treatment system received low-level radioactive waste from laboratory experiments involving ^{90}Sr .

The ^{226}Ra and ^{90}Sr treatment and leach field systems have been subdivided into two sites: the ^{226}Ra treatment and leach field system and the ^{90}Sr treatment and leach field system. Each of these two sites collectively consist of structures, soils, and cobbles. Structures consist of the treatment and septic tanks, pipelines, distribution box, and manholes, which are all composed primarily of concrete. The only structure associated with the leach fields is buried clay tiles and a concrete slab at the surface over part of the ^{90}Sr leach fields. Soils include those that are naturally occurring or fill material beneath or adjacent to the structures or leach fields. Soils could potentially be contaminated as a result of leakage through the structures and migration through the soils. Cobbles include coarse fill material for the three dry wells and for the ^{226}Ra trench.

2.2.2 Presumptive Remedial Response Actions

Table 1.1 shows the presumptive remedial actions evaluated for each of the OU2 components. These presumptive remedial actions were taken the April 14, 1995, memo from S. Golian (Appendix A), which presents the general rationale for selection of these presumptive remedial actions. Presumptive remedial response actions for each of the treatment and leach field systems included the following:

- no action
- in situ treatment
- removal and disposal (onsite and offsite)
- removal, treatment, and disposal (onsite and offsite).

No Action Alternative. No remedial action will be taken; however, characterization will be performed to justify leaving the structures, soils, and cobbles in place. Characterization will include a literature review and geophysical survey to locate the distribution box, piping, and leach fields. Backhoe exploration will allow for direct sampling of soils and cobbles in the ^{226}Ra trench and leach fields and along the pipelines, as described in the RI/FS Work Plan (DOE-Oakland 1994). Soil borings will be installed adjacent to the structures; the number and location is dependent on analysis results of the wipe samples and concrete cores. Physical testing of soil samples will not be needed.

Soils refer to soil material within approximately 2 ft adjacent to and beneath the structures and in the ^{90}Sr leach fields, ^{226}Ra trench, and dry wells. Structures refer primarily to concrete material composing the tanks, distribution box, pipes, and dry wells. It is assumed that the soil borings will be drilled to approximately 2 ft below the structures and bottom of the leach fields or to the maximum downward extent of contamination (i.e., drilling will be stopped when clean soil beneath the structures and leach fields has been encountered), whichever depth is greater.

The RI/FS Work Plan (DOE-Oakland 1994) was used as a guideline for selecting the types of characterization needed. A Limited Field Investigation is assumed to be sufficient to characterize the site.

In Situ Treatment Response Action. In situ treatment involves solidification of soils and buried structures for the purpose of immobilizing radiological contaminants beneath the treatment and leach field systems. The contaminants considered for treatment are primarily ^{226}Ra and ^{90}Sr . These contaminants have low diffusion coefficients in cement matrixes and are more likely to be effectively immobilized in a solidified waste form.

In situ treatment will include a bench-scale treatability study, actual treatment of the structures and soils, and collection of samples for assessing the effectiveness of the treatment (i.e., verification samples). Toxic Characteristic Leach Procedure (TCLP) tests will be conducted on verification samples collected during the solidification process for evaluating the leachability of the contaminants.

Radium-226 Treatment and Leach Field System. Pressure grouting could be used to solidify the tanks, dry wells, and distribution box. Jet grouting will probably be conducted at the trench and along the distribution pipelines. The total volume to treat is assumed to be 1,327 yd³.

Strontium-90 Treatment and Leach Field System. Because part of the ^{90}Sr leach fields is beneath a concrete slab, jetting grouting techniques will be needed to treat the underlying soils. Pressure grouting could be used to solidify the Imhoff tanks. The total volume of material to treat is assumed to be 1,126 yd³.

Removal and Disposal Response Action. This response action involves the excavation, removal, and disposal of buried structures and contaminated soils and cobbles without segregation or treatment. The treatment and leach field systems are likely contaminated with low levels of ^{226}Ra and ^{90}Sr . All excavated material (including soils and cobbles) are assumed to be disposed as low-level waste debris. It is likely that the receiving waste facility will not accept the material as low-level waste soil, which has a lower cost, because it would have debris in it. Envirocare, Salt Lake City, Utah, which is located 625 mi from LEHR, is assumed to be the receiver of the waste debris.

Characterization includes a geophysical survey and backhoe exploration. The geophysical survey will be conducted to locate the leach fields. Backhoe exploration will be conducted to definitively locate and define the boundaries of the leach fields. Portable field instrumentation will be used to determine the highest level of personal protection required.

Radium-226 Treatment and Leach Field System. The total volume of structure material, soils, and cobbles to be excavated and disposed from the ^{226}Ra treatment and leach field system is approximately 1,327 yd³. This volume includes concrete debris material from the tanks, dry wells, distribution box, and distribution piping; cobbles from the trench and dry wells; and soils beneath and/or adjacent to the trench and structures. This volume assumes a 2-ft-thick excavation of soil from beneath the trench, with 10% overdig, and a 2-ft-thick excavation from beneath and adjacent to the structures, with a 10% overdig. There may be some cost savings with excavation of two of the dry wells because of their proximity to the trench.

Strontium-90 Treatment and Leach Field System. The total volume of structure material and soils excavated for disposal in the ^{90}Sr treatment and leach field system is estimated to be 1,126 yd³.

Disposal material consists of concrete debris from the Imhoff tanks, clay tiles and soils from the leach fields, and debris from the concrete slab demolition.

The ^{90}Sr leach fields are assumed to be excavated as one whole area (50 ft by 30 ft) rather than as a series of trenches. Most of the material from the leach fields will consist of soils. Access to a part of the ^{90}Sr leach field will require concrete slab demolition.

The tanks are assumed to have similar areal size as the leach fields. Concrete slab demolition will be required for access, as well as for removal of tank walls and interiors. Excavation depth of soils adjacent to and beneath the tanks is assumed to be 2 ft, with an overdig of 10%.

Removal, Segregation, Treatment, and Disposal Response Action. This response action is similar to the previous removal and disposal response action except that the soils and cobbles will be segregated from the concrete debris and from each other, and then treated. The soils and cobbles should only be treated if a portion can be cleaned enough for return to the site. The debris, which is assumed to make up 20% of the total volume excavated, will not be treated but will be disposed of as low-level waste debris.

The soils and cobbles will be treated using wet soil washing techniques. The assumption is that 75% of the treated soils and cobbles will be returned to the site as clean material. The other 25% of treated soils and cobbles not deemed clean enough will be disposed as low-level waste soil. The primary contaminants to remove from the soils and cobbles are ^{226}Ra and ^{90}Sr .

Similar characterization as for the removal and disposal response action will include geophysical surveys and backhoe exploration. Additional characterization will include concrete core and soil physical property sample analyses. Concrete cores will be collected from the tanks and analyzed to determine the concentration and treatability of radiological constituents. Soil physical property analysis, which includes particle-size distribution, bulk density, particle density, and porosity, is needed for the soil washing treatment process.

Radium-226 Treatment and Leach Field System. The total volume of structure material, soils, and cobbles to be excavated from the ^{226}Ra treatment and leach field system is approximately 1,327 yd³. Approximately 80%, or 1,062 yd³, of the excavated material assumed to be soil will be washed.

Strontium-90 Treatment and Leach Field System. The total volume of structure material and soils excavated at the ^{90}Sr treatment and leach field system is estimated to be 1,126 yd³. Approximately 904 yd³ of soil will be washed, with 679 yd³ returned to the site and 225 yd³ disposed as low-level waste soil.

2.3 OPERABLE UNIT 3

Operable Unit 3 (OU3) consists of the western set of dog pens and the north chemical dispensing area. The April 14, 1995, memo from S. Golian (Appendix A) proposes two presumptive remedial actions for the soils beneath the gravels of the dog pen area: no action, and removal and disposal.

2.3.1 Background

The outdoor dog pens consist of a gravel floor, chainlink fence, and cement borders. The pens were used to house beagles that had received dosages of ^{226}Ra and ^{90}Sr . Excreta from the dogs contained low-levels of radiological constituents. Chlordane and a chlordane/diesel or kerosene mixture were used to control fleas on the dogs. The contaminants of concern and their derived preliminary remedial goals are shown in Table 2.1.

Shallow soil sampling (to a depth of 18 in.) indicated some impacts to the soil from chlordane (up to 480 $\mu\text{g/kg}$) and nitrate (up to 168 mg/kg) (DOE-San Francisco 1993). The vertical extent of contamination is currently unknown; however, the low water solubility (0.056 mg/L) (White and Bryant 1995) and high carbon matter partitioning coefficient (9,500 L/g) (White and Bryant 1995) of chlordane indicate that it would have a relatively low mobility and a small vertical spread. The high water solubility of nitrate indicates a higher mobility and a greater vertical spread. The highest soil concentrations found to date only approach the preliminary remediation goals for soil (see Table 2.1). Thus, the extent of contamination requiring remediation is uncertain.

Table 2.1. Contaminants of Concern and Preliminary Remediation Goals

Potential Contaminants of Concern	Preliminary Remediation Goal (a)
Chlordane	340 $\mu\text{g/kg}$
Diesel (kerosene)	Not available
Nitrate (as nitrogen)	22,000 mg/kg
^{226}Ra (b)	0.0071 pCi/g
^{90}Sr (b)	22.2 pCi/g
(a) After <i>Region IX Preliminary Remediation Goals (PRGs) First Half 1995</i> , from Stanford J. Smucker, February 1, 1995.	
(b) PRGs for radiocnuclides were calculated by dividing a 10^{-6} risk level by the listed risk per pCi/g for total exposure to residential soil. This yields a concentration in pCi/g corresponding to a 10^{-6} risk.	

2.3.2 Presumptive Remedial Response Actions

The scope of the presumptive remedial response actions for the western dog pen area is focused only on the soils immediately beneath the gravel surface cover (Appendix A). The presumptive remedial actions selected in the April 14, 1995, memo from S. Golian (Appendix A) included the following:

- no action
- removal and disposal (onsite and offsite).

For the purposes of this study, all of the physical dog pen structures are assumed to have been decontaminated and demolished, including the surficial gravel cover, before initiating these remedial actions.

No Action Alternative. The no action alternative only involves characterization to justify leaving the soils in place. Characterization will include a literature review, soil borings, and chemical testing of soil samples as described in the RI/FS Work Plan (DOE-Oakland 1994).

Removal and Disposal Response Action. The volume of soil requiring remediation is uncertain. However, no further preremedial action characterization is assumed to be necessary. All soil directly beneath the surface gravel cover of the dog pens is assumed to be excavated to a depth of 18 in. This would include the entire area of the dog pens, including the area where the dog pens had previously been removed. However, it would not include the area beneath the existing Cellular Biology Laboratory. Table 2.2 shows the calculated volume to be removed. Some waste classification and postexcavation verification sampling would be necessary. For estimation purposes, the excavated soils are assumed to meet the waste classification for radioactive mixed waste soil; thus, offsite disposal to Envirocare, Salt Lake City, Utah, is assumed.

Table 2.2. Estimated Volume of Soil to be Removed from the Dog Pen Area

Area	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)
Dog Pens	550 + 20	210 + 20	1.5	188,250(a)	6,972(a)

(a) Does not include the area beneath the Cellular Biology Laboratory.

2.4 OPERABLE UNIT 4

Operable Unit 4 (OU4) consists of seven domestic septic tanks and associated leach fields used at the LEHR facility. Only six of these septic systems (#2 through #7) are included in this discussion of presumptive remedial response actions. The remaining system (#1) is intimately intermingled with the ²²⁶Ra dry well and leach field system and will be remediated in concert with that system (refer to the discussions in Section 2.2). The April 14, 1995, memo from S. Golian (Appendix A) breaks this operable unit into two components: soils and structures.

2.4.1 Background

The domestic septic tanks are believed to be made of concrete, with clay tile piping leading to the distribution box and leach field. The volume of the septic tanks and size/configuration of the leach fields are unknown. These septic systems potentially received hazardous or radioactive materials from laboratory sinks and floor drains until the facility was connected to the University of California, Davis Wastewater Treatment Plant, in the early 1970s. The tanks are thought to have been backfilled with sand, rubble, or pea gravel when they were abandoned. Potential contaminants of concern are unknown but may contain typical laboratory and/or x-ray chemicals.

Investigation of these septic systems has been very limited; only three of the seven septic tanks (#1, #2, and #5) had been positively located when the RI/FS Work Plan (DOE-Oakland 1994) was

written, and no soil samples have been collected. One of the tanks (#2) is thought to be partially under a building, tank #4 may contain "x-ray chemicals," tank #5 is cut by utilities, and tank #7 may not even exist.

2.4.2 Presumptive Remedial Response Actions

For the purposes of remediation, the domestic septic systems have been subdivided by medium into two problem areas: the soils associated with the leach fields and the physical structures (Appendix A). General response actions proposed in the April 14, 1995, memo from S. Golian (Appendix A) for this operable unit included the following:

- no action
- in situ treatment (of soils) or grouting in place (for structures)
- removal and disposal (onsite and offsite).

For cost estimation purposes, all tanks and leach fields are assumed to be of the same design and accessible. The volume of each septic tank is assumed to have been 400 gal, with a now partially filled void space of 40%. The volume of soil associated with each leach field is assumed to be 70 yd³ (30 ft by 21 ft by 3 ft).

The RI/FS Work Plan (DOE-Oakland 1994) calls for a variety of investigative techniques to be used to evaluate these domestic septic systems. Many of these investigative techniques are in progress and should provide additional data on the location of these systems, nature and extent of contamination, and associated risk to human health and the environment. The guidance provided in the RI/FS Work Plan (DOE-Oakland 1994) was used as a basis for determining the characterization actions for each remedial response action.

In determining the characterization needs for each response action, any characterization of the soils is assumed to have been preceded and/or performed in concert with characterization of the tanks and other structures. Thus, the costs for characterizing the soils alone are artificially low and must be combined with the costs for locating and characterizing the physical structure of the septic systems.

No Action Alternative. The no action alternative will only involve characterization to justify leaving the structures and soils in place. Characterization will include a literature review and geophysical survey to identify the location of buried tanks, piping, and leach fields. Backhoe exploration will confirm the location and allow access and sampling of the septic tank contents. Effluent lines and distribution boxes will be physically located and smear samples collected. The RI/FS Work Plan (DOE-Oakland 1994) calls for three soil borings at each system to collect soil samples beneath and/or adjacent to the structures and within the leach fields. However, the actual number and location of the soil borings will be dependent on access and the results of the structure sampling. All samples will be analyzed for the chemical and radiological parameters listed in the RI/FS Work Plan (DOE-Oakland 1994). Soil analyses will include TCLP testing. Physical testing of the soil samples is not necessary.

In Situ Treatment Response Action. In situ treatment involves solidification and/or stabilization of soils and grouting of the buried structures for the purpose of immobilizing the contaminants in place. Possible techniques for solidifying soils in place include mixing with conventional mechanical equipment, shallow soil mixing, injection grouting, and jet grouting (Appendix B).

The potential contaminants of concern are unknown but may contain typical laboratory or x-ray chemicals. Assessing the potential effectiveness of the solidification technologies without better chemical characterization is not possible. However, the assumption is that typical solidification agents can be used to successfully immobilize the contaminants. Because the leach fields are near or under buildings, they will likely need to be treated with injection or jet grouting techniques.

The implementation of this general response action will involve treatability testing, actual treatment of the structures and soils, and collection of verification samples for assessing the effectiveness of the treatment. The TCLP tests will be conducted on verification samples collected after completion of the solidification process for evaluating the leachability of the contaminants.

Removal and Onsite Disposal Response Action. This response action involves excavation, removal, and onsite disposal of buried structures and contaminated soils without treatment. All excavated structural material and soil are assumed to be disposed to an onsite RCRA-designed landfill.

Removal and Offsite Disposal Response Action. This response action involves excavation, removal, and disposal of buried structures and contaminated soils without treatment. The septic systems are described as potentially receiving hazardous and/or radioactive material. Potential contaminants of concern are unknown but may contain typical laboratory or x-ray chemicals. The potential presence of x-ray chemicals suggests that the excavated material may be a low-level radioactive waste, while the presence of typical laboratory chemicals may make this a hazardous waste. Because these were sanitary septic systems and probably not used to dispose large amounts of radioactive material, these wastes are considered as hazardous waste for the purpose of cost estimation. Disposal is assumed to be to the Chemical Waste Management Inc. landfill in Kettleman City, California.

2.5 OPERABLE UNIT 5

Operable Unit 5 (OU5) includes the University of California, Davis Landfill Units #1, #2, and #3. The April 14, 1995, memo from S. Golian (Appendix A) further subdivides Landfill Unit #3 into two source areas: the landfill area itself and a possible area of surface contamination caused by inadvertent human intrusion. For the purposes of this study, however, the area of human intrusion is assumed to be remediated with any remedial action involving the landfill area itself. A separate evaluation was not performed for the area of human intrusion. A brief description of the three landfills is followed by a discussion of the presumptive remedial response actions.

2.5.1 Background

Landfill Unit #1 (LF01) operated from the 1940s until the 1950s and received general campus wastes (possibly including chemical wastes) and sewage sludge (DOE-Oakland 1994).

Landfill Unit #2 (LF02) operated from 1956 to 1967 and consists of 12 east-west-oriented disposal trenches. These trenches are unlined and are estimated to be 10-ft deep. Types of waste were not documented but apparently included general refuse, animal parts, ash from the incinerator, and some liquid chemicals (DOE-Oakland 1994).

Landfill Unit #3 (LF03) operated from 1963 to 1967 and consisted of two large, pit-like excavations (DOE-Oakland 1994), probably containing similar wastes as LF01 and LF02.

Based on available sampling data to date, the main constituents of concern for the landfills appear to be hexavalent chromium and chloroform. It is doubtful that radioactive material was disposed in the landfills. However, because of the lack of records for these units, the possibility of encountering radioactive materials in the landfills cannot be completely discounted.

2.5.2 Presumptive Remedial Response Actions

The presumptive remedial response actions evaluated for LF01, LF02, and LF03 were taken from the April 14, 1995, memo from S. Golian (Appendix A). These included the following:

- hotspot removal (with onsite and offsite disposal) and capping
- capping
- removal and disposal (onsite and offsite).

In addition, the No Action Alternative was also evaluated. Each of these response actions are described in this section. Because all the landfills received similar types of wastes, the potential implementation methods for the actions do not generally change from site to site. Therefore, the discussion will refer to the landfill sites as a group, rather than individually, except where special actions for a particular site are necessary or appropriate.

No Action Alternative. Characterization activities will be required to determine if the No Action Alternative is appropriate. The primary purpose of this characterization is to make a reasonable effort to identify the highest concentration of each contaminant released to the OU5 landfills. These activities included the following:

- surface geophysical survey
- soil-gas sampling
- surface radiation survey
- subsurface soil sampling.

Surface Geophysical Survey. Surface geophysical surveys have been performed at selected areas of LEHR, including portions of all three landfills. Additional surface geophysical surveys are needed for portions of LF01 and LF02 that were not initially surveyed. Information obtained from this survey will be used in locating additional subsurface soil borings. At LF01, a survey will be conducted in the vicinity of the goat isolation buildings, which overlie the easternmost portion of the landfill, as indicated by aerial photographs. At LF02, a survey will be conducted in the dog pen area after the pen structures have been removed. No further surface geophysical activities are necessary for LF03.

Soil-Gas Sampling. Soil-gas sampling is in progress at each of the landfills to identify locations of elevated volatile organic compounds, including chloroform. Results of this survey will help identify locations for subsurface soil sampling. For this cost estimation, soil-gas samples are assumed to be collected in a grid pattern, up to approximately 20 grid locations per landfill.

Surface Radiation Survey. A surface radiation survey will be conducted over each landfill to detect surface/near-surface radionuclides. Two surveys will be performed: 1) using a germanium

detector to measure for gamma radiation, including ^{60}Co and ^{226}Ra , and 2) using a beta scintillation sensor that can detect ^{90}Sr and provide real-time results. Results of these surveys will be used to help identify locations for subsurface soil sampling. For both types of surveys, counts will be made at selected grid locations at the landfills. For the germanium detector survey, approximately 10, 22, and 8 grid points will be surveyed for LF01, LF02, and LF03, respectively. For the beta scintillation survey, approximately 20, 40, and 16 grid points will be surveyed for LF01, LF02, and LF03, respectively.

Subsurface Soil Sampling. Soil borings will be used to collect subsurface soil samples from all three landfills. Analytical results from these samples will be the primary justification for the No Action Alternative. A total of approximately 8, 14, and 3 boreholes will be drilled in LF01, LF02, and LF03, respectively. The number of boreholes was determined based on the presence of geophysical anomalies in the initial surface geophysical survey. Boreholes will be drilled to a depth of approximately 12 ft (or 2 ft deeper than the deepest identifiable waste level). Continuous core samples will be collected. Every 2.5 ft of core will be analyzed for the constituents shown in Table 5.15 in DOE-Oakland (1994). All core samples will be surveyed with portable instruments (Geiger-Muller detector, portable alpha meter, and photoionization detector).

Hotspot Removal and Capping Response Action. The primary purpose of hotspot removal is source reduction. The removal of the hotspots provides an additional measure of groundwater protection from potential migration of contaminants compared to simply capping the landfills.

Hotspots are assumed to consist primarily of chromium and chloroform, the main constituents of concern for the landfills. However, because of the uncertain composition of the landfill waste, an extensive characterization effort is required. Therefore, the type of characterization activities required for this response action will be the same as that described for the No Action Alternative.

In addition to characterization, actions required for this alternative include excavation, removal, treatment, and either onsite or offsite disposal. For cost estimation purposes, the volumes of hotspots for each landfill were estimated by the areal extent of geophysical anomalies identified in the initial surface geophysical survey. The assumed volumes of hotspots are 10%, 25%, and 10% for LF01, LF02, and LF03, respectively.

The hotspots would be excavated and treated using soil washing. Excavation and soil washing technologies are described in detail in Appendix B. Following soil washing, 50% of the hotspots are assumed to be designated as hazardous waste and the remaining 50% is returned to the site as backfill. Table 2.3 summarizes the disposal volumes for this response action. Onsite disposal will be to a RCRA-designed landfill. Offsite disposal will be hazardous waste only and will be to the Chemical Waste Management, Inc., landfill in Kettleman City, California.

Capping is described in detail in Appendices B and C. Assumptions used for the capping cost estimate include the following:

- cut-off walls will not be required (hydraulic conductivity is low enough [$2.7\text{E-}04$ cm/s])
- vadose-zone monitoring will not be required as part of landfill operation
- cap design will meet California seismic design standards

- where the cap is adjacent to a building, a retaining wall would be required (e.g., at the eastern end of LF01 and the northern end of LF02)
- in areas where buildings overlie landfill materials, the building structure is assumed to be an adequate cap
- toe drains (for surface runoff) will be installed as part of the cap
- gas venting of the cap will not be required.

Table 2.3. Disposal Volumes for Hotspot Removal and Capping

	LF01	LF02	LF03
Area of landfill (ft ²)	52,736	99,756	19,186
Total volume of landfill (yd ³)	18,182	38,401	7,794
Assumed volume of hotspots	~10%	~25%	~10%
Volume of hotspots (yd ³)	1,850	8,890	650
Number of separate hotspots	4	4	2
Assumed hotspot hazardous waste material	50%	50%	50%
Assumed nonhazardous hotspot material that can be returned as clean backfill	50%	50%	50%
Volume of hotspot material to be disposed as hazardous waste (yd ³)	925	4,445	325

Capping Response Action. The response action considers capping of the entire area of each landfill. Characterization activities for this response action are minimal and consist only of soil-gas sampling. Soil-gas sampling will be required for characterization of methane within the landfill to determine if venting of the cap will be necessary. For cost estimation purposes, venting was assumed to be unnecessary. Capping is described in detail in Appendices B and C. Assumptions used for the capping cost estimate are the same as those for the hotspot removal and capping response action discussed previously.

Removal and Disposal Response Action. Entire removal of the landfill contents provides complete source reduction (excluding deep vadose zone contamination). Because the boundaries of all the landfills are known, no characterization is needed for this action.

Response actions required consist of excavation, removal, and either onsite or offsite disposal. Onsite disposal will be to a RCRA-designed landfill. Offsite disposal will include hazardous waste only and will be to the Chemical Waste Management, Inc. landfill in Kettleman City, California.

3.0 RESULTS AND DISCUSSION

This section presents the order-of-magnitude costs for each of the presumptive remedial response actions proposed for the LEHR facility waste sources. These costs are intended for qualitative planning purposes only and are not intended to be as accurate nor as complete as estimates prepared under the normal CERCLA Feasibility Study process (EPA 1988). Some of the uncertainties and the estimated sensitivity of the cost estimates to these uncertainties is also presented. A summary of costs for each response action, technology, and process option is provided in Table 3.1. Details of the cost estimates are presented in Appendices D through H.

3.1 ESTIMATED REMEDIAL RESPONSE ACTION COSTS

These cost estimates are order-of-magnitude with no intended level of accuracy (such as the +50% or -30% required under the CERCLA Feasibility Study process). Actual remedial response action costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final remedial design, final schedule, firm selected to perform the engineering, and many other variables. As a result, the final project cost will differ from the estimates presented here. Because of the inherent variability, financial needs and resources must be carefully reviewed before decisions are made or final remedial response action budgets are estimated.

The specific technologies for each action were selected to provide only a basis for cost estimating. The actual remedial response actions and their associated costs will be determined when the EPA in concert with the other remedial project managers select the approach for the final design.

Cost estimates include characterization, total capital cost for remedial actions, annual O&M costs, and present worth costs. Total characterization, remedial action capital, and unit price costs are based on information solicited from local contractors, current pricing data, ENVEST model, previous experience, and engineering judgment.

3.1.1 Characterization Costs

Characterization costs are the direct and indirect costs needed to acquire site-specific data required to select, design, and implement a presumptive remedial action. These costs include only those expenditures needed before implementation of a remedial action. They exclude waste designation sampling and analysis, remedial confirmation and/or verification sampling and analysis, and postclosure monitoring costs.

Characterization costs may include capital costs (such as installation of monitoring wells) as well as the costs needed to prepare for or implement the characterization actions (such as the costs for materials, labor, and equipment). The costs were adjusted for the Sacramento, California, area wherever possible.

3.1.2 Capital Costs

Capital costs are the direct and indirect costs required to initiate and install components of a remedial action. They include only those expenditures needed to design, construct, and install a remedial action. They exclude the costs needed to maintain a remedial action throughout its design life.

Table 3.1. Summary of Estimated Costs

GENERAL RESPONSE ACTION			NO ACTION	IN SITU TREATMENT	CAPPING	HOTSPOT REMOVAL & CAPPING		HOTSPOT REMOVAL, SEGREGATION & CAPPING		REMOVAL AND DISPOSAL		REMOVAL, TREATMENT, AND DISPOSAL		REMOVAL, SEGREGATION, AND DISPOSAL		REMOVAL, SEGREGATION, TREATMENT AND DISPOSAL	
Operable Unit	Source Area	Division of Problem (Site/Media)				Onsite	Offsite	Onsite	Offsite	Onsite	Offsite	Onsite	Offsite	Onsite	Offsite	Onsite	Offsite
OU1	Disposal Trenches	Southwest Trenches				\$70,283	\$70,283							\$22,545	\$22,545	\$22,545	\$22,545
						\$166,449	\$961,868							\$123,374	\$1,462,476	\$804,999	\$1,054,170
						\$236,732	\$1,032,151							\$145,919	\$1,485,020	\$246,069	\$1,076,714
		Intrusion				Included With SW Trenches	Included With SW Trenches							Included With SW Trenches	Included With SW Trenches	Included With SW Trenches	Included With SW Trenches
		Solid Waste Trenches				\$109,014	\$109,014							\$31,973	\$31,973	\$31,973	\$31,973
						\$1,055,894	\$5,777,640							\$506,657	\$8,455,790	\$804,999	\$6,347,745
						\$1,164,908	\$5,886,654							\$538,630	\$8,487,763	\$836,971	\$6,379,718
	DOE Disposal Box									\$16,217	\$16,217						
	49 Waste Holes									\$92,875	\$1,175,999						
										\$109,092	\$1,192,216						
						\$116,029	\$116,029			\$31,973	\$31,973					\$31,973	\$31,973
OU2	Ra & SR Leach Fields	Structures	\$153,683	\$150,504													
			\$0	\$209,158						\$6,788	\$6,788	\$34,340	\$34,340				
			\$153,683	\$359,662						\$140,794	\$491,075	\$262,611	\$559,771				
		Soils	\$266,501	\$279,988						\$147,582	\$497,863	\$296,951	\$594,111				
			\$0	\$1,104,076						\$6,788	\$6,788	\$8,149	\$8,149				
		Cobbles	\$266,501	\$1,384,064						\$576,365	\$1,872,090	\$1,162,809	\$1,481,129				
			Included With Soils	Included With Soils						\$583,153	\$1,878,877	\$1,170,958	\$1,489,278				
										Included With Soils	Included With Soils	Included With Soils	Included With Soils				
	Soil	None	\$46,052							\$0	\$0						
			\$0							\$1,147,183	\$17,277,693						
OU3	Septic Systems	Soils	\$103,758	\$106,563													
			\$0	\$272,708						\$0	\$0						
			\$103,758	\$379,271						\$88,477	\$103,187						
		Structures	\$120,502	\$114,302						\$88,477	\$103,187						
			\$0	\$28,301						\$67,596	\$67,596						
			\$120,502	\$142,603						\$144,751	\$203,936						
										\$212,348	\$271,533						
	LF01		\$173,467		\$6,914			\$171,190	\$171,190	\$0	\$0						
			\$0		\$854,463			\$1,603,273	\$1,796,514	\$2,593,891	\$6,178,036						
			\$173,467		\$861,378			\$1,774,463	\$1,967,705	\$2,593,891	\$6,178,036						
		LF02	\$288,790		\$12,003			\$288,790	\$288,790	\$0	\$0						
			\$0		\$1,457,861			\$4,847,683	\$5,723,908	\$5,394,483	\$12,964,318						
			\$288,790		\$1,469,864			\$5,136,474	\$6,012,699	\$5,394,483	\$12,964,318						
	LF03	Landfill	\$82,690		\$8,122			\$77,055	\$77,055	\$0	\$0						
			\$0		\$343,349			\$639,916	\$710,449	\$2,016,839	\$3,553,239						
			\$82,690		\$351,471			\$716,971	\$787,505	\$2,016,839	\$3,553,239						
		Intrusion	Included With Landfill		Included With Landfill			Included With Landfill	Included With Landfill	Included With Landfill	Included With Landfill						

LEGEND	
Cost of Characterization to Support Remedial Action	\$279,755
Present Worth Cost of Remedial Action	\$1,104,015
Total Cost to Implement Remedial Action	\$1,383,770

Installation costs include such items as costs for construction, site development, and buildings and services. Construction costs include costs needed to prepare for or implement the actions (such as the costs for materials, labor, and equipment). These costs were adjusted for the Sacramento, California, area wherever possible. Decontamination facilities, health and safety equipment, and costs associated with confirmatory sampling are also included, where possible.

Indirect costs consist of engineering, supervision during construction, licenses and permits, and other services necessary to carry out a remedial action. They are not incurred as part of the remedial action but are ancillary to installation and construction costs. Indirect capital costs include bid and scope contingencies that reduce the likelihood of a cost overrun. Bid contingencies cover unknowns associated with the construction of the project (such as material or labor shortages). Scope contingencies include provisions for changes that normally occur as part of the final design and implementation. The EPA and state administration are also indirect costs, but they have not been included in the cost estimate.

3.1.3 Annual Operating and Maintenance Costs

Annual O&M costs for a remedial action include those incurred each year following construction or installation of a project. For the purposes of the economic evaluation, they are assumed to be paid at the end of the year in which they occur.

3.1.4 Present Worth

Annual O&M costs occur over different periods of time for different response actions. Present-worth analyses provide a method for comparing costs that occur over different periods of time by discounting future costs to the present year. Present worth calculations were based on a maximum 30-year period. The O&M costs that are incurred beyond the 30-year period become insignificant in the present-worth analysis. The present-worth analyses were calculated assuming 3%, 5%, and 10% interest rates to provide a range of values. Future costs are not escalated for inflation.

3.2 UNCERTAINTY AND SENSITIVITY OF THE ESTIMATES

There are many uncertainties that can significantly affect the outcome of these cost estimates. Although no formal sensitivity analysis has been conducted, the most significant uncertainties appear to be those that affect the choice of onsite or offsite disposal and designation of the waste to be disposed (e.g., low-level radioactive soil waste versus radioactive mixed debris waste). Other important uncertainties are those affecting the size of the area to be capped and the volume of waste requiring removal or in situ treatment. A number of these uncertainties and their relative effects are listed in Table 3.2.

3.3 DISCUSSION

Examination of the order-of-magnitude cost estimates presented (Table 3.1) provides some insights into the relative costs of the various presumptive remedial actions and their associated characterization activities. A brief synopsis of the observations made for each operable unit are presented in the following section.

Table 3.2 Uncertainties and Their Relative Effects on Cost Estimates

Uncertainty	Effect	Potential Magnitude of Change in Cost Estimate
Potential for Onsite Landfill Disposal	Cost of disposal	Very large
Waste Classification	Volumes and type of disposal (LLW, RMW, HW, SW, backfill) required	Very large
Preliminary Remediation Goals or Remedial Action Objectives (clean-up levels)	Volume to be removed or treated in situ Area to be capped	Large
Nature and Extent of Contamination	Volume to be removed or treated in situ Area to be capped	Large
Natural Attenuation Rates	Selection of no action or containment versus removal actions	Large
Effectiveness of Segregation/Classification	Volumes and type of disposal (LLW, RMW, HW, SW) required	Moderate
Safety Levels	Productivity levels	Moderate
Need to Backfill Shallow Excavations versus Regrading	Volume of backfill materials required (including transportation and emplacement costs)	Moderate
Combined Characterization or Remedial Actions	Costs of multiple activities (e.g., mobilization)	Moderate
HW = hazardous waste. LLW = low-level waste. RMW = radioactive mixed waste. SW = solid waste.		

3.3.1 Operable Unit 1

The most economical presumptive remedial response action appears to be removal (with or without segregation) and onsite disposal. However, if offsite disposal is necessary, the most economical action appears to be removal (with segregation), classification and soil washing (to reduce the waste volume), and disposal. The cost of offsite disposal can vary greatly, depending on the results of waste designation analyses versus waste acceptance criteria. The least economical action appears to be removal and segregation without treatment and offsite disposal.

3.3.2 Operable Unit 2

The most economical presumptive remedial response action (besides the No Action Alternative) again is removal and onsite disposal. The order-of-magnitude costs for either in situ treatment or removal, treatment, and onsite disposal are about the same. There does not appear to be an economical advantage to treat the soils and cobbles before offsite disposal. Waste designation, again, plays an important role in the costs for offsite disposal.

3.3.3 Operable Unit 3

The most economical presumptive response action for OU3 (besides the No Action Alternative) is removal and onsite disposal. Removal and offsite disposal appears to be at least an order of magnitude higher. If offsite disposal is necessary and the waste is designated as radioactive mixed waste, soil classification and soil washing technologies might be worthwhile to reduce the waste volume and thus reduce the offsite disposal costs.

3.3.4 Operable Unit 4

The cost of characterization relative to the cost of presumptive remedial response actions has driven the cost of the No Action Alternative to be on the same order as removal and disposal. The highest costs appear to be associated with in situ treatment of the soils and removal and offsite disposal of the structures and soils.

3.3.5 Operable Unit 5

Straight capping (without hotspot removal) of the landfills appears to be the most economical presumptive remedial response action besides the No Action Alternative. The expected waste volumes for these landfills are so large that hotspot removal (with segregation), treatment, and either onsite or offsite disposal followed by capping appears to be more economical than complete removal and disposal (onsite or offsite). Again, waste designation for offsite disposal can make a big difference in the relative ranking of the presumptive remedial response actions.

4.0 REFERENCES

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APPENDIX A - INFORMAL NOTE FROM S. GOLIAN; APRIL 14, 1995

INFORMAL NOTE

TO: LEHR Core Team
FROM: S. Golian, EM-22
DATE: April 14, 1995

Enclosed is the most current site conceptual model and summary notes from our meeting on April 4&5, 1995. Table 3 has been revised and an appendix prepared which outlines additional information needs and actions required to begin a more detailed evaluation of those likely response actions identified by the team.

Below I have outlined some thoughts for your consideration on how you may want to proceed over the next several weeks.

- o Initiate a more detailed evaluation of the response options discussed in our meeting as being the most appropriate, i.e., 1) capping of landfills, on-site disposal of non-adjacent areas into a RCRA-type cell; 2) capping of landfills and off-site disposal of non-adjacent areas. Team will also need to finalize a decision regarding the characterization of the landfills and the appropriateness of capping them in accordance with state and Federal recommendations. Should you elect to consider other options than capping for the landfills, this would serve to constitute a third or fourth alternative with either on-site or offsite disposal of materials in the landfills. [NOTE: related to these evaluations will be the consideration of treatment as an appropriate or possibly required response and the University's desire to look at the possibility of future research options on any waste remaining at the site; with respect to treatment needs, I have asked Jeff, Liz and Steve to begin drafting some thoughts on implementing treatment contingencies during excavation].
- o Begin evaluating the potential timing of response actions (e.g., removal of the dog pens and Goldman's box this fiscal year, sign interim action ROD for sources in early FY96 with remedial action in late FY96 or early FY97?????)
- o Begin comparing identified data needs (Table 3 and Appendix A) against the current draft of the RI/FS workplan to ensure all necessary data will be collected and any unnecessary data collection is eliminated. [NOTE: for most activities, necessary data collection may not be defined until the action items in Table 3 are addressed]
- o Compile and organize existing ground water data to facilitate the generation of a "picture" of the current conditions and what the remaining ground water data needs may be.
- o Generate a "user-friendly" site map identifying known sources with an accompanying table which describes what is currently known about each source. Particularly useful for each source would be a comparison of contaminant levels (either from samples or known release quantities) against the EPA and State preliminary remediation goals and action levels.
- o Revisit the public participation strategy in light of the direction the team is now moving, i.e., should a public meeting be held to 1) summarize known conditions (the site map, accompanying tables, and site conceptual model would be helpful to facilitate communication); 2) review the teams' initial screening of alternatives and supporting rationale (the "1st cut" FS analyses would be useful here); 3) identify what alternatives are designated to be evaluated in detail; and 4) outline the possible timing of response actions. Such a meeting would allow the public to inform you of other options they may want to have considered or concerns they may have with the alternatives being evaluated.

I believe the majority of the activities discussed above are "desk-top" paper exercises that could be completed over the next four to six weeks. If you think it would be helpful, we could hold one more

meeting together in late May or early June to wrap up the uncertainty discussions and data needs for all sources, establish ground water data needs and investigation strategy, timing of response actions, and develop decision rules for potential treatment contingencies, etc.

Please let me know how you would like to proceed. Thank you again for your participation with the strategic milestone review initiative.

II. Workshop Summary Notes

- I. Cover Memo
- II. Workshop Summary Notes
- III. Agenda For LEHR Strategic Milestone Initiative Meetings
- IV. Development of Conceptual Site Model and Likely Response Actions
 - 1. Describe the basis of the conceptual model (from the Draft RI/FS Work Plan)
 - 2. Expected Site Conditions Based on Existing Information
 - 3. Likely Response Actions Based on Expected Site Conditions
 - 4. Display of results of the conceptual model development in table and figure
 - 5. Display of results of likely response action development in table
 - 6. LEHR site map
- V. Development of Data Needs
 - 1. Describe Approach
 - 2. Display of Data/Information Needs in Tables by Likely General Response Action
- VI. Approximate Cost Comparison of Selected Alternatives
 - 1. Rationale and Limits
 - 2. Sensitivities
 - 3. Incompleteness of Cost Estimate
 - 4. Alternatives
 - 3. Results

Appendix A: Revisions to Summary Notes

III. Agenda For LEHR Strategic Milestone Initiative Meetings

1. Develop a conceptual site model based on existing information by identifying likely source areas, pathways, and receptors
Goal: Come to an agreement on how site works and remaining uncertainties
2. Identify site concerns
Goal: Come to agreement on priorities for response
3. Identify likely general response actions and land use
Goal: Focus the feasibility study to a discrete set (2-3) of viable alternatives
4. Identify remaining data needs, manageable uncertainties, and requirements for a risk assessment
Goal: Come to agreement on what data must be collected before response(s) and what data may be collected during response(s)
5. Develop a site management strategy
 1. Sampling/Analysis plan
 2. Type/Timing of response
 3. Public participation plan*Goal:* Appropriately remediate the site as efficiently and effectively as possible

IV. Development of Conceptual Site Model and Likely Response Actions

The conceptual model described in the Draft RI/FS Work Plan (Figure 1) was used as the starting point for discussions held in Oakland on March 15th and 16th. This conceptual model was revised based on the following:

- Use of existing information from LEHR (historical and current data)
- Consensus of LEHR core project team (Duncan Austin, Cal/EPA Department of Toxic Substances Control; Jim Littlejohn, DOE/OAK; Julie M'Neal, U.C. Davis; Alice Tackett, U.C. Davis; Lida Tan, U.S. EPA; Susan Timm, Regional Water Quality Control Board) with regards to current site conditions

The revised conceptual model (Figure 2) is the result of these discussions and represents only current site conditions. Probable or expected conditions are shown with solid lines. Uncertain conditions which were felt to be reasonable possibilities are shown with dotted lines. Table 1 summarizes the changes made to the original RI/FS conceptual model and the rationale for those changes.

Expected Site Conditions

Following a consensus on how the site was currently working, the extended LEHR team discussed site problems, expected conditions, and likely general response actions. Three site problems were identified:

- 1) Continuous releases to soil sub-surface from sources that leach to the upper and lower hydrostratigraphic units. The sources include:
 - Radium-226 leach field
 - Strontium-90 leach field/Imhoff underground tanks
 - Forty-nine waste holes
 - Southwest trenches
 - Solid waste trenches adjacent to landfill unit #2
 - DOE box
 - Disposal trenches
 - Landfill units # 1, 2, and 3
 - Chemical dispensing area
 - Seven septic systems
 - Southwestern dog pens soils
- 2) Groundwater contamination that is known to exceed MCLs at specific points (both spatial and temporal). This includes contamination of both the upper and lower hydrostratigraphic units. This site problem has uncertainty associated with it because unknown sources may contribute to groundwater contamination.
- 3) Unknown "spills" to soil surface that have unknown likelihood of being resuspended by wind and storm water and being transported to offsite receptors, on-site workers, and Putah Creek. This includes intrusion into Landfill unit #3 and the southwestern trenches.

The team ranked the groundwater as the primary overall concern of these three site problems, but agreed that the first priority for considering general response actions should be the problem of continuous releases from the sources to the sub-surface soil. This decision was based on two key factors:

- The groundwater will continue to be affected as long as the sources are releasing contaminants to the sub-surface soil because the contaminants leach to the upper and lower hydrostatigraphic units; and
- Current data indicates that the groundwater contamination does not demand immediate attention or an emergency action.

Under these circumstances, the primary concern is for the long-term protection of the groundwater. This can only be accomplished by addressing the problem at the sources. Any remediation of currently contaminated groundwater is a second priority for considering general response actions.

Likely Response Actions

Consequently, the extended LEHR team focused the remaining time at the March 16th meeting discussing the site problems contributing to the continuous releases to the sub-surface soil. Table 2: Site Problems and Likely Response Actions at LEHR summarizes the sources contributing to this site problem, the expected conditions and the likely general response actions identified by the extended LEHR team. Please note that disposal signifies either on-site or off-site disposal.

Figure 1

Conceptual Model Found in the RI/FS Work Plan

Table 1
Revisions to the Conceptual Model

Type of Change	Change	Rationale
Source (Number 10 in Figure 1)	Eliminated the chemical dispensing area as a discrete source.	Combined with the solid waste trenches because of proximity in location and similarity of probable response actions.
Source (Numbers 1 & 2 in Figure 1)	Combined radium-226 and strontium-90 leach fields as one source area.	Combined the leach fields because of proximity in location, similarity of probable response actions, and similarity of probable contaminants. Although the leach fields received primarily either radium or strontium, some overlap in dispensing existed.
Source (Number 11 in Figure 1)	Eliminated septic system #1 from the septic systems source area.	Added septic system #1 to the leach fields source area because of proximity in location and similarity of probable response actions.
Source (Number 9 in Figure 1)	Eliminated the Imhoff underground tanks as a discrete source.	Combined with the radium and strontium leach fields source area because of proximity in location, similarity of probable response actions, and similarity of probable contaminants.
Release Mechanism	Deletion of the radiation/ radioactive decay release mechanism from the sources to the air.	Samples show no indication of contamination from this release mechanism. The only problem observed with radon is following rains, which is considered normal. Radioactive materials will not get into the air unless it is attached to volatiles.
Release Mechanism	Infiltration/Percolation release mechanism redefined as intrusion	Intrusion more adequately describes the possible release of contaminants from the sources. The consensus was that there was a possibility that sources could contaminate the surface soil because of historical disturbances, but not via infiltration or percolation.

Type of Change	Change	Rationale
Pathway	The pathway via intrusion was defined as uncertain.	Data do not show any indication of contamination of the surface soil. However, there are reports of historical disturbances into Landfill unit #3 and the Southwestern trenches, which could result in contamination via this pathway. Therefore, the entire pathway of contaminants being released via intrusion is considered an uncertainty.
Source/Release Mechanism	A number of sources were eliminated as possible contributors to contamination to the surface soil once the release mechanism was redefined as intrusion.	Past disturbances (e.g., digging) could have redeposited contaminants so that surface soil is a potential secondary source. There is an indication that two sources were disturbed: the southwest trenches and landfill unit #3. Although the pathway is uncertain, these two sources are displayed in the conceptual model as possible contaminators via intrusion. All other sources were eliminated as contributors to the surface soil. Consensus was that these sources were not contributing via infiltration, percolation, or intrusion.
Transport Mechanism	The transport of contaminants from the surface soil to the air was changed to an uncertainty, and chemical diffusion was eliminated as a transport mechanism.	Although data does not indicate that the air is contaminated, uncertainty exists because of historical disturbances which could have redistributed contaminants in the surface soils. However, consensus was that these contaminants would travel via volatilization or resuspension into the air, but not via chemical diffusion.
Receptors	Future site workers and future site residents were eliminated as receptors.	For the purposes of this conceptual model, future receptors were eliminated. This conceptual model reflects only the current condition of the site.

Type of Change	Change	Rationale
Source	Surface water was eliminated as part of the pathway for contaminants to reach receptors.	Surface water does not exist on-site except under storm conditions. In such a case, excess storm water would discharge into Putah Creek. The only place where surface water collects in along the western trenches. Consensus was that this is not a problem and that the only possible receptors of surface water contamination were exposed via Putah Creek.
Exposure Route	Inhalation was eliminated as an exposure route for contaminants that could be in Putah Creek.	Consensus was that inhalation was not a viable exposure route for possible contaminants in Putah Creek.
Release Mechanism	Leaching was redefined as dispersion.	Dispersion better describes the release of contaminants from the sources. It includes leaching, but also includes the movement of contaminants via release mechanisms that are not associated with water.
Transport Mechanism	Volatilization was eliminated as a transport mechanism from the sub-surface soil to the surface soil.	Contaminants in the upper hydrostatigraphic unit volatilize into the sub-surface soil, but the probable transport of these contaminants to the surface soil was eliminated. There is no indication from existing data that this is occurring. The soil is tight, which makes transport unlikely, and the quantities of contaminants makes this pathway insignificant.
Transport Mechanism	Volatilization was added as an uncertain transport mechanism into the surface soil of contaminants dispersing from the sources. and	Consensus of the group was that volatilization could not be eliminated as a transport mechanism of contaminants to the surface soil. The volatilization is shown from the dispersion release mechanism to the surface soil so as not to indicate that contaminants volatilize from the groundwater through the sub-surface soil to the surface soil.

Type of Change	Change	Rationale
Receptors	Groundwater was changed from a tertiary source to a receptor.	The State of California considers groundwater to be a receptor, per groundwater antidegradation policy.

Figure 2

Revised Conceptual Model

Table 2
Site Problems and Likely Response Actions at LEHR
Continuous Releases to Soil Sub-Surface

Sources Contributing to Site Problem	Expected Conditions	Division of Problem for Response Actions	Likely General Response Action
Radium and Strontium leach fields	<p>Radium leach field: No VOCs and very low levels of radium-226 and strontium-90 are expected. A total of 3 millicuries of radium was released to these systems. Consists of 3 dry wells, each are approx. 30" in diameter and 40' deep; a trench, which is approx. 91' long, 3' wide, and 14' deep. Public concern exists because of clogging of the system may have resulted in spills. No sampling was done inside of the trenches, dry wells, or directly underneath the trenches.</p> <p>Strontium leach field: This area consists of 2 fields, a box, and lines. The original leach field is located under a building. An estimated 2.5 millicuries of strontium-90 was discharged. 1 millicurie of plutonium-231 was discharged. Cesium was also detected. The Imhoff underground storage tanks and septic system #1 (see Figure 3), which processed sanitary waste, are included as part of the Ra/Sr leach systems.</p>	Soils	<ol style="list-style-type: none"> 1. No action 2. Removal, treat and disposal 3. In-situ treatment or containment
		Cobbles (includes trench and dry wells)	<ol style="list-style-type: none"> 1. Removal, treat and disposal 2. Removal and disposal 3. In-situ treatment or containment 4. No action
		Structures (includes distribution box, tanks, piping, manholes and septic system #1)	<ol style="list-style-type: none"> 1. Removal, treatment and disposal 2. Removal and disposal 3. In-situ treatment or containment 4. No action

Sources Contributing to Site Problem	Expected Conditions	Division of Problem for Response Actions	Likely General Response Action
Forty-nine waste holes	Radiological materials are expected, including: 17 different radionuclides, 8 of which were long-lived isotopes, and tritium. Records show that higher levels of tritium and bottles containing chemicals were disposed in the waste holes. Documents indicate that a total of 1.7 curies of radionuclides were disposed. One wipe sample detected alpha radionuclides. The dimensions of the waste holes are approximately 4'x4'x8-10'.	No division required	<ol style="list-style-type: none"> 1. Removal, treat, and disposal 2. Removal and disposal 3. Selective/hot spot removal/capping
Disposal Trenches	Potential mixed waste, very low levels of chloroform and radium have been detected. Reported to be approx. 120' long and oriented roughly in a north/south direction. The exact number, location and depth of the trenches is not known. This category includes the chemical dispensing area. Chlordane is a possible contaminant.	Southwestern trenches	<ol style="list-style-type: none"> 1. Removal, segregate and dispose 2. Removal, segregate, treat, and dispose 3. Selective/hot spot removal/capping
		Intrusion resulting in surface contamination (uncertain)	<ol style="list-style-type: none"> 1. Removal, segregate and dispose 2. Removal, segregate, treat, and dispose 3. Selective/hot spot removal/capping

Sources Contributing to Site Problem	Expected Conditions	Division of Problem for Response Actions	Likely General Response Action
Disposal Trenches (Continued)	Chloroform is expected in the solid waste trenches adjacent to landfill unit #2. Containers with pesticides have been found. The trenches were typically 2' wide, ranged in length from 33' to 270', and estimated to be between 8-10' deep.	Solid waste trenches (both radiological and chemical)	<ol style="list-style-type: none"> 1. Removal, segregate and dispose 2. Removal, segregate, treat, and dispose 3. Selective/hot spot removal/capping
Landfill unit #1	Received waste from campus and sludge from the wastewater treatment plant. Recent data has showed that landfill unit #1 is probably about 30' larger than originally expected. There is more of a random dumping pattern in landfill unit #1 than in either #2 or #3. A small quantity of mixed waste is possible. Chromium has been detected in the groundwater that may have come from landfill unit #1.	No division required	<ol style="list-style-type: none"> 1. Capping 2. Selective removal, segregation, treat, dispose 3. Entire removal and disposal
Landfill unit #2	Trench and fill technique was used. Often the chemicals were burned to reduce the volume. Mixed waste is uncertain. The quantity of wastes disposed in #2 is estimated at 19,260 cubic yards.	No division required	<ol style="list-style-type: none"> 1. Capping 2. Selective removal, segregation, treat, dispose 3. Entire removal and disposal

Sources Contributing to Site Problem	Expected Conditions	Division of Problem for Response Actions	Likely General Response Action
Landfill unit #3	Located off-site and only used for about 4 years. A trench and fill technique was used to dispose. Mixed waste is uncertain.	Landfill	1. Capping 2. Selective removal, segregation, treat, dispose 3. Entire removal and disposal
	The combined total acreage for the three disposal areas is estimated at approximately 6 acres	Intrusion resulting in surface contamination (uncertain)	1. Capping 2. Selective removal, segregation, treat, dispose 3. Entire removal and disposal
DOE disposal box	A metal box is expected. No contamination has been detected in adjacent soil, but radiologic, and possibly mixed, waste is expected in the box.	No division required	1. Remove/excavate and disposal
Septic systems numbered 2-7 (See Figure 3)	Septic system #2 is at least partially under a building and may have been destroyed. Septic system #4 may contain x-ray chemicals Septic system #5 is cut by utilities Septic system #7 may not exist	Soils	1. No action 2. Removal and disposal 3. In situ treatment
		Structures	1. No action 2. Removal and disposal 3. Grout in place
Soil underneath the southwestern dog pens (below gravel)	Some chlordane and some low levels of radiation are expected. The expectation is for shallow contamination.	No division required	1. No action 2. Removal and disposal

Figure #3--LEHR Site Map

Adapted from:
**FORMER WASTE
 DISPOSAL AREAS**
 RI/FS Work Plan
 LEHR Environmental Restoration
 Davis, California

V. Development of Data Needs

The extended LEHR project team met in Oakland on April 4th and 5th to:

- Review the summary sheets of the prior LEHR meeting, and
- Discuss data needs for probable general response actions identified for sources of contamination at the site.

Corrections and modifications to the March 15th and 16th summary package have been incorporated into the previous sections and are summarized in Appendix A: Revisions to Summary Notes. These changes are based on the consensus of LEHR core project team (Duncan Austin, Cal/EPA Department of Toxic Substances Control; Jim Littlejohn, DOE/OAK; Julie McNeal, U.C. Davis; Lida Tan, U.S. EPA; Susan Timm, Regional Water Quality Control Board).

Following a consensus on revisions to the summary sheets of the March 15th and 16th meetings, discussions were held to determine data needs for the likely general response actions. The first sources discussed were landfill units #1, 2, and 3. The discussion focused on establishing criteria (i.e., what information is necessary) for determining whether entire removal (i.e., excavation) of the landfills or capping is more appropriate. These discussions were largely inconclusive because of the nature of characterization uncertainties (i.e., determining when the landfills have been sufficiently characterized).

In the interest of time, the following compromise was proposed and accepted. Generally, there are three types of uncertainties related to determining data needs:

1. Characterization uncertainties,
2. Regulatory uncertainties, and
3. Technical uncertainties.

In the case of the landfills discussion, the core group was trying to resolve characterization uncertainties. For landfills, resolving regulatory and technical uncertainties may resolve characterization uncertainties. There are two primary reasons for this:

- EPA and the Regional Water Quality Control Board technically have set precedents for capping landfills, and
- EPA and the Regional Water Quality Control Board have regulations and guidance that cap landfills as a preference.

As a result, the core group agreed to the following approach of discussing data needs:

- To shift their discussion of data needs to focus on uncertainties/data needs of other sources
- To evaluate regulatory and technical uncertainties to determine if reasons exist that would not allow the LEHR landfills to be capped and would require a response action different than the precedent.

During the remaining time, the team discussed the technical data needs of identified likely response actions. The discussions are summarized in Tables 3-9. Due to time constraints, the team was unable to discuss data needs for in-situ and ex-situ treatment.

Table 3
Likely General Response Action: No Action

Sources for which alternative has been designated likely: Radium & Strontium Leach Fields (soils and cobbles), Septic Systems numbered 2-7 (soils and structures), and Soil underneath the Southwestern Dog Pens (below gravel).

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
Is future land-use consistent with no-action?	UC Davis would like to have limited use of LEHR.	None	UC Davis needs to determine long-term land use for LEHR
Are contaminant levels above action levels?	Sufficient soil contamination data exists to make initial screen. (See table of expected conditions).	None	Use action levels to conduct a preliminary risk screening: 1. Compare expected conditions by source to EPA Region IX Preliminary Remediation Goals (PRGs) 2. Use PRG values in Regional WQCB's Water Board's Designated Level Methodology (DLM) methodology to develop Regional WQCB action levels 3. Compare expected conditions by source to DLM values 4. Use action levels to distinguish which units cannot be considered for the no action alternative.

Table 3
Likely General Response Action: No Action

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
For sources that have contaminant levels below action levels, what additional data are required to support the no action alternative?	Sufficient soil data is expected to exist for the newer strontium-90 leach field to further support the no action alternative. Other sources do not have sufficient information.	None	If the preferred alternative is no action, DQOs must be developed to determine what constitutes sufficient information to support no action. This may be necessary for the following locations: the old Sr-90 leach field, the Ra-226 leach field, septic system #1 leach field, along the dry wells, along the trenches, and below the tanks. Other sources are not being considered for no action.
What is the cost of collecting data to support a no action alternative vs. the cost of excavation?	Sufficient data exists to do a preliminary cost analysis. The public would prefer an action alternative. If the cost to support a no action alternative is comparable in cost to an action alternative, action is preferable.	None	Determine if no action is cost-effective alternative by comparing relative costs of no action and action alternatives. Specifically, 1. Data collection to support a no action alternative (see above), and 2. Excavation and disposal Prior analysis discussed above must be completed before performing this analysis.

Table 3
Likely General Response Action: No Action

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
Is no action a feasible alternative when considering interacting components?	Some sources are divided into separate components for the purpose of evaluating alternatives. If one component requires action, a no action alternative may no longer be feasible for other components of the source.	None	<ol style="list-style-type: none"> 1. Determine if no action is the likely preferred alternative for all components of a divided source. 2. If no action is not the likely preferred alternative for all of the components, evaluate how the components of the source influence or interact with each other to determine if a no action alternative is still feasible for some of the components of the source.

Table 4
Likely General Response Action: Excavation

Sources for which alternative has been designated as likely: Radium & Strontium Leach Fields (soils, cobbles, and structures), Forty-nine waste holes, Disposal Trenches (southwestern trenches, area of intrusion, and solid waste trenches), DOE Disposal Box, Septic Systems numbered 2-7 (soils and structures), and Soil underneath the Southwestern Dog Pens (below gravel).

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
Are there health and safety issues associated with excavation?	Contaminants of concern for H&S issues and ranges of levels expected are known	None	Confirm uncertainties are manageable. Proposed contingency plan is to start at Level B and drop down to Level C if appropriate.
What are the approximate dimensions of needed excavations for use in feasibility study and design?	Varies. For some sources, location and general dimensions are known. For other sources, even location is not exactly known.	None	Develop order of magnitude volume/costs. Sufficient information exists to make relative, but not absolute, cost comparisons. This information will be used to determine if existing information can support FS-level definition and evaluation of alternatives.

Table 4
Likely General Response Action: Excavation

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
When should excavation be stopped?	Enough information is available to facilitate FS-level and design-level calculations of excavation volumes. Actual extent of contamination is not known for any source. Actual dimensions cannot be determined with great confidence prior to excavation.	None	There will always be surprises with volumes. This uncertainty is manageable with a contingency plan to guide the excavation. To assess the feasibility of this approach, use existing information to develop concentration profiles. The profiles are used to estimate depths and lengths/widths of required excavations with sufficient accuracy to determine when excavation methods would change.
What ARARs exist that affect the excavation alternative?	State has PRG type cleanup rules that may be ARARs for the excavation	None	Preliminary ARARs analysis to determine when to stop excavation. Use State/EPA PRGs as a first step in this determination
Will a CEQA analysis of the excavation will be required?	State has indicated preliminarily that a CEQA analysis will be required	None	Preliminary ARARs analysis to identify regulatory (e.g., CEQA) issues that the State, EPA, and DOE must resolve

Table 5
Likely General Response Action: On-Site Disposal

Sources for which alternative has been designated as likely: Radium and Strontium Leach Fields (soils, cobbles, and structures). Forty-Nine Waste Holes, Disposal Trenches (southwestern trenches, area of intrusion, and solid waste trenches), DOE Disposal Box. Septic Systems Numbered 2-7 (soils and structures), and Soil underneath the Southwestern Dog Pens (below gravel)

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
Is future land-use consistent with on-site disposal?	UC Davis has indicated acceptance of on-site disposal	None	1. Location for on-site disposal 2. UC Davis' final land-use designation
What is the cost of constructing an on-site landfill?	Sufficient data exists to do a preliminary cost analysis (e.g., sizing and construction costs) of on-site disposal.	None	1. Develop preliminary cost 2. Determine volume sensitivity of costs
What regulations could impact on-site disposal?	Radioactive materials are expected in most of the sources listed above	None	ARARs analysis to determine radiological waste disposal requirements
Will the majority of the community accept on-site disposal?	Community preference is for off-site disposal. However, the majority of the community will base its acceptance on technical data and risk analysis.	Level of community acceptance with on-site disposal	Go to the public as early and as often as possible. Commit to public participation in the alternative selection process. Public opinion is one of many factors that will determine the final remediation strategy.

Table 5
Likely General Response Action: On-Site Disposal

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
Are there permitting issues that could impact on-site disposal?	<p>The State has indicated that it may waive the land ban ARAR</p> <p>CA rules and regulations are being developed for building a mixed waste facility</p>	None	<p>ARARs analysis in first-cut FS to determine:</p> <ol style="list-style-type: none"> 1. Land ban restrictions 2. Feasibility of disposing mixed or radiologic waste on-site 3. May need to meet substantive requirements that are being developed in CA for building a mixed waste facility

Table 6
Likely General Response Action: Off-Site Disposal

Sources for which alternative has been designated as likely: Radium and Strontium Leach Fields (soils, cobbles, and structures), Forty-Nine Waste Holes, Disposal Trenches (southwestern trenches, area of intrusion, and solid waste trenches), DOE Disposal Box, Septic Systems Numbered 2-7 (soils and structures), and Soil underneath the Southwestern Dog Pens (below gravel)

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
What criteria must waste meet to be shipped off-site?	Existing information is sufficient to evaluate. DOE-OAK has waste acceptance criteria (WAC) for Hanford and Envirocare.	None	Compare WAC at likely disposal sites to expected conditions
What is the cost of shipping waste to an off-site disposal facility vs. the cost of on-site disposal or hot spot removal and capping?	Sufficient data exists to develop a preliminary cost analysis of off-site disposal for both Hanford and Envirocare.	None	Develop preliminary cost estimate of off-site disposal.
What other requirements (e.g., regulations, paperwork requirements) could impact off-site disposal?	Existing information is sufficient to evaluate	None	Evaluate paperwork requirements for off-site disposal

Table 6
Likely General Response Action: Off-Site Disposal

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
To which off-site disposal facility will LEHR send waste?	LEHR has previously shipped waste to Hanford. DOE has access to COE contract for Envirocare.	Cost and contract terms at each disposal facility.	Confirm that waste can be accepted at an off-site disposal facility and determine destination

Table 7
Likely General Response Action: In-Situ Containment

Sources for which alternative has been designated as likely: Radium and Strontium Leach Fields (structures) and Septic Systems Structures (systems numbered 2-7)

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
Is the backfilling of systems' structures and the decision to leave them in place consistent with planned future land use?	University has indicated desire to not prohibit building or transportation over these sources	Future land-use	UC Davis to determine long-term future land use for LEHR
Will the stability of structures after backfilling be consistent with UC Davis expected land use?	General information on the sizes and types of structures	None	Explore backfilling methods and stability of structures after backfilling
Is backfilling and leaving structures in place protective of human health and the environment?	Information on materials of construction and conditions of liners. Information on the level of radioactivity is available for some lines.	Physical samples from structures to determine radiologic constituents/contamination	Action levels analysis using PRGs and DLM
Would in-place backfilling be inconsistent with other actions (e.g., removal of soils under structures)?	GRAs identified for the soils around and under the structures	None	Determine the interactions that have to be considered in evaluating the alternatives

Table 8
Likely General Response Action: Hot Spot Removal

Sources for which alternative has been designated as likely: Forty-nine waste holes and Disposal Trenches (southwestern trenches, area of intrusion, and solid waste trenches)

Uncertainty	Existing Information	Additional Information Required Prior to Resolving Action-Item	Action Required
Which alternative (i.e., hot spot removal/capping or entire removal) is more cost effective?	Costs of excavation and disposal is known or can be determined.	None	Develop cost of excavation & disposal vs. cost of analysis, hot spot excavation & capping
What is a hot spot?	Currently a hot spot is defined as anything that does not meet the no action criteria	None	Develop definition of hot spot
Will the efforts needed to identify hot spots be cost effective?	References are available on this type of sampling. Limited site information available that would support identification of hot spots.	None	Determine sample types and number needed to identify hot spot locations (i.e., DQOs).

VI. Relative Cost Comparisons

Introduction

This package contains initial cost estimates for four general remediation alternatives for the LEHR site at the University of California at Davis. The alternatives were developed based on general guidelines from the extended project team and are intended to bound the range of alternatives considered to be "likely". Consideration of the range of feasible alternatives for the LEHR site is at a very preliminary stage. Initial cost estimates are useful at this stage in a CERCLA investigation to identify cost ranges for the possible alternatives that might be considered and to focus any additional data collection and evaluation toward the critical factors that determine feasibility, effectiveness, and cost. These initial cost estimates were prepared for initial comparison of *relative* costs of the alternatives. They also provide insight on the factors the final cost estimates will be most determined by, that is, the factors that costs are most sensitive to. They are not accurate or complete estimates of total costs that would be incurred to implement the alternatives. But, since they each contain the major cost items that will influence total costs, and because they are based on consistent assumptions about volumes, unit disposal costs, areas to be remediated, and other major factors, they can be used in relative comparisons. Where the estimates for two alternatives differ by a large factor and differences in potential protectiveness are not potentially worth the multiplication of costs, some modification or focussing of the alternatives under consideration might be warranted.

Limits

The costs determined by this estimating effort are not as accurate as required for a CERCLA feasibility study; the latter are "order of magnitude" estimates defined as being accurate within + 50% and - 30%. No similar accuracy factor can be reliably attached to the estimates provided here. They are not, as CERCLA cost estimates typically are, built up from a semi-detailed breakout of line items that would be incurred in actually implementing the alternatives at a specific site. They are instead based on typical unit costs for large cost items, such as constructing a cap, plus large allowances for the sums of all the smaller cost items that are not broken out in detail. Cost estimates in a feasibility study are based on much better defined alternatives and are typically much more detailed and expensive to prepare than is necessary or justifiable at this early stage of exploring alternatives for the LEHR site. More accurate cost estimates will be appropriate later in the process of investigating the LEHR site, when the range of feasible alternatives is better understood.

More accurate and complete estimates of costs will have to await the development of better engineering descriptions of the alternatives in a feasibility study and perhaps additional information about the site. Based on the uncertainties identified in preparing these initial cost estimates, any additional information needed to improve the accuracy and reliability of the cost estimates can be identified. Whether current site information can support cost estimates sufficiently accurate to facilitate selection of remedial actions for the LEHR site needs to be

determined.

Sensitivities

The following are large cost determining factors and thus have the potential to significantly affect the total cost estimates:

- Actual waste quantities assumed to be excavated. (All of the alternatives assume at least partial excavation.) At any level of detail (i.e., preliminary or final) it is always difficult to estimate volumes of waste that will result from excavation, with errors approaching 50% not being uncommon.
- Type of cap assumed for those alternatives that assume at least partial capping of wastes in place. (i.e., Alternatives 2 and 3). The cost estimates are based on a RCRA type cap, which is traditionally considered to be a high efficiency and high cost capping method. There is no standard RCRA cap applicable in all settings. However the general features of a RCRA cap are: approximately five feet total thickness with a flexible membrane liner, a compacted clay layer, a sand drainage layer, and a topsoil layer. The entire cap is graded and sloped for drainage. While the exact requirements that would apply at the LEHR site have not been determined, the forgoing is typical and is not inconsistent with the approximate cost assumed for these estimates: \$250,000 per acre. Less expensive capping alternatives, that meet minimum California regulatory requirements for closing old landfills, might reduce the unit cost for capping by as much as 40%.
- Unit costs for off-site disposal the wastes. The estimates are based on the current costs for DOE wastes going to a particular facility under a specific cost contract held by another federal agency. These are the probable costs that would be incurred. However, these are very favorable costs. If for any reason, that contract could not be used, LEHR could reasonably see unit costs twice as high as assumed in these estimates.
- Assumed waste designations for the wastes (i.e., hazardous waste, radioactive waste, or mixed waste). The assumed unit cost for transportation and disposal of soil classed as hazardous waste is \$300 per cubic yard; for soil classed as low-level radioactive waste the same unit cost factor is \$400 per cubic yard; for soil classed as mixed waste it is \$1,400. Thus, the designations of the wastes assumed in the costs estimates are very large determining factors.

Incompleteness of Cost Estimate

The alternatives estimated here are not complete. The alternatives address source control actions. Additional remediation efforts may be required to address deeper soils if they are contaminated; additional efforts that may be necessary address groundwater cannot be designed or estimated at this time.

- Deep vadose zone soils. Contaminants have reached the groundwater and must have

passed through vadose zone soils to reach that point. Whether there are any areas of concentrated contamination that can or should be excavated or remediated in place has not been determined. The cost estimates do not assume any actions for deeper soils.

- Groundwater contamination. The precise needs for groundwater remediation, including general approach, extent, and pumping rates, have not been determined, and may be significantly altered by the source control efforts envisioned in the alternatives addressed here. The cost estimates do not address the potential need for groundwater remediation.
- The estimates do not fully account for LEHR being a DOE site. The estimates do not account for the higher programmatic, administrative, and procedural costs associated with DOE site remediations. Some of the unit costs are based on limited data available for working on a DOE site; some cost indications are available for capping and excavation on DOE sites, but not for constructing an onsite landfill.
- The estimates do not adequately account for differences in costs for handling radioactive, hazardous, and mixed wastes. Some of the unit costs for site work (excavation, capping, transportation, onsite landfilling) may vary significantly between these waste types. No allowances have been made for these differences.

Alternative 1: Remove All Wastes from Their Current Locations and Consolidate in an On-Site, RCRA-Compliant Disposal Facility.

- The following sources would be excavated:
 1. Radium and Strontium Leach Fields (includes Imhoff tanks and septic system #1)
 2. Forty-nine Waste Holes
 3. Disposal Trenches (including the southwest disposal trenches and the chemical dispensing area)
 4. Landfill # 2
 5. Landfill # 1
 6. Landfill # 3
 7. DOE Disposal Box
 8. Septic Systems 2 - 7
 9. Western Dog Pen Soils
- The total volume of soils and wastes assumed to be excavated and disposed in the RCRA-compliant unit is 50,000 cubic yards. (For comparative purposes, this volume would, if placed evenly on a three acre site, stack up to approximately ten feet deep.)
- Volumes of wastes to be excavated are estimated based on known and/or suspected dimensions of the original disposal units (e.g., trenches, holes), or based on assumed dispersion of the contaminants from the units. Over-excavation and bulking factors are added to the estimated, in-ground volumes of the wastes to better estimate the volumes that will be produced by the excavation activities.
- The estimate does not assume any particular action levels, either for excavation or demonstration of remediation completion/success (i.e., excavate until the residual levels are below X). Available data on the contamination distribution would not allow calculation of the impacts of assuming various action levels.
- Landfill 3 is assumed to be excavated only within the areas that showed anomalies on the geophysical surveys, approximately 30% of the total area of the landfill on the available maps. The landfill was operated for only a few years and the entire area of the landfill shown on some maps is not likely to contain wastes.
- The Western Dog Pen Soils would be excavated to six inches below the existing, clean gravel, a total of 2,100 cubic yards. The clean gravel would not be placed in the RCRA landfill.
- The landfill would be RCRA compliant, with liners, leachate collection, leak detection, RCRA cap, monitoring wells, and post-closure care and maintenance. The cost of

constructing, operating, closing, and maintaining the RCRA disposal unit are estimated on a per-cubic-yard-of-disposal-space basis, at \$300 per cubic yard. Note that this assumes that disposing radioactive and mixed waste in a RCRA-type landfill will be acceptable.

- No location for the RCRA unit is assumed, but it is assumed that the exact location on the UCD site would not significantly affect the cost estimate.
- The RCRA landfill would be built first to avoid the need for temporary storage of wastes between the time of excavation and the availability of the disposal facility.
- Air emissions during remediation are considered to be manageable without extraordinary means, such as building temporary containment structures. Thus, the cost estimates do not include an allowance for air emissions control during remediation.
- Groundwater remediation is not considered in this alternative (or any of the other three alternatives).
- Unrestricted use of the site would be allowed by this alternative, but the remediation is assumed to include only backfilling of the excavations to grade, without any other replacements or modifications of infrastructure (e.g., roads, buildings).

Sensitivities

Other than the major cost determinants noted in the Introduction, no additional factors have the potential to significantly affect the total cost of the alternative as estimated here.

Alternative 2: Remove Wastes from Sources Not Adjacent to Landfills 1, 2, and 3 and Consolidate in on-Site, RCRA-Compliant Disposal Facility. Cap Landfills 1, 2, and 3 and Their Adjacent Sources.

The following units would be excavated:

1. Radium and Strontium Leach Fields (includes Imhoff tanks and septic system #1)
3. Trenches 1-5 of the Disposal Trenches
7. DOE Disposal Box
8. Septic Systems 2 - 7

The following sources are considered adjacent to one or more of the landfills for this alternative and would be capped in addition to the capping of the three landfills:

2. Forty-nine Waste Holes
3. Trenches 6-17 of the Disposal Trenches, which includes the SW Disposal Trenches (i.e., trenches 15, 16, and 17)
9. The Western Dog Pen Soils

The total volume of soils and wastes assumed to be excavated and disposed in the RCRA-compliant unit is 1,250 cubic yards. (For comparative purposes, this volume would, if placed evenly on a three acre site, stack up to approximately 3 inches deep.)

- Volumes of wastes to be excavated are estimated based on known and/or suspected dimensions of the original disposal units (e.g., trenches, holes), or based on assumed dispersion of the contaminants from the units. Over-excavation and bulking factors are added to the estimated, in-ground volumes of the wastes to better estimate the volumes that will be produced by the excavation activities.
- The estimate does not assume any particular action levels, either for excavation or demonstration of remediation completion/success (i.e., excavate until the residual levels are below X). Available data on the contamination distribution would not allow calculation of the impacts of assuming various action levels.
- Landfill 3 is assumed to be capped only at the areas that showed anomalies on the geophysical surveys, approximately 30% of the total area of the landfill on the available maps. The landfill was operated for only a few years and the entire area of the landfill shown on some maps is not likely to contain wastes.
- The landfill would be RCRA compliant, with liners, leachate collection, leak detection, RCRA cap, monitoring wells, and post-closure care and maintenance. The cost of

constructing, operating, closing, and maintaining the RCRA disposal unit are estimated on a per-cubic-yard-of-disposal-space basis, at \$300 per cubic yard. Note that this assumes that disposing radioactive and mixed waste in a RCRA-type landfill will be acceptable.

- No location for the RCRA unit is assumed, but it is assumed that the exact location on the UCD site would not significantly affect the cost estimate.
- The RCRA landfill would be built first to avoid the need for temporary storage of wastes between the time of excavation and the availability of the disposal facility.
- The cap on Landfills 1 and 2, the forty-nine waste holes, the disposal trenches except trenches 1-5, and the southwest area would be one continuous cap. The area of this cap is assumed to be approximately 7.1 acres.
- The cap is assumed to comply with the standard requirements for a cap on a closed RCRA disposal unit. It would be approximately five feet thick and incorporate a flexible membrane liner, a compacted clay layer, a sand drainage layer, and a topsoil layer. The entire cover would be graded and sloped for drainage.
- Air emissions during remediation are considered to be manageable without extraordinary means, such as building temporary containment structures. Thus, the cost estimates do not include an allowance for air emissions control during remediation.
- Groundwater remediation is not considered in this alternative (or any of the other three alternatives).

Sensitivities

In addition to the major cost drivers noted in the Introduction, the following factors have the potential to significantly affect the total cost of the alternative as presented here.

- Whether or not the western dog pen soils are included in the area to be capped. These soils are very lightly contaminated, if contaminated at all. Further investigation may indicate that they do not require remediation. The 2,100 cubic yards are spread over an area of approximately 2 acres, which would cost \$500,000 to cap.
- Type of cap assumed for the landfills and adjacent areas. A RCRA-type cap is assumed. A simpler, but perhaps equally effective cap could be constructed at a reduction in cost as high as 40%.

Alternative 3: Remove Wastes from Sources Not Adjacent to Landfills 1, 2, and 3 and Dispose of Off-Site in Appropriate Disposal Facilities. Cap Landfills 1, 2, and 3 and Their Adjacent Sources.

- The following units would be excavated:

1. Radium and Strontium Leach Fields (includes Imhoff tanks and septic system #1)
3. Trenches 1-5 of the Disposal Trenches
7. DOE Disposal Box
8. Septic Systems 2 - 7

The following sources are considered adjacent to one or more of the landfills for this alternative and would be capped in addition to the capping of the three landfills:

2. Forty-nine Waste Holes
3. Trenches 6-17 of the Disposal Trenches, which includes the SW Disposal Trenches (i.e., trenches 15, 16, and 17)
9. The Western Dog Pen Soils

- The total volume of soils and wastes assumed to be excavated and disposed is 1,250 cubic yards. (For comparative purposes, this volume would, if placed evenly on a three acre site, stack up to approximately 3 inches deep.)
- Volumes of wastes to be excavated are estimated based on known and/or suspected dimensions of the original disposal units (e.g., trenches, holes), or based on assumed dispersion of the contaminants from the units. Over-excavation and bulking factors are added to the estimated, in-ground volumes of the wastes to better estimate the volumes that will be produced by the excavation activities.
- The estimate does not assume any particular action levels, either for excavation or demonstration of remediation completion/success (i.e., excavate until the residual levels are below X). Available data on the contamination distribution would not allow calculation of the impacts of assuming various action levels.
- Off-site disposal is assumed to be at commercial facilities permitted to receive the types of wastes present at UCD. For purposes of this estimate, each waste unit was designated as containing either hazardous waste, radioactive waste, or mixed waste. The disposal requirements and disposal costs for these three types of wastes vary substantially (i.e., \$300, \$400, and \$1,400 per cubic yard) and have a very significant impact on the overall

cost estimates for this alternative.

- Landfill 3 is assumed to be capped only at the areas that showed anomalies on the geophysical surveys, approximately 30% of the total area of the landfill on the available maps. The landfill was operated for only a few years and the entire area of the landfill shown on some maps is not likely to contain wastes.
- The cap on Landfills 1 and 2, the forty-nine waste holes, the disposal trenches except trenches 1-5, and the southwest area would be one continuous cap. The area of this cap is assumed to be approximately 7.1 acres.
- The cap is assumed to comply with the standard requirements for a cap on a closed RCRA disposal unit. It would be approximately five feet thick and incorporate a flexible membrane liner, a compacted clay layer, a sand drainage layer, and a topsoil layer. The entire cover would be graded and sloped for drainage.
- Air emissions during remediation are considered to be manageable without extraordinary means, such as building temporary containment structures. Thus, the cost estimates do not include an allowance for air emissions control during remediation.
- Groundwater remediation is not considered in this alternative (or any of the other three alternatives).

Sensitivities

In addition to the major cost drivers noted in the Introduction, the following factors have the potential to significantly affect the total cost of the alternative as presented here.

- Whether or not the western dog pen soils are included in the area to be capped. These soils are very lightly contaminated, if contaminated at all. The 2,100 cubic yards are spread over an area of approximately 2 acres, which would cost \$500,000 to cap. Further investigation may indicate that they do not require remediation.
- Type of cap assumed for the landfills and adjacent areas. A RCRA-type cap is assumed. A simpler, but perhaps equally effective cap could be constructed at a reduction in cost as high as 40%.

Alternative 4: Remove All Wastes from Their Current Locations and Transport to Appropriate Off-Site Disposal Facilities for Disposal

- The following sources would be excavated:
 1. Radium and Strontium Leach Fields (includes Imhoff tanks and septic system #1)
 2. Forty-nine Waste Holes
 3. Disposal Trenches (including the southwest disposal trenches and the chemical dispensing area)
 4. Landfill # 2
 5. Landfill # 1
 6. Landfill # 3
 7. DOE Disposal Box
 8. Septic Systems 2 - 7
 9. Western Dog Pen Soils
- The total volume of soils and wastes assumed to be excavated and disposed in the RCRA-compliant unit is 50,000 cubic yards. (For comparative purposes, this volume would, if placed evenly on a three acre site, stack up to approximately ten feet deep.)
- Volumes of wastes to be excavated are estimated based on known and/or suspected dimensions of the original disposal units (e.g., trenches, holes), or based on assumed dispersion of the contaminants from the units. Over-excavation and bulking factors are added to the estimated, in-ground volumes of the wastes to better estimate the volumes that will be produced by the excavation activities.
- No action levels for excavation or demonstration of remediation completion/success are assumed. Available data on the contamination distribution do not allow calculation of the impacts of various action levels.
- Landfill 3 is assumed to be excavated only within the areas that showed anomalies on the geophysical surveys. The landfill was operated for only a few years and the entire area of the landfill shown on some maps is not likely to contain wastes.
- The Western Dog Pen Soils would be excavated to six inches below the existing, clean gravel. The clean gravel would not be disposed of offsite.
- Off-site disposal is assumed to be at commercial facilities permitted to receive the types of wastes present at UCD. For purposes of this estimate, each waste unit was designated as containing either hazardous waste, radioactive waste, or mixed waste. The disposal

requirements and disposal costs for these three types of wastes vary substantially (i.e., \$300, \$400, and \$1,400 per cubic yard) and have a very significant impact on the overall cost estimates for this alternative.

- Air emissions during remediation are considered to manageable without extraordinary means, such as building temporary containment structures.
- Groundwater remediation is not considered in this alternative (or any of the other three alternatives).
- Unrestricted use of the site would be allowed by this alternative, but the remediation is assumed to include only backfilling of the excavations to grade, without any other replacements or modifications of infrastructure (e.g., roads, buildings).

Sensitivities

Other than the major cost determinants noted in the Introduction, no additional factors have the potential to significantly affect the total cost of the alternative as estimated here.

LEHR COST ESTIMATE(preliminary) -- Quantity Spreadsheet

SITE AREA	ALT 1 Onsite LF Volumes (cy)	ALT 2 Onsite LF Volumes (cy)	ALT 2 Cap Area (acres)	ALT 3 Offsite LF Volumes (cy)	ALT 3 Cap Area (acres)	ALT 4 Offsite LF Volumes (cy)	ALT 5 Consol/Cap Volumes (cy)	ALT 5 Cap Area (acres)	WASTE TYPE Rad,Haz,Mixed Soil or Debris RWS	Comments
1. RADIUM/Sr LEACH FIELDS	500	500		500		500	500			Imhoff tanks, Ssys #1
2. 49 WASTE HOLES	400		Incl w/ LF #2		Incl w/ LF #2	400		Incl w/ LF #2	RWS	
3. SOLID WASTE TRENCHES	2500	300	Incl w/ LF #2	300	Incl w/ LF #2	2500	300	Incl w/ LF #2	RWS	
4. LANDFILL # 2	22000		2.4		2.4	22000		2.4	HW	All as Mixed waste
5. LANDFILL #1	23000		2.6		2.6	23000		2.6	HW	All as Mixed waste
6. LANDFILL #3	2600		0.2		0.2	2600		0.2	HW	All as Mixed waste
7. DOE DISPOSAL BOX	50	50		50		50	50		MWD	Volume allowance
8. SEPTIC SYSTEMS 2 THRU	400	400		400		400	400		RWS	
9. SW DOG PEN SOILS	2100		2.1		2.1	2100		2.1	RWS	
Incremental Cap from consolid								0.2		
TOTALS	53550	1250	7.3	1250	7.3	53550	1250	7.5		
Soil Bulking Factor	1.25									
Overexcavation Factor	1.3									

LEHR COST ESTIMATE (preliminary) -- Unit Costs

UNIT COSTS	Waste Type	Unit cost	Unit	Comments
Transport/dispose mixed waste (soil)	MWS	\$2,000	cy	Approx. 750 mi haul
Transport /dispose mixed waste debris	MWD	\$3,700	cy	Approx. 750 mi haul
Transport/dispose rad waste (soil)	RWS	\$430	cy	Approx. 750 mi haul
Transport/dispose rad waste debris	RWD	\$980	cy	Approx. 750 mi haul
Transport/dispose haz waste	HW	\$300	cy	Approx. 250 mi haul
RCRA Cap		\$325,000	Ac	
Excavate haz, rad, or mixed waste		\$75	cy	Soil excav. & analyses;H&S, air monit, backfill
Onsite Landfill -- large		\$150	cy	construction, handling, placement, closure
Onsite Landfill -- small		\$250	cy	construction, handling, placement, closure

LEHR COST ESTIMATE(preliminary)
Cost Summary for Restoration Alternatives

ALTERNATIVE	COST	COMMENTS
ALT 1 -- Onsite Landfill	\$23,000,000	Excav. all areas incl. 70% of LF #1 & LF #2, and 30% of LF #3
ALT 2 -- Cap and Onsite Landfill	\$10,000,000	Excav. Ra/Sr leach, some SW trenches, DOE box, septic sys #2 to 7
ALT 3 -- Cap and Offsite Landfill	\$10,000,000	Excav. Ra/Sr leach, some SW trenches, DOE box, septic sys #2 to 7
ALT 4 -- Offsite Landfill	\$31,000,000	Landfills 1,2, and 3 as Hazardous Waste
ALT 4 -- Offsite Landfill	\$137,000,000	Landfills 1,2, and 3 as Mixed Waste

LEHR COST ESTIMATE (preliminary)
Alternative 1 -- Excavate/Onsite Landfill

AREA/Cost Item	QUANTITY	UNITS	UNIT COST	COST TOTAL	COMMENTS
GENERAL COSTS					
Investigations	1	ls	\$1,000,000	\$1,000,000	Preliminary allowance (2x offsite landfill Alt. 4)
Site Preparation	1	ls	\$200,000	\$200,000	Preliminary allowance (2x offsite landfill Alt. 4)
Site Controls	1	ls	\$200,000	\$200,000	Preliminary allowance (2x offsite landfill Alt. 4)
Temporary Facilities	1	ls	\$200,000	\$200,000	Preliminary allowance (2x offsite landfill Alt. 4)
1. RADIUM/Sr LEACH FIELDS					Trenches, Imhoff tank, Septic system #1
Excavate	500	cy	\$75	\$38,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Onsite Landfill	500	cy	\$150	\$75,000	
2. 49 WASTE HOLES					
Excavate	400	cy	\$75	\$30,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Onsite Landfill	400	cy	\$150	\$60,000	
3. SOLID WASTE TRENCHES					
Excavate	2500	cy	\$75	\$188,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Onsite Landfill	2500	cy	\$150	\$375,000	
4. LANDFILL # 2					
Excavate	22000	cy	\$75	\$1,650,000	Assumed excavate 70%, soil analyses, air monitoring, H&S
Onsite Landfill	22000	cy	\$150	\$3,300,000	
5. LANDFILL #1					
Excavate	20000	cy	\$75	\$1,500,000	Assumed excavate 70%, soil analyses, air monitoring, H&S
Onsite Landfill	20000	cy	\$150	\$3,000,000	
6. LANDFILL #3					
Excavate	6000	cy	\$75	\$450,000	Assumed excavate 30%, soil analyses, air monitoring, H&S
Onsite Landfill	6000	cy	\$150	\$900,000	
7. DOE DISPOSAL BOX					
Excavate	50	cy	\$75	\$4,000	
Onsite Landfill	50	cy	\$150	\$8,000	
8. SEPTIC SYSTEMS 2 THRU 7					
Excavate	400	cy	\$75	\$30,000	
Onsite Landfill	400	cy	\$150	\$60,000	
9. SW DOG PEN SOILS					
Excavate	2100	cy	\$75	\$158,000	Excavate 6 inches over entire area;gravel not incl.
Onsite Landfill	2100	cy	\$150	\$315,000	
GROUNDWATER					Not included in preliminary estimate
Extraction Well Installation(Cr)					___ wells, avg depth ea =
Groundwater Treatment System					___ gpm system;Cr(6) reduction/pp1 and IX
Discharge Line					

LEHR COST ESTIMATE (preliminary)
Alternative 1 -- Excavate/Onsite Landfill

AREA/Cost Item	QUANTITY	UNITS	UNIT COST	COST TOTAL	COMMENTS
Monitoring Well Installation					Additional wells
Extraction Well Installation(CHC13)					_____ wells, avg depth ea =
Groundwater Treatment System					_____ gpm system, GAC
Discharge Line					
Monitoring Well Installation					
VADOSE ZONE REMEDIATION					Not included in preliminary estimate
Soil Vapor Extraction/Offgas Trtmt					
CONSTRUCTION SUBTOTAL				\$13,700,000	
Mobilization/demobilization	1	ls	\$400,000	\$400,000	Preliminary allowance (2x offsite landfill Alt. 4)
Site Preparation and Utility Hookups	1	ls	\$200,000	\$200,000	Preliminary allowance (2x offsite landfill Alt. 4)
Bonding and Insurance	1	ls	\$1,000,000	\$1,000,000	Preliminary allowance (2x offsite landfill Alt. 4)
Permitting and Legal	1	ls	\$500,000	\$500,000	Preliminary allowance (2x offsite landfill Alt. 4)
Site Administration	1	ls	\$200,000	\$200,000	Contractor office admin; Preliminary allowance (2x offsite landfill Alt. 4)
Corrective Action Plans/Designs	1	ls	\$1,000,000	\$1,000,000	Preliminary allowance (2x offsite landfill Alt. 4)
Services During Construction	1	ls	\$200,000	\$200,000	Preliminary allowance (2x offsite landfill Alt. 4)
SITE REMEDIATION SUBTOTAL				\$17,200,000	
Contingency	1	ls	30%	\$5,200,000	
REMEDATION CONSTRUCTION TOTAL				\$22,000,000	
ANNUAL O&M					
Landfill cap monitoring, maintenance	1	ls	\$20,000	\$20,000	Allowance
Groundwater monitoring	1	ls	\$20,000	\$20,000	Allowance
Groundwater Treatment O&M				\$0	Not incl. in preliminary estimate
SVE system O&M					Not incl. in preliminary estimate
Site Administration	1	ls	20%	\$8,000	
Oversite Services	1	ls	10%	\$4,000	
Annual O&M Subtotal				\$52,000	
Contingency	1	ls	30%	\$15,600	
Annual O&M Total				\$67,600	
30-Yr O&M Present Worth	1	ls	15.372	\$1,040,000	At 5% discount rate
Total Present Worth				\$23,000,000	

LEHR COST ESTIMATE (preliminary)
Alternative 2 -- Cap and Onsite Landfill

AREA/Cost Item	QUANTITY	UNITS	UNIT COST	COST TOTAL	COMMENTS
GENERAL COSTS					
Investigations	1	ls	\$750,000	\$750,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Preparation	1	ls	\$150,000	\$150,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Controls	1	ls	\$150,000	\$150,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Temporary Facilities	1	ls	\$150,000	\$150,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
1. RADIUM/Sr LEACH FIELDS					Trenches, Imhoff tank, Septic system #1
Excavate	500	cy	\$75	\$38,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Onsite Landfill	500	cy	\$250	\$125,000	
2. 49 WASTE HOLES					
Cap	0	Ac	\$325,000	\$0	Incl. with landfill #2 cap
3. SOLID WASTE TRENCHES					Trenches 1 thru 5 only; 6 thru 17 incl. with LF #2 cap
Excavate	300	cy	\$75	\$23,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Onsite Landfill	300	cy	\$250	\$75,000	
4. LANDFILL # 2					
Cap	2.4	Ac	\$325,000	\$780,000	
5. LANDFILL #1					
Cap	2.6	Ac	\$325,000	\$845,000	
6. LANDFILL #3					
Cap	0.2	Ac	\$325,000	\$65,000	
7. DOE DISPOSAL BOX					
Excavate Hot Spots	50	cy	\$75	\$4,000	
Onsite Landfill	50	cy	\$250	\$13,000	
8. SEPTIC SYSTEMS 2 THRU 7					
Excavate Hot Spots	400	cy	\$75	\$30,000	
Onsite Landfill	400	cy	\$250	\$100,000	
9. SW DOG PEN SOILS					
Cap	2.1	Ac	\$325,000	\$683,000	
GROUNDWATER					Not included in preliminary estimate
Extraction Well Installation(Cr)					___ wells, avg depth ea =
Groundwater Treatment System					___ gpm system;Cr(6) reduction/ppt and IX
Discharge Line					
Monitoring Well Installation					Additional wells
Extraction Well Installation(CHCl3)					___ wells, avg depth ea =
Groundwater Treatment System					___ gpm system, GAC
Discharge Line					

LEHR COST ESTIMATE (preliminary)
Alternative 2 -- Cap and Onsite Landfill

AREA/Cost Item	QUANTITY	UNITS	UNIT COST	COST TOTAL	COMMENTS
Monitoring Well Installation					
VADOSE ZONE REMEDIATION					Not included in preliminary estimate
Soil Vapor Extraction/Offgas Trlmt					
CONSTRUCTION SUBTOTAL				\$4,000,000	
Mobilization/demobilization	1	ls	\$300,000	\$300,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Preparation and Utility Hookups	1	ls	\$150,000	\$150,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Bonding and Insurance	1	ls	\$750,000	\$750,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Permitting and Legal	1	ls	\$375,000	\$375,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Administration	1	ls	\$150,000	\$150,000	Contractor office admin; preliminary allowance (1.5x offsite landfill Alt. 4)
Corrective Action Plans/Designs	1	ls	\$750,000	\$750,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Services During Construction	1	ls	\$150,000	\$150,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
SITE REMEDIATION SUBTOTAL				\$6,600,000	
Contingency	1	ls	30%	\$2,000,000	
REMEDATION CONSTRUCTION	TOTAL			\$9,000,000	
ANNUAL O&M					
Landfill/cap monitoring, maintenance	1	ls	\$20,000	\$15,000	Allowance
Groundwater monitoring	1	ls	\$20,000	\$20,000	Allowance
Groundwater Treatment O&M				\$0	Not incl. in preliminary estimate
SVE system O&M					Not incl. in preliminary estimate
Site Administration	1	ls	20%	\$7,000	
Oversite Services	1	ls	10%	\$3,500	
Annual O&M Subtotal				\$45,500	
Contingency	1	ls	50%	\$22,750	
Annual O&M Total				\$68,250	
30-Yr O&M Present Worth	1	ls	15.372	\$1,050,000	At 5% discount rate
Total Present Worth				\$10,000,000	

LEHR COST ESTIMATE(preliminary)
Alternative 3 -- Cap and Offsite Landfill

AREA/Cost Item	QUANTITY	UNITS	TYPE	UNIT COST	COST TOTAL	COMMENTS
GENERAL COSTS						
Investigations	1	ls		\$650,000	\$650,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Preparation	1	ls		\$130,000	\$130,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Controls	1	ls		\$130,000	\$130,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Temporary Facilities	1	ls		\$130,000	\$130,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
1. RADIUM/Sr LEACH FIELDS						
						Trenches, Imhoff tank, Septic system #1
Excavate	500	cy		\$75	\$38,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Offsite Landfill	500	cy	RWS	\$430	\$215,000	
2. 49 WASTE HOLES						
Cap	0	Ac		\$325,000	\$0	Incl. with landfill #2 cap
3. SOLID WASTE TRENCHES						
						Trenches 1 thru 5 only; 6.thru 17 incl. with LF #2 cap
Excavate	300	cy		\$75	\$23,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Offsite Landfill	300	cy	RWS	\$430	\$129,000	
4. LANDFILL # 2						
Cap	2.4	Ac		\$325,000	\$780,000	
5. LANDFILL #1						
Cap	2.6	Ac		\$325,000	\$845,000	
6. LANDFILL #3						
Cap	0.2	Ac		\$325,000	\$65,000	
7. DOE DISPOSAL BOX						
Excavate Hot Spots	50	cy		\$75	\$4,000	Volume allowance
Onsite Landfill	50	cy	MWD	\$3,700	\$185,000	
8. SEPTIC SYSTEMS 2 THRU 7						
Excavate Hot Spots	400	cy		\$75	\$30,000	
Onsite Landfill	400	cy	RWS	\$430	\$172,000	
9. SW DOG PEN SOILS						
Cap	2.1	Ac		\$325,000	\$683,000	
GROUNDWATER						
						Not included in preliminary estimate
Extraction Well Installation(Cr)						___ wells, avg depth ea =
Groundwater Treatment System						___ gpm system;Cr(6) reduction/ppt and IX
Discharge Line						
Monitoring Well Installation						Additional wells
Extraction Well Installation(CHCl3)						___ wells, avg depth ea =
Groundwater Treatment System						___ gpm system, GAC
Discharge Line						

**LEHR COST ESTIMATE(preliminary)
Alternative 3 -- Cap and Offsite Landfill**

AREA/Cost Item	QUANTITY	UNITS	TYPE	UNIT COST	COST TOTAL	COMMENTS
Monitoring Well Installation						
VADOSE ZONE REMEDIATION						Not included in preliminary estimate
Soil Vapor Extraction/Offgas Trtmt						
CONSTRUCTION SUBTOTAL					\$4,200,000	
Mobilization/demobilization	1	ls		\$300,000	\$300,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Preparation and Utility Hookups	1	ls		\$150,000	\$150,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Bonding and Insurance	1	ls		\$750,000	\$750,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Permitting and Legal	1	ls		\$375,000	\$375,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Site Administration	1	ls		\$150,000	\$150,000	Contractor office admin; preliminary allowance (1.5x offsite landfill Alt. 4)
Corrective Action Plans/Designs	1	ls		\$750,000	\$750,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
Services During Construction	1	ls		\$150,000	\$150,000	Preliminary allowance (1.5x offsite landfill Alt. 4)
SITE REMEDIATION SUBTOTAL					\$6,800,000	
Contingency	1	ls		30%	\$2,000,000	
REMEDATION CONSTRUCTION	TOTAL				\$9,000,000	
ANNUAL O&M						
Cap monitoring, maintenance	1	ls		\$10,000	\$10,000	Allowance
Groundwater monitoring	1	ls		\$20,000	\$20,000	Allowance
Groundwater Treatment O&M					\$0	Not incl. in preliminary estimate
SVE system O&M						Not incl. in preliminary estimate
Site Administration	1	ls		20%	\$6,000	
Oversite Services	1	ls		10%	\$3,000	
Annual O&M Subtotal					\$39,000	
Contingency	1	ls		50%	\$19,500	
Annual O&M Total					\$58,500	
30-Yr O&M Present Worth	1	ls		15.372	\$900,000	At 5% discount rate
Total Present Worth					\$10,000,000	

LEHR COST ESTIMATE (preliminary)
Alternative 4 -- Excavate/Dispose Offsite:
landfills as hazardous waste

AREA/Cost Item	QUANTITY	UNITS	TYPE	UNIT COST	COST TOTAL	COMMENTS
GENERAL COSTS						
Investigations	1	ls		\$500,000	\$500,000	prelim allowance
Site Preparation	1	ls		\$100,000	\$100,000	prelim allowance
Site Controls	1	ls		\$100,000	\$100,000	prelim allowance
Temporary Facilities	1	ls		\$100,000	\$100,000	prelim allowance
1. RADIUM/Sr LEACH FIELDS						
Excavate	500	cy		\$75	\$38,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Transport and Dispose	500	cy	RWS	\$430	\$215,000	Transport approximately 750 miles and dispose
2. 49 WASTE HOLES						
Excavate	400	cy		\$75	\$30,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Transport and Dispose	400	cy	RWS	\$430	\$172,000	Transport approximately 750 miles and dispose
3. SOLID WASTE TRENCHES						
Excavate	2500	cy		\$75	\$188,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Transport and Dispose	2500	cy	RWS	\$430	\$1,075,000	Transport approximately 750 miles and dispose
4. LANDFILL # 2						
Excavate	22000	cy		\$75	\$1,650,000	Assumed excavate 70%, soil analyses, air monitoring, H&S
Transport and Dispose	22000	cy	HW	\$300	\$6,600,000	Transport approx. 250 mi. if Haz Waste, 750 mi. if Mixed Waste
5. LANDFILL #1						
Excavate	20000	cy		\$75	\$1,500,000	Assumed excavate 70%, soil analyses, air monitoring, H&S
Transport and Dispose	20000	cy	HW	\$300	\$6,000,000	Transport approx. 250 mi. if Haz Waste, 750 mi. if Mixed Waste
6. LANDFILL #3						
Excavate	6000	cy		\$75	\$450,000	Assumed excavate 30%, soil analyses, air monitoring, H&S
Transport and Dispose	6000	cy	HW	\$300	\$1,800,000	Transport approx. 250 mi. if Haz Waste, 750 mi. if Mixed Waste
7. DOE DISPOSAL BOX						
Excavate	50	cy		\$75	\$4,000	
Transport and Dispose	50	cy	MWD	\$3,700	\$185,000	
8. SEPTIC SYSTEMS 2 THRU 7						
Excavate	400	cy		\$75	\$30,000	
Transport and Dispose	400	cy	RWS	\$430	\$172,000	
9. SW DOG PEN SOILS						
Excavate	2100	cy		\$75	\$158,000	Excavate 6 inches over entire area;gravel not incl.
Transport and Dispose	2100	cy	RWS	\$430	\$903,000	
GROUNDWATER						
Extraction Well Installation(Cr)						Not included in preliminary estimate
Groundwater Treatment System						____ wells, avg depth ea =
Discharge Line						____ gpm system;Cr(6) reduction/ppt and IX

LEHR COST ESTIMATE (preliminary)
Alternative 4 -- Excavate/Dispose Offsite:
landfills as hazardous waste

AREA/Cost Item	QUANTITY	UNITS	TYPE	UNIT COST	COST TOTAL	COMMENTS
Monitoring Well Installation						Additional wells
Extraction Well Installation(CHCl3)						wells, avg depth ea =
Groundwater Treatment System						gpm system, GAC
Discharge Line						
Monitoring Well Installation						
VADOSE ZONE REMEDIATION						Not included in preliminary estimate
Soil Vapor Extraction/Offgas Trtmt						
CONSTRUCTION SUBTOTAL					\$22,000,000	
Mobilization/demobilization	1	ls		\$200,000	\$200,000	preliminary allowance
Site Preparation and Utility Hookups	1	ls		\$100,000	\$100,000	preliminary allowance
Bonding and Insurance	1	ls		\$500,000	\$500,000	preliminary allowance
Permitting and Legal	1	ls		\$250,000	\$250,000	preliminary allowance
Site Administration	1	ls		\$100,000	\$100,000	Contractor field and home office admin; preliminary allowance
Corrective Action Plans/Designs	1	ls		\$500,000	\$500,000	preliminary allowance
Services During Construction	1	ls		\$100,000	\$100,000	preliminary allowance
SITE REMEDIATION SUBTOTAL					\$23,800,000	
Contingency	1	ls		30%	\$7,100,000	
REMEDATION CONSTRUCTION	TOTAL				\$31,000,000	
ANNUAL O&M						
Groundwater monitoring	1	ls		\$5,000	\$5,000	Allowance
Groundwater Treatment O&M					\$0	Not incl. in preliminary estimate
SVE system O&M						Not incl. in preliminary estimate
Site Administration	1	ls		20%	\$1,000	
Oversite Services	1	ls		10%	\$500	
Annual O&M Subtotal					\$6,500	
Contingency	1	ls		50%	\$3,250	
Annual O&M Total					\$9,750	
30-Yr O&M Present Worth	1	ls		15.372	\$150,000	At 5% discount rate
Total Present Worth					\$31,000,000	

LEHR COST ESTIMATE(preliminary)
Alternative 4 -- Excavate/Dispose Offsite:
landfills as mixed waste

AREA/Cost Item	QUANTITY	UNITS	TYPE	UNIT COST	COST TOTAL	COMMENTS
GENERAL COSTS						
Investigations	1	ls		\$500,000	\$500,000	prelim allowance
Site Preparation	1	ls		\$100,000	\$100,000	prelim allowance
Site Controls	1	ls		\$100,000	\$100,000	prelim allowance
Temporary Facilities	1	ls		\$100,000	\$100,000	prelim allowance
1. RADIUM/Sr LEACH FIELDS						
						Trenches, Imhoff tank, Septic system #1
Excavate	500	cy		\$75	\$38,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Transport and Dispose	500	cy	RWS	\$430	\$215,000	Transport approximately 750 miles and dispose
2. 49 WASTE HOLES						
Excavate	400	cy		\$75	\$30,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Transport and Dispose	400	cy	RWS	\$430	\$172,000	Transport approximately 750 miles and dispose
3. SOLID WASTE TRENCHES						
Excavate	2500	cy		\$75	\$188,000	Soil excavation and analyses;incl. air monitoring and health and safety costs
Transport and Dispose	2500	cy	RWS	\$430	\$1,075,000	Transport approximately 750 miles and dispose
4. LANDFILL # 2						
Excavate	22000	cy		\$75	\$1,650,000	Assumed excavate 70%, soil analyses, air monitoring, H&S
Transport and Dispose	22000	cy	MWS	\$2,000	\$44,000,000	Transport approx. 250 mi. if Haz Waste, 750 mi. if Mixed Waste
5. LANDFILL #1						
Excavate	20000	cy		\$75	\$1,500,000	Assumed excavate 70%, soil analyses, air monitoring, H&S
Transport and Dispose	20000	cy	MWS	\$2,000	\$40,000,000	Transport approx. 250 mi. if Haz Waste, 750 mi. if Mixed Waste
6. LANDFILL #3						
Excavate	6000	cy		\$75	\$450,000	Assumed excavate 30%, soil analyses, air monitoring, H&S
Transport and Dispose	6000	cy	MWS	\$2,000	\$12,000,000	Transport approx. 250 mi. if Haz Waste, 750 mi. if Mixed Waste
7. DOE DISPOSAL BOX						
Excavate	50	cy		\$75	\$4,000	
Transport and Dispose	50	cy	MWD	\$3,700	\$185,000	
8. SEPTIC SYSTEMS 2 THRU 7						
Excavate	400	cy		\$75	\$30,000	
Transport and Dispose	400	cy	RWS	\$430	\$172,000	
9. SW DOG PEN SOILS						
						Excavate 6 inches over entire area;gravel not incl.
Excavate	2100	cy		\$75	\$158,000	
Transport and Dispose	2100	cy	RWS	\$430	\$903,000	
GROUNDWATER						
						Not included in preliminary estimate
Extraction Well Installation(Cr)						____ wells, avg depth ea =
Groundwater Treatment System						____ gpm system;Cr(6) reduction/ppt and IX
Discharge Line						

LEHR COST ESTIMATE(preliminary)
Alternative 4 -- Excavate/Dispose Offsite:
landfills as mixed waste

AREA/Cost Item	QUANTITY	UNITS	TYPE	UNIT COST	COST TOTAL	COMMENTS
Monitoring Well Installation						Additional wells
Extraction Well Installation(CHCl3)						wells, avg depth ea =
Groundwater Treatment System						gpm system, GAC
Discharge Line						
Monitoring Well Installation						
VADOSE ZONE REMEDIATION						Not Included In preliminary estimate
Soil Vapor Extraction/Offgas Trmt						
CONSTRUCTION SUBTOTAL					\$103,600,000	
Mobilization/demobilization	1	ls		\$200,000	\$200,000	preliminary allowance
Site Preparation and Utility Hookups	1	ls		\$100,000	\$100,000	preliminary allowance
Bonding and Insurance	1	ls		\$500,000	\$500,000	preliminary allowance
Permitting and Legal	1	ls		\$250,000	\$250,000	preliminary allowance
Site Administration	1	ls		\$100,000	\$100,000	Contractor field and home office admin;preliminary allowance
Corrective Action Plans/Designs	1	ls		\$500,000	\$500,000	preliminary allowance
Services During Construction	1	ls		\$100,000	\$100,000	preliminary allowance
SITE REMEDIATION SUBTOTAL					\$105,400,000	
Contingency	1	ls		30%	\$31,600,000	
REMEDATION CONSTRUCTION	TOTAL				\$137,000,000	
ANNUAL O&M						
Groundwater monitoring	1	ls		\$5,000	\$5,000	Allowance
Groundwater Treatment O&M						Not Incl. in preliminary estimate
SVE system O&M						Not incl. in preliminary estimate
Site Administration	1	ls		20%	\$1,000	
Oversite Services	1	ls		10%	\$500	
Annual O&M Subtotal					\$6,500	
Contingency	1	ls		50%	\$3,250	
Annual O&M Total					\$9,750	
30-Yr O&M Present Worth	1	ls		15.372	\$150,000	At 5% discount rate
Total Present Worth					\$137,000,000	

Appendix A

Appendix A
Revisions to Summary Notes

Document Changed	Type of Change	Change	Rationale
Figure 2: Revised Conceptual Model	Modification to upper and lower HSUs	Replace the average hydraulic conductivity numbers (located in the descriptions of the hydrostratigraphic units) with relative descriptions of conductivity	Uncertainty exists in the actual numbers and it is more important to convey the relative hydraulic conductivities of the two hydrostratigraphic units
Figure 2: Revised Conceptual Model	Modification to upper and lower HSUs	Note which contaminants have been detected in the upper and lower HSUs and their relative concentrations, but do not distinguish between those that have been detected over or under MCLs	The core group agreed to reflect facts that are unarguable in the conceptual model.
Table 1: Revisions to the Conceptual Model	Correction to a type of change	Refer to surface water as a source, rather than a tertiary source.	Tertiary sources were not delineated as such in Figure 1.
Table 2: Site Problems and Likely Response Action at LEHR	Modification to Radium and Strontium leach fields	Add no action as an alternative for Radium and Strontium leach fields: cobbles	No action is a likely general response action for this source
Table 2: Site Problems and Likely Response Action at LEHR	Modification to Radium and Strontium leach fields	Replace in-situ treatment or containment with containment as an alternative for Radium and Strontium leach fields: structures	In-situ treatment is not a likely general response action for this source. However, containment remains a viable response action for the tanks and septic systems.

Document Changed	Type of Change	Change	Rationale
Table 2: Site Problems and Likely Response Action at LEHR	Modification to Radium and Strontium leach fields	Delete no treatment (should have read no action) as an alternative for Radium and Strontium leach fields: Structures	No action is not a likely general response action for this source.
Table 2: Site Problems and Likely Response Action at LEHR	Modification to 49 waste holes and disposal trenches	Add capping to the Selective/hot spot removal alternative for the forty-nine waste holes and the disposal trenches	Hot spot removal, or selective removal is not a likely general response action without capping included as a part of the action
Table 2: Site Problems and Likely Response Action at LEHR	Correction to disposal trenches	Modify the expected conditions section of the disposal trenches to correct errors	Sections of the southwestern and the solid waste trenches descriptions were switched and there were errors in the expected contaminants
Table 2: Site Problems and Likely Response Action at LEHR	Modification to disposal trenches	Add a division to the Disposal Trenches to reflect the area where intrusion may have resulted in surface contamination	The area of the disposal trenches where intrusion may have resulted in surface contamination should be looked at separately as a different general response action may be appropriate
Table 2: Site Problems and Likely Response Action at LEHR	Modification to Landfill unit #1	Add to the expected conditions of Landfill unit #1 that a small quantity of mixed waste is possible and that chromium, which may have originated in the landfill, has been detected in the groundwater	Additions clarify the expected conditions

Document Changed	Type of Change	Change	Rationale
Table 2: Site Problems and Likely Response Action at LEHR	Correction to Landfill unit #2 and 49 waste holes	Move the sentence beginning, "Records show..." from the expected conditions of Landfill unit #2 to the expected conditions of the 49 waste holes	Description was in the wrong location
Table 2: Site Problems and Likely Response Action at LEHR	Modification to Landfill unit #3	Add a division to Landfill unit #3 to reflect the area where intrusion may have resulted in surface contamination	The area of Landfill unit #1 where intrusion may have resulted in surface contamination should be looked at separately, as a different general response action may be appropriate
Table 2: Site Problems and Likely Response Action at LEHR	Modification to Landfill units #2 and 3	Change wording in the expected conditions of Landfill units #2 and 3 to read that mixed waste is uncertain	The Expected Conditions section should reflect that mixed waste is an uncertainty in landfill units #2 and 3 rather than an expected waste
Table 2: Site Problems and Likely Response Action at LEHR	Modification to DOE disposal box	Modify the expected conditions to read that the metal box is expected to contain radiological contaminants	More accurate
Table 2: Site Problems and Likely Response Action at LEHR	Modification to septic systems numbered 2-7	Divide the source into soils and structures	There are different likely general response actions to be considered for the soils and the structures of the septic systems
Table 2: Site Problems and Likely Response Action at LEHR	Modification to septic systems numbered 2-7	The likely general response actions for the soils should be: 1. No action 2. Removal and disposal 3. In situ treatment	The likely general response actions are different for the soils than for the structures

Document Changed	Type of Change	Change	Rationale
Table 2: Site Problems and Likely Response Action at LEHR	Modification to septic systems numbered 2-7	The likely general response actions for the soils should be: 1. No action 2. Removal and disposal 3. Grout in place	The likely general response actions are different for the structures than for the soils
Table 2: Site Problems and Likely Response Action at LEHR	Modify the soil underneath the SW dog pens	Include that the soil is below the gravel	Clarification

APPENDIX B - REMEDIAL TECHNOLOGIES, ASSUMPTIONS, AND COST BASIS

This appendix provides background information on selected remedial technologies and various process options, assumptions made in applying these technologies to the presumptive remedial actions, data required for implementation of these technologies, and the basis used to estimate costs associated with these technologies. The technologies discussed include the following

- in situ solidification/stabilization
- capping
- excavation
- classification/soil washing
- onsite disposal
- offsite disposal.

B.1 IN SITU SOLIDIFICATION/STABILIZATION

In situ solidification/stabilization is a treatment technology that reduces the mobility of hazardous constituents.

B.1.1 Technology Description

In Situ Solidification/Stabilization processes can use a variety of solidification agents such as lime, fly ash, pozzolan, pozzolan/Portland cement, clays, silicates, and organic polymers to immobilize contaminants in place. Once mixed with one of these solidifying agents, the soil forms a solid matrix that reduces the mobility of contaminants, increases soil strength, and decreases soil permeability. Solidification processes have two main effects that help reduce contaminant mobility. First, the contaminants are immobilized. All contaminants are microencapsulated in the grout matrix. Other contaminants have very low solubilities in the high pH conditions of the grout matrix and precipitate as solids. Other contaminants are incorporated as a portion of the grout matrix. The overall effectiveness of final waste forms can be assessed by examining typical diffusion coefficients of contaminants in cement matrixes. The second effect involves the reduction of soil permeability. Cemented portions of soil have lower permeabilities and tend to shed water to more permeable soil regions. This effect can significantly reduce the percolation rate of water through the contaminated regions of the soil. Possible techniques for solidifying soils in place include: mixing with conventional mechanical equipment, shallow soil mixing (SSM), injection grouting, and jet grouting.

Conventional Mixing. The simplest form of soil mixing utilizes conventional mechanical equipment such as backhoes or specially designed backhoe actuated mixing equipment to mix the soil as a premixed grout slurry is added. The main advantage of conventional/backhoe actuated soil mixing is the low treatment costs. However, the depth of soil that can be treated is limited to a few feet and this method of soil stabilization tends to generate more airborne contamination than other methods. The degree of homogenization is lower for this method and can leave portions of

the soil only macroencapsulated in the solidifying agent. Also, it is difficult to control and verify the amount of solidifying agent added to a given volume of soil. The relatively small volume of the waste at LEHR indicates that better controlled techniques that reduce the spread of contamination should be used. Also, several of the sites are near or under existing buildings and this technique would not effectively solidify soils in those areas.

Shallow Soil Mixing. SSM uses a crane-mounted, single-shaft, auger head, normally 8 to 12 ft in diameter, to mix the soil and solidifying agent. For applications that require control of the fugitive dusts and gases that are generated during the mixing process, the auger is enclosed in a bottom-open cylinder. This allows for closed system mixing of the soil and solidifying agents. As the auger is advanced through the soil, solidifying agent is pumped through the hollow auger shaft and injected into the soil at the pilot bit. Solidifying agent is continuously injected as the auger penetrates through the soil. Once the desired depth is reached, the auger is removed while continuing to rotate and further mix the soil. The completion of one penetration leaves a column of solidified material with a diameter approximately equal to the diameter of the original auger. After completing the column, the blades are retracted into the bottom-opened cylinder and the cylinder is removed. The cylinder is then placed adjacent to and overlapping the previous cylinder and the process is repeated until all the waste has been treated. Support equipment for SSM includes a 100-ton crane, water and slurry pumps, grout plant (for grout batching and mixing), and bulk material trucks. This technique has a high throughput and can treat large quantities of soils in relatively short time periods. However, the augers are susceptible to large debris. The site proposed at LEHR are old leach fields that may still contain tanks, pipe, and other debris. This technique also can not be used near or under buildings.

Injection Grouting. The injection process involves drilling holes to the desired depth and injecting solidification and stabilization agents into the soil with high pressure pumps. The pressure gradient drives the solidification agent into the porosity of the soil. Injection technologies do not mechanically mix the soil so the high torque requirements associated with the in situ mixing technologies does not limit the treatment depth and also allows solidification of stronger materials including porous/fractured rock. The penetration radius of the S/S agent depends on the hydraulic conductivity and pore size of the contaminated soil and the properties of the solidification agent (e.g., viscosity and particle size). Variations in soil permeability can lead to different grout penetrations in different directions. Also, the injection method cannot be used near the surface where the path of least resistance is typically through fissures to the surface. This technique however, is useful for filling large voids and solidifying buried tank and other structures in place. If the LEHR septic system tanks are located, this technique could be used to solidify the tanks in place.

Jet Grouting. A widely used variation of the injection process is jet grouting. Like injection grouting, a small diameter hole (approximately 5 cm) is drilled to the design depth using a downward jet of air or water. However, instead of relying on the pressure gradient to force the solidification material into the soil pores, the solidification agent is pumped out laterally through jets located near the bottom of the drill pipe at pressures as high as 6000 psi. The drill pipe is then rotated continuously and drawn up at a predetermined rate. The solidification agent exiting the jets mixes with the soil and forms a cylindrical column of solidified soil. The diameter of the column is a function of the soil strength, soil composition, jetting pressure, processing rate, rotational speed, jet nozzle diameter, and S/S agent density but typical values are from 24 to 48 inches. Once the column diameter is determined, placement of subsequent drill holes at a spacing slightly less than the column radius allows the second column to join the unset material in the previous column. Continuing this pattern allows formation of subsurface walls or monoliths. The main advantages of the jet grouting processes for LEHR applications is that the equipment is small and easy to

maneuver. Injection wells can be drilled in tight places and at any angle so solidification near and under buildings is possible. Injection of soils with large quantities of natural debris (boulders, etc.) and/or waste debris (pipes, buried tanks, etc.) is also possible. However, processing rates tend to be slower making the mixing equipment more cost effective for large volumes. Support equipment for the injection techniques include water and slurry pumps, grout plant (for grout batching and mixing), and bulk material trucks.

B.1.2 Treatability Testing

A bench-scale laboratory treatability program is usually performed to determine the type and amount of S/S reagent required to satisfy treatment objectives and economic constraints. The extent of the laboratory treatability program commonly varies with the amount of waste to be treated and the potential cost savings for refining the S/S mix design. The small volumes at LEHR indicate that these studies would be as simple as possible and once a successful but not necessarily optimum formulation was determined, it would be used at the site.

B.1.3 Verification Sampling

After the proper mix has been designed, the injection rate of solidification agents is carefully metered to assure that the soils are uniformly treated. Samples of the treated soil are usually taken and properties to confirm treatment requirements are measured after the sampled have cured.

B.1.4 Assumptions

The main areas that are considered for in situ treatment include the ^{226}Ra and ^{90}Sr leach fields (OU2-Structures, OU2-Soils, and OU2-Cobbles) and the septic systems (OU4-Septic Tanks and Structures, and OU4-Leach Fields).

The main contaminants in the ^{226}Ra and ^{90}Sr leach fields are ^{226}Ra , ^{90}Sr , and plutonium. All these contaminants have low diffusion coefficients ($5\text{E}-11$ to $5\text{E}-13$ cm^2/sec) in cement matrixes indicating that they should have low mobility in a solidified waste form and be effectively immobilized. It is assumed that typical solidification agents can be used to successfully immobilize the contaminants at the site. The leach fields are near or under buildings and will need to be treated with injection or jet grouting techniques.

The contaminants in the septic systems are described only as "x-ray chemicals". It is not possible to assess the potential effectiveness of the solidification technologies from this description. It is assumed for these areas that typical solidification agents can be used to successfully immobilize the contaminants. The leach fields are near or under buildings and will need to be treated with injection or jet grouting techniques.

B.1.5 Data Requirements

1. Definition of a successfully immobilized contaminant. This is usually defined as a quantity that leaches out of a waste form when subjected to specified leaching tests. Although there are no established limits for ^{226}Ra , ^{90}Sr , and plutonium, a test similar to the Toxic Characteristic Leach Procedure (TCLP) could be adopted to quantify the required immobilization.
2. Release levels for solidification equipment to determine the decontamination requirements.

B.1.6 Cost Basis

The major costs associated with in situ solidification include the costs for conducting the bench-scale laboratory treatability program, the costs of treating the soils, and the costs of collecting and analyzing the verification samples collected during testing.

The major cost items in the treatability tests include the time for sample preparation, the costs of leach testing and analysis, and the costs of analysis reporting. The soil samples will be collected as a part of the site characterization. The small size of the site indicates that the formulations will be over designed to assure effective treatment which will tend to reduce treatability study costs but increase the per unit volume cost of treatment. Over designing the formulation will reduce concerns related to soil and contaminant concentration variations.

Based on the following articles, the cost for in situ solidification can range from \$25/m³ for near surface mixing with conventional equipment to \$325/m³ for deeper soils. The close proximity to buildings and the presence of pipes tanks and other debris indicate that these solidification jobs will be fairly difficult and more costly. The upper number of \$325/m³ will be used for LEHR cost estimates. Mobilization and decontamination costs are assumed to be the same as these costs for the soil sampling drill rig. A partial list of companies that could supply this type of grouting service is shown below.

Table B.1. Partial List of Companies Offering In Situ Cementation Services

Company Name	Location
Halliburton Environmental Technologies, Inc.	5950 North Course Dr. Houston, TX 77072
Geo-Con, Inc.	4075 Monroeville Blvd. Monroeville, PA 15146
Hayward Baker Environmental	1130 Annapolis Road Odenton, MD 21113
Westinghouse Hanford Company, Geo Technical Engineering Group	345 Hills St. Richland, WA 99352

The final cost associated with the treatment and collecting of samples includes collecting and analyzing treatment verification samples. Treatment verification samples will be taken as part of the treatment process. Four samples will be collected per area. These samples will be leach tested using procedures similar to the TCLP.

B.1.7 References

Arozarena, M. M. 1990. *Stabilization and Solidification of Hazardous Wastes*. Noyes Data Corporation. Pound Ridge, New Jersey.

Madden, M. P., and W. I. Johnson. 1992. *Installation Restoration and Hazardous Waste Control Technologies*. AD-B-172-770, National Institute for Petroleum and Energy Research. Bartlesville, Oklahoma.

Sawyer, S. 1990. *Technology Evaluation Report: International Waste Technologies/Geo-Con In Situ Stabilization/Solidification*. EPA/540/589/004D, Environmental Protection Agency, Cincinnati, Ohio.

B.2 CAPPING

Cost estimates for Resource Conservation and Recovery Act (RCRA) caps were based on the RACER ENVEST model 33.08.05. This model allows inputs to define layers of the cap and then calculates material requirements and installation costs. For this project the layers of the cap were as defined below (from bottom up).

- 1-ft final cover of compacted soil on top of the site
- 80-mil Geotextile fabric
- 2-ft impermeable clay layer
- 20-mil very low density polyethylene (VLDPE) membrane
- 1-ft sand (drainage) layer
- 80-mil Geotextile fabric
- 18-in soil layer
- 6-in layer of top soil
- grass covering.

If the cap option is selected it is assumed that the final cover will be placed over the existing soil cover. The cap will be constructed without excavation from existing elevation.

Cap design must control the flow of surfacewater runoff from the cap to prevent intrusion into the waste sight. To estimate the costs associated with potential designs to accomplish surfacewater control, two features were included in the cap estimate: 1) the cap dimensions were 6 ft wider and 6 ft longer than waste site dimensions to allow for overhang, and 2) a 10-ft-wide French drain trench with impermeable membrane and drain tile is constructed under the drainage layer and outer perimeter of the cap. The French drain component was estimated using ENVEST model 33.06.96 excluding costs for pumping and storage tanks. The excavation for the trench was estimated using ENVEST trench excavation model 33.03.97 with a 4 ft³ excavator and default cycle times.

The surface runoff from the trench is assumed to drain without pumping or treatment down the local gradient (e.g., to Putah Creek).

The ENVEST model can also calculate costs for gas venting from under a cap. No costs were included for this possibility because it is assumed that no biodegradable material has recently been placed in any of the waste sites. Therefore, gas venting will not be necessary. It is also assumed that the sites have already settled completely. Therefore special precautions to accommodate subsidence below the caps are also not necessary.

The source of specialty materials for the cap are assumed to be purchased and transported approximately 20 mi. to the site. Specialty materials would be clay, sand, top soil, and drain rock. It is assumed that unclassified soil (i.e., dirt) is available onsite.

Labor and equipment costs are estimated by the ENVEST model using local rates for the Sacramento, California, area.

Landfill #2 and landfill #3 have some structures which would interfere with the normal dimensions and slopes of a cap. In these cases extra costs are included for the installation of a 7' retaining wall to separate these structures from the cap. It is assumed that these modifications will not interfere with the cap performance in a more detailed cap design. The costs for the retaining wall installation was estimated using ENVEST 33.03.86, Retaining Walls.

B.3 REMOVAL (EXCAVATION)

Cost estimates for excavating waste sites were based upon the ENVEST model 33.08.01, Excavation of Buried Waste. Costs were based on using a 4 ft³ excavator for all the sites except the ²²⁶Ra drywells, dog pens, and landfills. A 4 ft³ clamshell excavator with a 40' boom was expected to be necessary to excavate the drywells because they are so narrow and deep. The dog pens were estimated to use a bulldozer for their excavation which is only to be 18 in. The landfills were much larger than other sites. Total excavations of the landfills were estimated using larger equipment default values embedded in the ENVEST model. "Hotspot" excavations of the landfills were estimated using the smaller 4 ft³ excavator assumed for other excavations.

When excavating buried waste it is assumed that at some time someone must go down into the hole. This may occur for any number of reasons such as sampling or inspection of an anomaly. The possibility of personnel in excavations deeper than 5 ft requires Occupational Safety and Health Administration (OSHA) approved precautions to prevent cave in. These estimates employ two alternatives for this protection. At excavations near buildings (e.g., septic tanks #2-#6 or ²²⁶Ra tanks) the side walls of the excavation are stabilized with heavy duty screen sheeting. Costs to place the sheeting, remove it, and decontaminate it are included in the excavation estimates.

At excavations where more room is available (e.g., trenches or waste holes) the side walls of the excavation are sloped 1:1 (run:rise). This makes the excavation considerably larger but the cost of excavating the larger volume is less than handling the sheeting. It is assumed that during the excavation the material from the actual waste site is readily separated from the side slope overdig and the overdig material can be returned to the site.

For options which include separating materials within the waste site dimensions, the excavation will be slower and the costs higher. The extra time to perform excavation with segregation was estimated using the same ENVEST model employing a smaller bucket fill factor and longer cycle time (150% of normal) of the excavator.

Excavation/demolition of concrete structures (e.g., septic tanks and Imhoff tanks) require demolition of the concrete in addition to excavating it. For these options even longer cycle times of the excavator (200% or normal) were employed in the ENVEST model. The smaller bucket fill factor was also employed. Costs for the initial break-up of the concrete walls was estimated using a concrete demolition model in ENVEST (Sidewalk Demolition, 33.03.71). It is more difficult to break-up walls than sidewalks. The extra costs for this are assumed covered by the extra cycle time for the excavator during excavation.

B.4 CLASSIFICATION/SOIL WASHING

Soil washing is a set of processes that remove contaminants from soils in one of two ways: by concentrating them into a smaller volume of soil through various classification techniques, or by dissolving and/or desorbing them into a wash solution.

B.4.1 Technology Description

The concept of the physical separation process option of soil washing is based on the theory that most organic and inorganic contaminants tend to bind, either chemically or physically, to the fine (i.e., clay and silt) fraction of a soil. The clay and silt soil particles are, in turn, physically bound to the coarser sand and gravel particles by compaction and adhesion. Thus, separating the fine clay and silt particles from the coarser sand and gravel soil particles would effectively concentrate the contaminants into a smaller volume of soil that could then be further treated or disposed. However, the assumption that more contamination is associated with the fine soil particles is not always correct and the distribution of contaminants throughout the soil matrix must be determined in order to assess the applicability of soil washing and to choose the appropriate physical separation technique.

Various classification techniques are available to separate the different types of particles that may be present in a soil matrix. The choice depends on the amount of debris present, the physicochemical nature of the soil and the desired separation and throughput. A few of the more common techniques; screens, liquid cyclones, jigs, tabling, and spiral concentration, are described below. For all of these techniques, water is the most common washing solution, although there are other options.

Screens. The simplest classification technique uses screens to separate soil particles based on size. Screening machines may be divided into five main classes: grizzlies, revolving screens, shaking screens, vibrating screens, and oscillating screens. Grizzlies are used primarily for separating rocks and debris that are 0.05 m and coarser, while revolving screens and shaking screens are generally used for the separation of particles above 0.013 m. These processes may be done either wet or dry. Vibrating screens cover a wide range of particle separations, from coarse down into the fine meshes. Oscillating screens are limited in general to the finer meshes below 4 mesh (0.0048 m). Finer particle screening is typically done wet.

Liquid Cyclones. Another wet classification technique uses a liquid cyclone to separate the soil particles. In simplest terms the unit has a top cylindrical section and a lower conical section terminating in an adjustable apex opening. The soil and wash solution enter the separator together in the top cylindrical section. Separation occurs in the cone-shaped part of the cyclone by the action of centrifugal and centripetal forces. The heavier portion of the feed leaves the cyclone at the apex opening and the lighter portion leaves at the overflow top orifice.

Jigs. A jig is a mechanical device used for separating soil particles of different specific gravities by the pulsation of a stream of liquid flowing through a bed of materials. The wash solution pulsates, or "jig" up and down, causing the heavy soil particles to work down to the bottom of the bed and the lighter ones to rise to the top. Each product is then drawn off separately.

Tabling. Tabling is a concentration process whereby a separation between two or more soil particles is effected by flowing a pulp across a riffled plane surface inclined slightly from the horizontal, differentially shaken in the direction of the long axis, and washed with an even flow of wash solution at right angles to the direction of motion. Separation depends mainly on the

difference in specific gravity between the soil particles and to a lesser degree on the shape and size of the particles.

Spiral Concentration. Spiral concentration is also based primarily on the specific gravity differentials of the materials to be separated. A typical spiral concentrator consists of a spirally shaped channel or launder with a modified semicircular cross-section. The standard spiral consists of five complete turns, however, less turns are used when an unusually rapid and clean separation takes place. As the feed slurry flows down the spiral channel, the soil particles with the highest specific gravity sink to the bottom and move inward toward the inside of the channel. The lighter weight particles move to the outside and are carried away by the faster more dilute pulp stream. Wash water is available along the entire inside edge of the spiral, thus providing repeated wash stages as the pulp flows down the channel. Although the spiral concentrator is mechanically a very simple piece of equipment, the separating action taking place is complex. It involves centrifugal force, friction against the spiral surface, gravity, and the drag of the water.

Attrition Scrubbing. Each of the above physical separation techniques can be enhanced by using attrition scrubbing to attain a higher particle separation effectiveness. Attrition scrubbing helps remove and separate fine particles that otherwise would stick to the large particles and remain in the coarse fraction. Attrition scrubbing can also remove the outer surface of larger particles where contaminants can concentrate in small cracks at the surface resulting in a better separation of contaminants into the fine fraction.

Soil Washing. The second type of soil washing involves chemical separation. A wide variety of chemical contaminants can be removed from soils through soil washing applications. Removal efficiencies depend on the type of contaminant, washing solution, and soil. The amount of each contaminant that will dissolve or desorb is a function of the partitioning effect of the wash solution and the volume of the washing solution that is contacted with the contaminated soil. Water is the most common washing solution, however, additives are often required to improve the contaminant removal efficiency. These additives may not only help the dissolution/desorption process, but may also modify the interfacial tension between soil particles or provide an electrolyte that improves particle dissociation.

Volatile organic contaminants are usually easily removed from soil by washing with water; experience shows that volatiles can be removed with 90% to 99% efficiency or more. Semivolatile organics can be removed to a lesser extent (40% to 90%) with the addition of a proper surfactant to the wash water. Metals and pesticides, which are more insoluble in water, often require the addition of acids or chelating agents for successful soil washing. Treatability studies are typically required to determine the best wash solutions.

There are generally two ways to use classification and soil washing techniques to reduce remediation costs. The greatest savings can be realized if a large portion of the soil can be treated and returned to the site. This eliminates the treatment and disposal costs for a large fraction of the waste. The main difficulty associated with this approach is to establish levels where the soils may be considered clean. The second way to use these techniques is to separate out different types of waste so that a large portion of the waste can be handled as low-level waste (LLW) or hazardous waste (HW), as opposed to radioactive mixed waste (RMW). There may be significant cost savings associated with keeping these waste segregated as opposed to disposing all the waste as the most restrictive category. There can also be different costs associated with debris and soil waste so that separating these materials may also result in a cost savings.

B.4.2. Assumptions

The areas where treatment of excavated soils is being considered include the disposal trenches (OU1-SW Trenches, OU1-South Solid Waste Trenches, and OU1-Eastern Solid Waste Trenches); the waste holes (OU1-49 Waste Holes); the ^{226}Ra and ^{90}Sr leach fields (OU2-Structures, OU2-Soils, and OU2-Cobbles); and portions of the landfills (OU5-Landfill 1, OU5-Landfill 2, and OU5-Landfill 3).

The main contaminants in the disposal trenches are ^{226}Ra and chloroform. Chlordane and pesticides are also possible contaminants. Removal of ^{226}Ra (Phillips et al. 1993) has been investigated at pilot-scale levels. Chloroform has a relatively high water solubility (9300 mg/L) (White and Bryant 1995) and should be effectively removed with soil washing. Chlordane has a low water solubility (0.056 mg/L) (White and Bryant 1995) but is likely to be strongly bound to the organic matter and fine particles in the soil thus making effective soil washing possible. Half of the excavated volume is assumed to be contaminated debris and the remaining is soil. This cost analysis assumes that the soil and debris can be separated using simple classification techniques. The analysis also assumes that the separated soil may be further treated using wet soil washing processes to return 75% of the material to the site as clean material.

The waste holes have the possibility of 17 different radionuclides. A total of 1.7 curies of contamination were disposed. If the holes are full of material with a density of 1.5 g/cc, and the contamination is evenly distributed, contamination levels may be as much as 6400 pCi/g. Depending on the type of radionuclide present, this material may need to be disposed as category three waste. The main treatment strategy for this site is to carefully excavate the waste holes in order to keep different waste types separated. Soils around the waste holes may have little contamination and would be kept segregated until analyses were conducted. When the waste holes were encountered, the operator would use simple dry screening techniques to separate the soil and debris found in the waste hole. For this cost analysis, it is assumed that the holes will be excavated in a single trench and that there are two types of material. The waste in the 49 waste holes has a volume of approximately 80 yd³ and consists of highly contaminated debris and soil. The remaining volume of the trench is low contamination soils. It is assumed that 75% of the soils around the waste holes can be segregated by careful excavation and will contain only low levels of radioactivity that can be disposed as LLW soils. The remaining material is screened into three fractions, a mixed waste soil (50% of remaining material), and a mixed waste debris (40% of remaining material) that may be disposed at Envirocare, and category three waste debris (10% of remaining material) that must be disposed as a class three waste at the Hanford waste disposal facility.

The main contaminants in the ^{226}Ra and ^{90}Sr leach fields are ^{226}Ra , ^{90}Sr , and plutonium all at levels between 10 to 20 pCi/g. These materials probably already meet the waste acceptance criteria (WAC) and should only be treated if a portion of the soil can be returned to the site. Removal of plutonium (Stevens et al. 1982) has been investigated in bench-scale tests and removal of ^{226}Ra (Phillips et al. 1993) has been investigated at the pilot-scale levels. These studies show that significant contaminant reduction are possible for these contaminants. This cost analysis assumes that the low levels of the contamination in these soils will make it possible to use wet soil washing techniques to treat the soil and return 75% of the material to the site as clean material.

The only contaminant specifically mentioned in the landfills is chromium and chloroform has also been detected. Chromium has been successfully removed with soil washing techniques (Anderson 1993). Chloroform, as mentioned above, has a high water solubility and probably can be effectively removed with soil washing techniques. This cost analysis assumes that the soils

removed from the hotspots are a mixture of hazardous soil and debris. Combined dry screening and soils washing techniques can be used to segregate and treat the hotspots to allow 50% of the excavated material to be returned to the site as clean material.

B.4.3 Data Requirements

The remediation goals for all contaminants of concern must be established to determine if soil washing can achieve those levels.

Once the goals are established, treatability studies on the site soils must be conducted to determine if the soil washing techniques can meet the goals and to estimate the potential volume reductions.

B.4.4 Cost Basis

The cost basis for this treatment step depends on the level of required treatment. Simple dry mechanical screening techniques are not expensive. Cost for these techniques are generally less than \$1/yd³. The \$1/yd³ figure will be used for this analysis. When excavation with segregation is estimated, the extra cost to segregate is reflected in a smaller bucket load (2/3 of normal) and longer cycle time (default +50%) (see discussion of excavation).

The soil washing cost module in ENVEST will be used to cost the wet soil washing techniques. For this model, the primary parameter for determining the cost of soil washing is the quantity of contaminated soil to be treated in tons. Estimated treatment costs for a mobile, commercial-scale, 20-ton per hour soil washing system are presented as a function of tons processed. Costs include capital recovery (charged as an equipment leasing rate) and water treatment; not included are costs for excavation, debris removal, and treatment or disposal of residuals generated during treatment. These are considered separate technologies. A bulk density of 1.5 g/cc is used to convert from tons to cubic yards.

Table B.2. ENVEST Soil Washing Costs

Quantity Treated (yd ³)	Total Unit Cost (\$/yd ³)
0 - 7900	132
7900 - 11900	103
11900 - 15800	91
15800 - 19800	86
19800 - 23700	83
23700 or greater	82

B.4.5 References

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Environmental Estimating (ENVEST) software (a portion of the Remedial Action Cost Estimating and Requirements (RACER) system), Delta Research Corp, Niceville, Florida.

Phillips, C. R., W. S. Richardson, C. Cox, M. C. Eagle. 1993. "A Pilot Plant for the Remediation of Radioactive Contaminated Soils using Particle-Size Separation Technology." ORNL-6769, *In Proceedings of Soil Decon '93: Technology Targeting Radionuclides and Heavy Metals*, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Stevens, J. R., R. L. Kochen, D. W. Rutherford, J. A. Riordan, and I. C. Delaney. 1982. *Comparative Scrub Solution Tests of Decontamination of Transuranic Radionuclides from Soils*. RFP-3161, DOE/TIC-4500, Rockwell International. Rocky Flats Plant, Golden, Colorado.

White, M. K., and J. L. Bryant. 1995. *ReOpt™ Version 3.0*. PNL-7840, Revision 2, Pacific Northwest Laboratory, Richland, Washington.

B.5 ONSITE DISPOSAL

Cost estimates for building a RCRA landfill onsite were developed by applying a multiple of ENVEST models for different aspects of the construction. The train of models employed is listed below.

Excavation, trenching	33.08.01	costs for excavating site
Parking lot construction	33.03.79	costs for grading and compacting "pit"
Cap construction	33.08.05	costs for liner materials and installation
Free product removal	33.06.96	costs to install leachate collection piping & sump pumps
Load and haul	33.08.87	costs to transport wastes from Lehr site to new landfill site (6 mi)
Parking lot construction	33.03.79	cost to compact waste
Cap construction	33.08.05	costs for final cap construction
Free product removal	33.06.96	costs for surfacewater collection from cap drainage

It was assumed that if onsite disposal can be permitted in a timely manner for this clean-up that all but the most hazardous wastes would be disposed onsite. Therefore, the volume of the constructed facility was assumed to be 70,000 yd³ (compacted). The dimensions were assumed to be 320 by 320 by 16.5 ft deep with 5:1 sloping side walls. The ground level dimensions would be approximately 400 by 400 ft. The depth is selected so that the bottom of the impervious liner would be above a high level water table @ 20 ft depth.

This facility should contain all of the wastes. Onsite disposal costs for individual waste site volumes are estimated as a volume fraction of the expected total cost for this facility. If a significantly smaller facility were constructed, it is expected that the per unit costs of onsite disposal would be higher.

Application of ENVEST model detail--ENVEST does not contain a model to build a landfill site. The Cap construction model was considered a valid approximation because building a multi layer RCRA landfill liner is similar to an inverted cap. The cap model was used to calculate the material volume requirements for each layer. Since the model is inverted the layers don't match. The top layer of a cap requires the greatest volume. In the landfill the bottom layer requires the greatest

volume of material. Therefore, the unit costs for a the correct material were applied to the volumes calculated for the inverted cap. The conversions are indicated below:

Cap (top down)	Landfill (bottom up)
Top soil--(none)	NA
soil cover (6 in.)	bedding layer (6 in.)
separation fabric	separation fabric
drainage layer (24 in.)	clay layer (24 in.)
impermeable membrane	impermeable membrane
clay layer (24 in.)	drainage layer (12 in.)
separation fabric	separation fabric
final cover (6 in.)	bedding layer (6 in.)

B.6 OFFSITE DISPOSAL

CERCLA derived waste from the LEHR facility may fit a number of waste classifications, each requiring a different type of disposal facility. A description of these waste types and the available disposal facilities for each waste type follows. Estimated transportation and disposal costs for each waste type are also presented along with the assumptions used to determine the type and amount of each waste that will be generated for a given remedy.

B.6.1 Description

The waste at the LEHR site may fall into any of seven different categories.

1. Municipal Solid Waste
2. HW
3. LLW soils
4. RMW soils
5. LLW debris
6. RMW debris
7. Low Level Category 3 Waste

These wastes will be disposed of at different facilities depending on the properties of the waste.

Municipal Solid Waste. A municipal solid waste landfill was not specifically identified. Typical solid waste disposal costs are used for this type of waste. Combined disposal and transportation costs are \$76/ton.

Hazardous Waste. The closest hazardous waste facility is the Chemical Waste Management, Inc. landfill in Kettleman City, California. This facility will accept bulk hazardous waste and has a stabilization facility that uses cement formulations to stabilize waste contaminated with heavy metals. The facility is approximately 220 miles south of the LEHR site. The cost for disposal, assuming no additional stabilization is required, depends on the total quantity but can range from \$40-80 per ton.

Low-Level Waste and Radioactive Mixed Waste. Envirocare and the Hanford Solid Waste Disposal Facility are two potential facilities that might be able to accept LLW and RMW generated at LEHR.

Envirocare. Envirocare is a waste disposal facility that accepts low level and radioactive mixed waste. This facility does not have different price schedules for waste that contain only hazardous constituents. The facility is located 75 miles west of Salt Lake City, Utah. The following table shows that Envirocare can accept waste containing contaminants known to be at the LEHR site.

Table B.3. Envirocare WAC for LEHR Contaminants

Contaminant	Maximum Allowed Concentration, Radioactive Contaminants (pCi/gram)	Approved Hazardous Contaminants
⁹⁰ Sr	2.0E+4	N/A
²²⁶ Ra	2.0E+3	N/A
²⁴¹ Pu	3.5E+3	N/A
²⁴¹ Am	2.3E+3	N/A
Chromium	N/A	Yes
Chloroform	N/A	Yes

Costs for disposal at Envirocare were obtained verbally (telecon 4-27-95) from Susan Rice.

- Envirocare already has a contract in place with the U.S. Department of Energy (DOE) for RMW. Costs are:
 - soil = \$40.00/ft³
 - debris (trash) = \$60.00/ft³
- DOE-Oakland has an IAA (Interagency Agreement) with the Corps of Engineers for disposal of LLW at Envirocare. Costs are:
 - soil = \$7- \$8.00/ft³
 - debris = \$16-\$17.00/ft³

Hanford Solid Waste Disposal Facility. The Hanford Solid Waste Disposal Facility also accepts low level and radioactive mixed waste. The facility is located on the Hanford site near Richland, Washington. The following table shows the allowable levels of radioactive contaminants at the LEHR site in two different waste categories. The category one waste limits are similar to the limits for Envirocare. The category three limits are several orders of magnitude greater.

Table B.4 Hanford WAC for LEHR Radioactive Contaminants

Contaminant	Hanford WAC (Ci/m ³)		Hanford WAC (pCi/g) assuming Bulk Density of 1.5 g/cc	
	Category 1	Category 3	Category 1	Category 3
⁹⁰ Sr	4.3E-3	1.5E+4	2.87E+3	1.0E+10
²²⁶ Ra	1.4E-4	3.6E-2	9.33E+1	2.4E+4
²⁴¹ Pu	7.7E-2	31	5.13E+4	2.07E+7
²⁴¹ Am	2.6E-3	1.1	1.73E+3	7.33E+5

Costs for disposal at the Hanford Solid Waste Disposal Facility, were obtained from the Westinghouse Hanford Company, Solid Wastes Programs.

- Costs for RMW are: \$120.24/ft³
- Costs for LLW are: \$36.01/ft³
- Costs for contact handled Category 3 LLW are: \$36.01/ft³ (for disposal) + \$45.77/ft³ (additional charge for high integrity containers) = total disposal charge of \$81.78/ft³

B.6.2 Shipping Costs

The other major cost associated with offsite disposal is the shipping costs. The travel distance to Envirocare is 625 miles (one-way). The travel distance to the Hanford disposal facility is 825 miles (one-way). The travel distance to the Chemical Waste Management, Inc. landfill in Kettleman City, California is approximately 220 miles (one-way). The shipping costs are:

- Hazardous Waste - \$0.246/yd³/mi (Chemical Waste Management 1995)
- LLW - \$0.227/yd³/mi (Tri-State, 1993)
- RMW - (costs assumed to be same as LLW)

B.6.3 Cost Summary/Basis

Based on the cost information and the distances to the available site, the following table shows the assumed disposal facility and the associated costs for each type of waste.

Table B.5. Offsite Disposal Costs.

Waste Type	Facility	Disposal Costs	Disposal Costs (\$/yd ³)	Transportation Costs (\$/yd ³)	Total Cost (\$/yd ³)
Municipal Solid Waste	Local Landfill				\$96*
Hazardous Waste	Chemical Waste, Kettleman City, CA	\$80/ton	\$101	\$54	\$155*
LLW (debris)	Envirocare	\$17/ft ³	\$459	\$142	\$601
LLW (soil)	Envirocare	\$8/ft ³	\$216	\$142	\$358
RMW (debris)	Envirocare	\$60/ft ³	\$1620	\$142	\$1762
RMW (soil)	Envirocare	\$40/ft ³	\$1080	\$142	\$1222
Low Level Category 3 Waste	Hanford	\$82/ft ³	\$2214	\$187	\$2401

*Conversion of 0.7910 yd³/ton

B.6.4 Site Assumptions

All areas are being considered for excavation and offsite disposal. These areas include the disposal trenches (OU1-SW Trenches, OU1-South Solid Waste Trenches, and OU1-Eastern Solid Waste Trenches); the DOE disposal box (OU1-DOE Disposal Box); the waste holes (OU1-49 Waste Holes); the ^{226}Ra and ^{90}Sr leach fields (OU2-Structures, OU2-Soils, and OU2-Cobbles); the dog pens (OU3-Dog Pens); the septic systems (OU4-Structures and OU4-Soils); and portions of the landfills (OU5-Landfill 1, OU5-Landfill 2, and OU5-Landfill 3).

The main contaminants in the disposal trenches are ^{226}Ra and chloroform. Chlordane and pesticides are also possible contaminants. These wastes are considered mixed wastes and will be disposed at the Envirocare facility.

The DOE disposal box is thought to contain mixed waste. If the radiation levels exceed the WAC at Envirocare, the waste will need to be shipped to Hanford. Initially, the radiation levels are assumed to be low enough to be disposed at Envirocare.

The waste holes have the possibility of 17 different radionuclides. A total of 1.7 curies of contamination were disposed. If the holes are full of material with a density of 1.5 g/cc, and the contamination is evenly distributed, contamination levels may be as much as 6400 pCi/g. This level of radioactivity may exceed the WAC for the Envirocare disposal facilities and without better characterization data, at least a portion will need to be disposed as category three waste at Hanford. The holes also contain a combination of soil and debris. Assumptions associated with classification/soil washing will dictate the relative amounts of each type of waste that will need to be disposed for this site.

The main contaminants in the ^{226}Ra and ^{90}Sr leach fields are ^{226}Ra , ^{90}Sr , and plutonium all at levels between 10-20 pCi/g. These materials meet the Envirocare WAC and will be disposed as low level soils.

The dog pens are thought to contain chlordane and low levels of radiation. Initially, these wastes should be considered as mixed waste and will be disposed at Envirocare as mixed waste soils.

The septic systems are described as having "x-ray chemicals." The x-ray portion could indicate a low-level aspect and the chemicals imply the possibility of a hazardous waste. However, these were sanitary septic systems and were probably not used to dispose of large amounts of radioactive material. Initially, these wastes are considered as hazardous waste and will be disposed at the Kettleman facility.

The only contaminant specifically mentioned in the landfills is chromium and chloroform has also been detected. Wastes from these areas may only be hazardous but mixed waste is a possibility. Initially, the waste will be assumed to be a mixture of hazardous soil and debris.

B.6.5 References

Chemical Waste Management, Inc. Proposal No: 7022Batl. May 1995.

Envirocare Waste Acceptance Criteria. May 1995. Utah Department of Health of Radiation Control Radioactive Material License. License No. UT 2300249. Expiration date: 2/28/96.

Tri-State Motor Transit Co. 1993. *Mileage Commodity Rates applying on Radioactive Materials, Equipment Contaminated with Radioactive Materials, and Empty Shipping Containers for Radioactive Materials*. Docket No. MC-109397. Joplin, Missouri.

Westinghouse. 1993. *Hanford Site Solid Waste Acceptance Criteria*. WHC-EP-0063-4, Westinghouse Hanford Company, Richland, Washington.

APPENDIX C - ENVEST COST MODEL RESULTS

This appendix contains results from various ENVEST cost model runs. The ENVEST code was used to develop the costs for application of the presumptive remedial technologies and process options to the source operable units. The technologies/process options applied using the ENVEST model include:

- Capping
- Excavation
- Excavation with Segregation
- Hotspot Removal
- Onsite Disposal (via construction and operation of a RCRA-designed landfill)
- Offsite Disposal (costs not developed using ENVEST)

In some cases the input parameters or assumptions (such as excavation volumes) used in the ENVEST model runs differ from those used in development of the final cost estimates. In these cases the ENVEST model results were used on a unit cost basis, assuming a linear relationship between the cubic yards of material being handled and the cost.

ENVEST MODEL ASSUMPTIONS INPUT

Assumptions:

Envest inputs:

Distance: Envest default distance to material sources is 6 mi. To be more conservative we assumed the materials sources (clay, sand, rock, top soil, etc.) will be 20 mi. away.
To estimate the extra travel charge the "Load and Haul" model was enlisted for a 14 mi. distance.
So that loading isn't double counted we subtracted the loading costs from the "Load and Haul" model.

Caps: Dimensions of cap are site dimensions plus 6' length and width for overhang.

1' final cover of onsite material (trench material)
2' clay impermeable layer from off-site material.
VLDPE impermeable membrane liner over clay.
1' drainage layer (sand) from off-site.
18" unclassified soil above drainage layer from on-site (trench material)
6" top soil on top from off-site.

Separation layers are: 80 mil Geotextile between soil and drainage layer.
80 mil Geotextile between sand and FML.

Parts of landfill #2 and #1 encroach on buildings. These estimates include building retaining walls around the appropriate building walls.

Toe drain:

Because so much of the local area may be covered with caps there is anticipated a problem handling storm surface water. To much run off may not percolate directly to the groundwater and may back up into the waste. A drain tile was installed under the cap from the drainage layer out to the perimeter. This drain tile was estimated using the French Drain model in Envest called "Free Product Removal". This model includes pumps. We assumed free flow to Putah Creek will be acceptable. All pump and associated charges were removed from the Envest total.
The Envest model included lining the 10'x3' deep trench with filter fabric.
For this application the costs of the liner were replaced with the prorated costs of additional VLDPE liner, using the per unit costs calculated for the cap FML. The cap costs for anchor trench were subtracted from the cap costs because the toe drain will also anchor the liner.
Trenching excavation assumed a 4CF bucket. The model assumes a 1 CY bucket.
To account for the smaller size a .16 loading factor was used in the EnVest model.

Loading and Hauling:

Loading and hauling the material is a large fraction of the cost.
For these estimates we assumed that all the trenching material and unclassified fill for the caps will be available on-site.
We also assumed that the necessary clay, sand, rock, and top soil for the cap and/or drain tile will be available 20 miles away. Costs for the material, labor, and equipment are embedded in the Envest model.
The specific locality is Sacramento, Calif.

Excavations:

Assume excavation is 10 ft deep.
Small units (all except landfill) are assumed too small to use a 1CY bucket. A 4 CF bucket is assumed.
When excavation w/ segregation is estimated the extra cost to segregate is reflected in a smaller bucket load (2/3 of normal) and longer cycle time (default +50%).
For landfill units use default bucket sizes selected by Envest.
Use side slope stabilization method w/1:1 side slope for excavating buried waste.
For all cases assume a 2' clean cover. 100% of the remaining excavated volume must be backfilled, except segregation of landfills. Then 50% of the volume may be returned.
Excavation site size is 1' larger in each direction than site because of overdig.

OVA rental is a monthly rental. It is estimated based on the excavation size. Landfill excavations are based on landfill #1 lasting 1 mo. Others are prorated accordingly. Other excavations are based on the waste holes excavation lasting one month using smaller equipment.

After excavation or excavation and segregation the holes are backfilled with fill available on-site.
The waste is in piles protected by plastic cover. The cost to load and haul the waste is estimated by the total volume of waste then prorated.

Demolition of concrete septic tanks was estimated using the Envest model for sidewalk demolition of the same volume plus the cost to excavate a the buried volume using a cycle time 2x default to account for the concrete.

At times the desired dimension was below the minimum of Envest. In that case Envest was used as the minimum and then prorated for the unexcavated volume.

Direct costs do NOT include mobilization and demobilization. That is added as part of project overhead.

Septic tanks #2-#6 are all close to buildings. Assume they can be excavated using steel sheeting for side wall stabilization.
Septic tanks #1 and #7 are sufficiently clear of buildings to use side slope excavation.

After excavations or segregations the waste is in piles. The loading of those piles into some container must be added to any project.
The loading is estimated by a single loading model using a 2 CY loader.

The effect of increasing safety level is to reduce productivity. The chart below lists the effects on labor and equipment productivity in the Envest model for each Safety Level.
Cost impacts are inversely proportional.

Level of Productivity		
Safety Level	Labor	Equipment
A	0.15	0.5
B	0.25	0.6
C	0.5	0.75
D	0.75	1
E	1	1

CAPPING COST SUMMARY

Summary Costs for Caps:

Totals for each "site".

Unit	Site	dimension		Cap Dimensions		description	sub-total
		length	width	length	width		
OU-1	SW trenches	120	15	126	21	Total Cap Capital	\$ 20,064
						Yearly O&M	\$ 75
						3' deep--Toe drain estimate:	\$ 18,787
						Yearly O&M	\$ 416
						Total site cost (Capital)	\$ 38,851
						Yearly O&M	\$ 491
OU-1	South Trench located at south end of western dog pens	270	6	276	12	Total Cap Capital	\$ 34,979
						Yearly O&M	\$ 123
						3' deep--Toe drain estimate:	\$ 33,559
						Yearly O&M	\$ 416
						Total site cost (Capital)	\$ 68,538
						Yearly O&M	\$ 539
OU-1	East Trench trench is located on the eastern border of Landfill #2.	150	6	156	12	Total Cap Capital	\$ 17,477
						Yearly O&M	\$ 61
						3' deep--Toe drain estimate:	\$ 21,870
						Yearly O&M	\$ 416
						Total site cost (Capital)	\$ 39,347
						Yearly O&M	\$ 477
OU-1	East Trench-2 trench is located on the eastern border of Landfill #2.	75	10	81	16	Total Cap Capital	\$ 13,325
						Yearly O&M	\$ 50
						3' deep--Toe drain estimate:	\$ 15,784
						Yearly O&M	\$ 416
						Total site cost (Capital)	\$ 29,108
						Yearly O&M	\$ 466
OU-1	49 Waste Holes	260	8	266	14	Total Cap Capital	\$ 35,505
						Yearly O&M	\$ 114
						3' deep--Toe drain estimate:	\$ 43,637
						Yearly O&M	\$ 416
						Total site cost (Capital)	\$ 79,142
						Yearly O&M	\$ 530
OU-5	Landfill #1	250	200	256	206	Total Cap Capital	\$ 265,027
						Yearly O&M	\$ 694
						3' deep--Toe drain estimate:	\$ 46,639
						Yearly O&M	\$ 416
						Total retaining wall	\$ 34,342
						Total site cost (Capital)	\$ 346,008
						Yearly O&M	\$ 1,110

Unit	Site	dimension length width	Cap Dimensions length width	description	sub-total
OU-5	Landfill #2	320 300	326 306	Total Cap Capital	\$ 476,704
				Yearly O&M	\$ 1,253
				3' deep--Toe drain estimate:	\$ 65,609
				Yearly O&M	\$ 416
				Total retaining wall	\$ 47,132
				Total site cost (Capital)	\$ 523,836
				Yearly O&M	\$ 1,669
OU-5	Landfill #3	175 100	181 106	Total Cap Capital	\$ 103,258
				Yearly O&M	\$ 292
				3' deep--Toe drain estimate:	\$ 33,125
				Yearly O&M	\$ 416
				Total site cost (Capital)	\$ 136,383
				Yearly O&M	\$ 708
OU-5&1	Combined Landfill 1&2 & neighboring sites	500 415	506 421	Total Cap Capital	\$ 960,675
				Yearly O&M	\$ 2,565
				3' deep--Toe drain estimate:	\$ 94,052
				Yearly O&M	\$ 416
				Total retaining wall	\$ 47,132
				Total site cost (Capital)	\$ 1,007,807
				Yearly O&M	\$ 2,981

CAPPING COSTS

Unit	Site	dimensions		Cap Dimensions		description	Cost Details					Reference		
		length	width	length	width		Material	Material-	Labor-\$	Equip.-\$	sub-total			
OU-1	SW trenches	120	15	126	21	1' final cover in 6" lifts	125	CY	\$ 22	\$ 252	\$ 372	\$ 645	33.08.05.08	
						Material hauling (14mi	884	CY	\$ -	\$ 2,224	\$ 2,573	\$ 4,797		
						Impervious layer					\$ 8,371			
						2' clay in 6" lifts	280	CY	\$ 1,002	\$ 1,539	\$ 1,016		33.08.05.06	Liner unit costs:
						herbicide	0.06	acr	\$ 3	\$ 7	\$ 3		"	labor equip material
						20 mil VLDPE liner	6643	SF	\$ 978	\$ 3,163	\$ 252		"	\$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	330	SY	\$ 243	\$ 157	\$ 8		"	
						Drainage layer					\$ 2,048			
						1' sand in 6" lifts	278	CY	\$ 1,340	\$ 311	\$ 397		33.08.05.05	
						80 mil geo textile filter	831	SY	\$ 612	\$ 396	\$ 20	\$ 1,029	33.08.05.03	
						Soil Cap					\$ 3,173			
						18" soil in 6" lifts	420	CY	\$ 74	\$ 845	\$ 1,249		33.08.05.02	
						6" top soil	158	CY	\$ -	\$ 289	\$ 464		33.08.05.01	
						seeding	0.015	acr	\$ 144	\$ 14	\$ 9		"	
						watering	1	acr	\$ -	\$ 54	\$ 29		"	
						Total Cap Capital						\$ 20,064		
						Yearly O&M						\$ 75		
						30 year O&M totals								
						reseeding	0.3	acre	\$ 289	\$ 29	\$ 19		33.08.05.99	
						mowing	12	/yr	\$ -	\$ 1,305	\$ 195		"	
						fertilizing	1	/yr	\$ 120	\$ 144	\$ 141		"	
						3' deep--Toe drain estimate:						\$ 18,787		
					390	10	Excavation	433	CY	\$ -	\$ 921	\$ 755		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
							Crushed rock	496	CY	\$ 3,258	\$ 1,612	\$ 203		"
							Compacting	496	CY	\$ -	\$ 1,808	\$ 56		"
							20 mil liner	11160	SF	\$ 1,643	\$ 5,313	\$ 424		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
							6" perf. PVC pipe	704	LF	\$ 269	\$ 1,661	\$ 484		33.06.96.01 times per unit costs for liner from cap installation
							4" PVC pipe to creek	50	LF	\$ 67	\$ 27	\$ 286		"
							Yearly O&M							
							pipe cleaning							
							(1/yr@ 8hr)	8	hr	\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out	
							Total site cost (Capital)					\$ 38,851		
							Yearly O&M					\$ 491		

Unit	Site	dimensions		Cap Dimensions		description	Cost Details					Reference
		length	width	length	width		Material	Material-	Labor-\$	Equip.-\$	sub-total	
OU-1	South Trench located at south end of western dog pens	270	6	276	12	1' final cover in 6" lifts	209 CY	\$ 37	\$ 421	\$ 622	\$ 1,079	33.08.05.08
						Material hauling (14mi	1532 CY	\$ -	\$ 3,855	\$ 4,459	\$ 8,314	
						Impervious layer					\$ 14,464	
						2' clay in 6" lifts	468 CY	\$ 1,675	\$ 2,572	\$ 1,699		33.08.05.06 Liner unit costs:
						herbicide	0.06 acr	\$ 4	\$ 11	\$ 5		" labor equip material
						20 mil VLDPE liner	11819 SF	\$ 1,740	\$ 5,627	\$ 449		" \$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	551 SY	\$ 406	\$ 262	\$ 13		"
						Drainage layer					\$ 3,632	
						1' sand in 6" lifts	493 CY	\$ 2,377	\$ 552	\$ 703		33.08.05.05
						80 mil geo textile filter	1478 SY	\$ 1,088	\$ 704	\$ 36	\$ 1,828	33.08.05.03
						Soil Cap					\$ 5,661	
						18" soil in 6" lifts	747 CY	\$ 131	\$ 1,504	\$ 2,222		33.08.05.02
						6" top soil	280 CY	\$ -	\$ 513	\$ 822		33.08.05.01
						seeding	0.27 acre	\$ 260	\$ 26	\$ 17		"
						watering	2 acre	\$ -	\$ 108	\$ 59		"
						Total Cap Capital					\$ 34,979	
						Yearly O&M					\$ 123	
						30 year O&M totals						
						reseeding	0.3 acre	\$ 289	\$ 29	\$ 19		33.08.05.99
						mowing	12 /yr	\$ -	\$ 2,290	\$ 342		"
						fertilizing	1 /yr	\$ 216	\$ 260	\$ 255		"
						3' deep--Toe drain estimate:					\$ 33,559	
					704	10 Excavation	782 CY	\$ -	\$ 1,648	\$ 1,350		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
						Crushed rock	894 CY	\$ 5,873	\$ 2,906	\$ 366		"
						Compacting	894 CY	\$ -	\$ 3,259	\$ 100		"
						20 mil liner	20142 SF	\$ 2,965	\$ 9,590	\$ 765		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
						6" perf. PVC pipe	704 LF	\$ 486	\$ 2,998	\$ 873		33.06.96.01 times per unit costs for liner from cap installation
						4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"
						Yearly O&M						
						pipe cleaning						
						(1/yr@ 8hr)	8 HR		\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out
						Total site cost (Capital)					\$ 68,538	
						Yearly O&M					\$ 539	

Unit	Site	dimensions		Cap Dimensions		description	Cost Details					Reference
		length	width	length	width		Material	Material-	Labor-\$	Equip.-\$	sub-total	
OU-1	East Trench trench is located on the eastern border of Landfill #2.	150	6	156	12	1' final cover in 6" lifts	89 CY	\$ 16	\$ 179	\$ 265	\$ 460	33.08.05.08
						Material hauling (14mi	760 CY	\$ -	\$ 1,914	\$ 2,213	\$ 4,127	
						Impervious layer					\$ 6,951	
						2' clay in 6" lifts	199 CY	\$ 712	\$ 1,094	\$ 722		33.08.05.06 Liner unit costs:
						herbicide	0.04 acre	\$ 2	\$ 4	\$ 2		" labor equip material
						20 mil VLDPE liner	6237 SF	\$ 918	\$ 2,970	\$ 237		" \$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	234 SY	\$ 172	\$ 111	\$ 6		"
						Drainage layer					\$ 1,960	
						1' sand in 6" lifts	266 CY	\$ 1,283	\$ 298	\$ 379		33.08.05.05
						80 mil geo textile filter	797 SY	\$ 587	\$ 380	\$ 19	\$ 986	33.08.05.03
						Soil Cap					\$ 2,994	
						18" soil in 6" lifts	394 CY	\$ 69	\$ 793	\$ 1,172		33.08.05.02
						6" top soil	151 CY	\$ -	\$ 277	\$ 443		33.08.05.01
						seeding	0.14 acre	\$ 135	\$ 13	\$ 9		"
						watering	1 acre	\$ -	\$ 54	\$ 29		"
						Total Cap Capital					\$ 17,477	
						Yearly O&M					\$ 61	
						30 year O&M totals						
						reseeding	0 acre	\$ -	\$ -	\$ -		33.08.05.99
						mowing	12 /yr	\$ -	\$ 1,237	\$ 184		"
						fertilizing	1 /yr	\$ 120	\$ 144	\$ 141		"
						3' deep--Toe drain estimate:					\$ 21,870	
	456				10	Excavation	507 CY	\$ -	\$ 1,066	\$ 874		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
						Crushed rock	579 CY	\$ 3,803	\$ 1,882	\$ 237		"
						Compacting	579 CY	\$ -	\$ 2,111	\$ 65		"
						20 mil liner	13050 SF	\$ 1,921	\$ 6,213	\$ 495		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
						6" perf. PVC pipe	456 LF	\$ 315	\$ 1,942	\$ 566		33.06.96.01 times per unit costs for liner from cap installation
						4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"
						Yearly O&M						
						pipe cleaning						
						(1/yr@ 8hr)	8 HR		\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out
						Total site cost (Capital)					\$ 39,347	
						Yearly O&M					\$ 477	

Unit	Site	dimensions		Cap Dimensions		description	Cost Details					Reference
		length	width	length	width		Material	Material-	Labor-\$	Equip.-\$	sub-total	
OU-1	East Trench-2 trench is located on the eastern border of Landfill #2.	75	10	81	16	1' final cover in 6" lifts	62 CY	\$ 225	\$ 69	\$ 93	\$ 388	33.08.05.08
						Material hauling (14mi	505 CY	\$ -	\$ 1,271	\$ 1,470	\$ 2,741	
						Impervious layer					\$ 4,624	
						2' clay in 6" lifts	138 CY	\$ 494	\$ 758	\$ 501		33.08.05.06 Liner unit costs:
						herbicide	0.03 acre	\$ 1	\$ 3	\$ 2		" labor equip material
						20 mil VLDPE liner	4029 SF	\$ 593	\$ 1,918	\$ 153		" \$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	162 SY	\$ 119	\$ 77	\$ 4		"
						Drainage layer					\$ 1,275	
						1' sand in 6" lifts	173 CY	\$ 834	\$ 194	\$ 247		33.08.05.05
						80 mil geo textile filter	517 SY	\$ 381	\$ 246	\$ 13	\$ 639	33.08.05.03
						Soil Cap					\$ 3,658	
						18" soil in 6" lifts	255 CY	\$ 927	\$ 284	\$ 385		33.08.05.02
						6" top soil	98 CY	\$ 1,262	\$ 469	\$ 147		33.08.05.01
						seeding	0.09 acre	\$ 87	\$ 9	\$ 6		"
						watering	1 acre	\$ -	\$ 54	\$ 29		"
						Total Cap Capital					\$ 13,325	
						Yearly O&M					\$ 50	
						30 year O&M totals						
						reseeding	0.3 acre	\$ 289	\$ 29	\$ 19		33.08.05.99
						mowing	12 /yr	\$ -	\$ 802	\$ 120		"
						fertilizing	1 /yr	\$ 72	\$ 87	\$ 85		"
						3' deep-Toe drain estimate:					\$ 15,784	
						456 10 Excavation	507 CY	\$ -	\$ 1,066	\$ 874		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
						Crushed rock	399 CY	\$ 2,621	\$ 1,297	\$ 163		"
						Compacting	399 CY	\$ -	\$ 1,455	\$ 45		"
						20 mil liner	8982 SF	\$ 1,322	\$ 4,276	\$ 341		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
						6" perf. PVC pipe	314 LF	\$ 217	\$ 1,337	\$ 390		33.06.96.01 times per unit costs for liner from cap installation
						4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"
						Yearly O&M						
						pipe cleaning						
						(1/yr@ 8hr)	8 HR		\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out
						Total site cost (Capital)					\$ 29,108	
						Yearly O&M					\$ 466	

Unit	Site	dimensions		Cap Dimensions		description	Cost Details					Reference
		length	width	length	width		Material	Material-	Labor-\$	Equip.-\$	sub-total	
OU-1	49 Waste hole	260	8	266	14	1' final cover in 6" lifts	175 CY	\$ 31	\$ 352	\$ 521	\$ 904	33.08.05.08
						Material hauling (14mi	1356 CY	\$ -	\$ 3,411	\$ 3,945	\$ 7,356	
						Impervious layer					\$ 12,655	
						2' clay in 6" lifts	391 CY	\$ 1,400	\$ 2,149	\$ 1,419		33.08.05.06 Liner unit costs:
						herbicide	0.08 acre	\$ 4	\$ 9	\$ 4		" labor equip material
						20 mil VLDPE liner	10739 SF	\$ 1,581	\$ 5,113	\$ 408		" \$ 0.48 \$ 0.02 \$ 0.74
						80 mil liner	460 SY	\$ 339	\$ 219	\$ 11		"
						Drainage layer					\$ 3,323	
						1' sand in 6" lifts	451 CY	\$ 2,175	\$ 505	\$ 643		33.08.05.05
						80 mil geo textile filter	1352 SY	\$ 995	\$ 644	\$ 33	\$ 1,672	33.08.05.03
						Soil Cap					\$ 9,595	
						18" soil in 6" lifts	678 CY	\$ 2,464	\$ 755	\$ 1,022		33.08.05.02
						6" top soil	256 CY	\$ 3,297	\$ 1,225	\$ 385		33.08.05.01
						seeding	0.25 acre	\$ 240	\$ 24	\$ 16		"
						watering	2 acre	\$ -	\$ 108	\$ 59		"
						Total Cap Capital					\$ 35,505	
						Yearly O&M					\$ 114	
						30 year O&M totals						
						reseeding	0.3 acre	\$ 289	\$ 29	\$ 19		33.08.05.99
						mowing	12 /yr	\$ -	\$ 2,107	\$ 314		"
						fertilizing	1 /yr	\$ 192	\$ 231	\$ 226		"
						3' deep--Toe drain estimate:					\$ 43,637	
					456	10 Excavation	756 CY	\$ -	\$ 1,599	\$ 1,311		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
						Crushed rock	864 CY	\$ 5,675	\$ 2,808	\$ 353		"
						Compacting	864 CY	\$ -	\$ 3,150	\$ 97		"
						20 mil liner	19449 SF	\$ 14,314	\$ 9,264	\$ 475		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
						6" perf. PVC pipe	680 LF	\$ 469	\$ 2,896	\$ 844		33.06.96.01 times per unit costs for liner from cap installation
						4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"
						Yearly O&M						
						pipe cleaning						
						(1/yr@ 8hr)	8 HR		\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out
						Total site cost (Capital)					\$ 79,142	
						Yearly O&M					\$ 530	

Unit	Site	dimensions		Cap Dimensions		description	Material	Cost Details				Reference
		length	width	length	width			Material-	Labor-\$	Equip.-\$	sub-total	
OU-5	Landfill #1	250	200	256	206	1' final cover in 6" lifts	2464 CY	\$ 433	\$ 4,960	\$ 7,330	\$ 12,722	33.08.05.08
						Material hauling (14mi)	13569 CY	\$ -	\$ 14,818	\$ 25,783	\$ 40,601	
						Impervious layer					\$ 124,151	
						2' clay in 6" lifts	5519 CY	\$ 19,755	\$ 30,334	\$ 20,033		33.08.05.06 Liner unit costs:
						herbicide	1.24 acre	\$ 55	\$ 137	\$ 67		" labor equip material
						20 mil VLDPE liner	69145 SF	\$ 10,178	\$ 32,921	\$ 2,625		" \$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	6505 SY	\$ 4,788	\$ 3,099	\$ 159		"
						Drainage layer					\$ 19,481	
						1' sand in 6" lifts	2644 CY	\$ 12,748	\$ 2,961	\$ 3,772		33.08.05.05
						80 mil geo textile filter	7931 SY	\$ 5,837	\$ 3,778	\$ 194	\$ 9,809	33.08.05.03
						Soil Cap					\$ 58,263	
						18" soil in 6" lifts	4366 CY	\$ 15,869	\$ 4,862	\$ 6,584		33.08.05.02
						6" top soil	1502 CY	\$ 19,346	\$ 7,190	\$ 2,257		33.08.05.01
						seeding	1.48 acre	\$ 1,423	\$ 142	\$ 92		"
						watering	6 acre	\$ -	\$ 323	\$ 176		"
						Total Cap Capital					\$ 265,027	
						Yearly O&M					\$ 694	
						30 Year O&M totals						
						reseeding	2.7 acre	\$ 2,597	\$ 260	\$ 168		33.08.05.99
						mowing	12 /yr	\$ -	\$ 12,297	\$ 1,834		"
						fertilizing	1 /yr	\$ 1,300	\$ 1,273	\$ 1,082		"
3' deep--Toe drain estimate:									\$ 46,639			
	456			10	Excavation	1160 CY	\$ -	\$ 662	\$ 841		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator	
					Crushed rock	1326 CY	\$ 8,710	\$ 4,310	\$ 543		"	
					Compacting	1326 CY	\$ -	\$ 4,834	\$ 149		"	
					20 mil liner	29862 SF	\$ 4,396	\$ 14,218	\$ 1,134		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;	
					6" perf. PVC pipe	1044 LF	\$ 720	\$ 4,447	\$ 1,295		33.06.96.01 times per unit costs for liner from cap installation	
					4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"	
					Yearly O&M							
					pipe cleaning							
					(1/yr@ 8hr)	8 HR	\$ 416		\$ 416	assume labor rate @\$20/hr w/ a	\$52 /hr charge out	
7' retaining wall estimate									\$ 34,342			
	200				Total retaining wall							
					Fine Grading, Hand	312 SY	\$ -	\$ 693	\$ 4		33.03.86.01	
					Fine Grading	78 SY	\$ -	\$ 7	\$ 4		"	
					Trenching	178 CY	\$ -	\$ 108	\$ 66		"	
					Backfilling	110 CY	\$ -	\$ 60	\$ 59		"	
					Compacting	110 CY	\$ -	\$ 224	\$ 14		"	
					Footing forms	400 SF	\$ 188	\$ 1,099	\$ 17		"	
					Footing, rebar	2074 lb	\$ 396	\$ 708	\$ 143		"	
					Footing, concrete	47 CY	\$ 2,109	\$ 1,287	\$ 368		"	
					Walls, form and strip	2800 SF	\$ 2,138	\$ 13,980	\$ 229		"	
					Wall, steel	5899 lb	\$ 1,126	\$ 1,544	\$ 311		"	
					Wall, concrete	57 CY	\$ 2,642	\$ 2,289	\$ 424		"	
					Bush Hammer Finish	1000 SF	\$ 18	\$ 1,893	\$ 9		"	
					Keyway	200 LF	\$ 11	\$ 172	\$ 1		"	
					Total site cost (Capital)					\$ 346,008		
					Yearly O&M					\$ 1,110		

Unit	Site	dimensions		Cap Dimensions		description	Material	Material-	Cost Details			Reference
		length	width	length	width				Labor-\$	Equip.-\$	sub-total	
OU-5	Landfill #2	320	300	326	306	1' final cover in 6" lifts	4651 CY	\$ 816	\$ 9,362	\$ 13,836	\$ 24,014	33.08.05.08
						Material hauling (14mi)	24200 CY	\$ -	\$ 21,124	\$ 52,415	\$ 73,538	
						Impervious layer					\$ 230,578	
						2' clay in 6" lifts	10417 CY	\$ 37,288	\$ 57,254	\$ 37,812		33.08.05.06 Liner unit costs:
						herbicide	2.35 acre	\$ 105	\$ 260	\$ 127		" labor equip material
						20 mil VLDPE liner	124831 SF	\$ 18,375	\$ 59,434	\$ 4,740		" \$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	12277 SY	\$ 9,036	\$ 5,848	\$ 300		"
						Drainage layer					\$ 34,880	
						1' sand in 6" lifts	4734 CY	\$ 22,825	\$ 5,301	\$ 6,754		33.08.05.05
						80 mil geo textile filter	14201 SY	\$ 10,452	\$ 6,765	\$ 347	\$ 17,563	33.08.05.03
						Soil Cap					\$ 96,130	
						18" soil in 6" lifts	7881 CY	\$ 1,383	\$ 15,863	\$ 23,446		33.08.05.02
						6" top soil	2690 CY	\$ 34,627	\$ 12,876	\$ 4,041		33.08.05.01
						seeding	2.66 acre	\$ 2,558	\$ 256	\$ 165		"
						watering	11 acre	\$ -	\$ 591	\$ 322		"
						Total Cap Capital					\$ 476,704	
						Yearly O&M					\$ 1,253	
						30 Year O&M totals						
						reseeding	5.1 acre	\$ 4,905	\$ 491	\$ 317		33.08.05.99
						mowing	12 /yr	\$ -	\$ 22,007	\$ 3,282		"
						fertilizing	1 /yr	\$ 1,947	\$ 2,340	\$ 2,291		"
						3' deep--Toe drain estimate:					\$ 65,609	
					456	10 Excavation	1538 CY	\$ -	\$ 3,247	\$ 2,661		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
						Crushed rock	1757 CY	\$ 11,541	\$ 5,710	\$ 719		"
						Compacting	1757 CY	\$ -	\$ 6,406	\$ 197		"
						20 mil liner	39591 SF	\$ 5,828	\$ 18,850	\$ 1,503		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
						6" perf. PVC pipe	1384 LF	\$ 955	\$ 5,895	\$ 1,717		33.06.96.01 times per unit costs for liner from cap installation
						4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"
						Yearly O&M						
						pipe cleaning						
						(1/yr@ 8hr)	8 HR		\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out
					7' retaining wall estimate	Total retaining wall					\$ 47,132	
					275	Fine Grading, Hand	428 SY	\$ -	\$ 951	\$ 5		33.03.86.01
						Fine Grading	107 SY	\$ -	\$ 10	\$ 6		"
						Trenching	245 CY	\$ -	\$ 149	\$ 90		"
						Backfilling	151 CY	\$ -	\$ 83	\$ 81		"
						Compacting	151 CY	\$ -	\$ 308	\$ 19		"
						Footing forms	550 SF	\$ 258	\$ 1,511	\$ 24		"
						Footing, rebar	2851 lb	\$ 544	\$ 974	\$ 196		"
						Footing, concrete	64 CY	\$ 2,872	\$ 1,753	\$ 501		"
						Walls, form and strip	3850 SF	\$ 2,940	\$ 19,222	\$ 315		"
						Wall, steel	8110 lb	\$ 1,548	\$ 2,123	\$ 428		"
						Wall, concrete	78 CY	\$ 3,616	\$ 3,132	\$ 580		"
						Bush Hammer Finish	1375 SF	\$ 25	\$ 2,603	\$ 12		"
						Keyway	275 LF	\$ 15	\$ 237	\$ 2		"
						Total site cost (Capital)					\$ 523,836	
						Yearly O&M					\$ 1,669	

Unit	Site	dimensions		Cap Dimensions		description	Material	Cost Details				Reference
		length	width	length	width			Material-	Labor-\$	Equip.-\$	sub-total	
OU-5	Landfill #3	175	100	181	106	1' final cover in 6" lifts	901 CY	\$ 158	\$ 1,814	\$ 2,680	\$ 4,652	33.08.05.08
						Material hauling (14mi)	5700 CY	\$ -	\$ 6,234	\$ 10,847	\$ 17,081	
						Impervious layer					\$ 47,297	
						2' clay in 6" lifts	2018 CY	\$ 7,224	\$ 11,091	\$ 7,325		33.08.05.06 Liner unit costs:
						herbicide	0.45 acre	\$ 20	\$ 50	\$ 24		" labor equip material
						20 mil VLDPE liner	28159 SF	\$ 4,145	\$ 13,407	\$ 1,069		" \$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	2379 SY	\$ 1,751	\$ 1,133	\$ 58		"
						Drainage layer					\$ 8,083	
						1' sand in 6" lifts	1097 CY	\$ 5,289	\$ 1,228	\$ 1,565		33.08.05.05
						80 mil geo textile filter	3291 SY	\$ 2,422	\$ 1,568	\$ 80	\$ 4,070	33.08.05.03
						Soil Cap					\$ 22,074	
						18" soil in 6" lifts	1778 CY	\$ 312	\$ 3,579	\$ 5,289		33.08.05.02
						6" top soil	624 CY	\$ 8,037	\$ 2,987	\$ 937		33.08.05.01
						seeding	0.61 acre	\$ 587	\$ 59	\$ 38		"
						watering	3 acre	\$ -	\$ 161	\$ 88		"
						Total Cap Capital					\$ 103,258	
						Yearly O&M					\$ 292	
						30 Year O&M totals						
						reseeding	1.2 acre	\$ 1,154	\$ 116	\$ 75		33.08.05.99
						mowing	12 /yr	\$ -	\$ 5,107	\$ 762		"
						fertilizing	1 /yr	\$ 457	\$ 549	\$ 537		"
3' deep--Toe drain estimate:						\$ 33,125						
		456			10	Excavation	771 CY	\$ -	\$ 1,648	\$ 1,350		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
						Crushed rock	881 CY	\$ 5,787	\$ 2,863	\$ 360		"
						Compacting	881 CY	\$ -	\$ 3,212	\$ 99		"
						20 mil liner	19854 SF	\$ 2,923	\$ 9,453	\$ 754		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
						6" perf. PVC pipe	694 LF	\$ 479	\$ 2,956	\$ 861		33.06.96.01 times per unit costs for liner from cap installation
						4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"
						Yearly O&M						
						pipe cleaning						
						(1/yr@ 8hr)	8 HR	\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out	
						Total site cost (Capital)				\$ 136,383		
						Yearly O&M				\$ 708		

Unit	Site	dimensions		Cap Dimensions		description	Cost Details					Reference
		length	width	length	width		Material	Material-	Labor-\$	Equip.-\$	sub-total	
OU-5&1	Combined	500	415	506	421	1' final cover in 6" lifts	9911 CY	\$ 1,740	\$ 19,949	\$ 29,485	\$ 51,173	33.08.05.08
	Landfill 1&2					Material hauling (14mi	39842 CY	\$ -	\$ 34,767	\$ 86,267	\$ 121,034	
	& neighboring sites					Impervious layer					\$ 484,963	
						2' clay in 6" lifts	22200 CY	\$ 79,466	\$ 122,016	\$ 80,582		33.08.05.06 Liner unit costs:
						herbicide	5.01 acre	\$ 223	\$ 554	\$ 272		" labor equip material
						20 mil VLDPE liner	256308 SF	\$ 37,729	\$ 122,032	\$ 9,732		" \$ 0.48 \$ 0.04 \$ 0.15
						80 mil liner	26164 SY	\$ 19,257	\$ 12,463	\$ 639		"
						Drainage layer					\$ 71,116	
						1' sand in 6" lifts	9652 CY	\$ 46,537	\$ 10,808	\$ 13,770		33.08.05.05
						80 mil geo textile filter	28954 SY	\$ 21,310	\$ 13,792	\$ 707	\$ 35,809	33.08.05.03
						Soil Cap					\$ 196,580	
						18" soil in 6" lifts	16181 CY	\$ 2,840	\$ 32,569	\$ 48,138		33.08.05.02
						6" top soil	5484 CY	\$ 70,634	\$ 26,251	\$ 8,239		33.08.05.01
						seeding	5.43 acre	\$ 5,223	\$ 523	\$ 338		"
						watering	22 acre	\$ -	\$ 1,183	\$ 644		"
						Total Cap Capital					\$ 960,675	
						Yearly O&M					\$ 2,565	
						30 Year O&M totals						
						reseeding	10.8 acre	\$ 10,387	\$ 1,039	\$ 672		33.08.05.99
						mowing	12 /yr	\$ -	\$ 44,838	\$ 6,687		"
						fertilizing	1 /yr	\$ 3,942	\$ 4,738	\$ 4,638		"
						3' deep--Toe drain estimate:					\$ 94,052	
		456		10		Excavation	2193 CY	\$ -	\$ 4,603	\$ 4,467		33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavator
						Crushed rock	2506 CY	\$ 16,461	\$ 8,145	\$ 1,025		"
						Compacting	2506 CY	\$ -	\$ 9,136	\$ 282		"
						20 mil liner	56457 SF	\$ 8,310	\$ 26,880	\$ 2,144		33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
						6" perf. PVC pipe	1974 LF	\$ 1,362	\$ 8,408	\$ 2,449		33.06.96.01 times per unit costs for liner from cap installation
						4" PVC pipe to creek	50 LF	\$ 67	\$ 286	\$ 27		"
						Yearly O&M						
						pipe cleaning						
						(1/yr@ 8hr)	8 HR		\$ 416		\$ 416	assume labor rate @\$20/hr w/ a \$52 /hr charge out
						7' retaining wall estimate					\$ 47,132	
		275				Total retaining wall						
						Fine Grading, Hand	428 SY	\$ -	\$ 951	\$ 5		33.03.86.01
						Fine Grading	107 SY	\$ -	\$ 10	\$ 6		"
						Trenching	245 CY	\$ -	\$ 149	\$ 90		"
						Backfilling	151 CY	\$ -	\$ 83	\$ 81		"
						Compacting	151 CY	\$ -	\$ 308	\$ 19		"
						Footing forms	550 SF	\$ 258	\$ 1,511	\$ 24		"
						Footing, rebar	2851 lb	\$ 544	\$ 974	\$ 196		"
						Footing, concrete	64 CY	\$ 2,872	\$ 1,753	\$ 501		"
						Walls, form and strip	3850 SF	\$ 2,940	\$ 19,222	\$ 315		"
						Wall, steel	8110 lb	\$ 1,548	\$ 2,123	\$ 428		"
						Wall, concrete	78 CY	\$ 3,616	\$ 3,132	\$ 580		"
						Bush Hammer Finish	1375 SF	\$ 25	\$ 2,603	\$ 12		"
						Keyway	275 LF	\$ 15	\$ 237	\$ 2		"
						Total site cost (Capital)					\$ 1,007,807	
						Yearly O&M					\$ 2,981	

EXCAVATION COSTS

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU-1	SW trenches	120	15	Excavation Total					\$ 20,795		
				Excavator	1357 CY	\$ -	\$ 4,070	\$ 3,177	\$ 7,248	33.08.01.01	
				backfill clean cover	363 CY	\$ 64	\$ 1,371	\$ 355	\$ 1,790	"	
				backfill, hauled fill	1186 CY	\$ 4,311	\$ 1,849	\$ 2,385	\$ 8,544	"	
				load waste	1186 CY	\$ -	\$ 661	\$ 400	\$ 1,061	"	
				Dust suppressant	10222 SY	\$ -	\$ 160	\$ 82	\$ 243	"	
				Waste Pile cover	6572 SF	\$ 665	\$ 191	\$ 1	\$ 857	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 634	\$ -	\$ -	\$ 634	"	
OU-1	South trench	270	10	Excavation Total					\$ 35,138		
				Excavator	2334 CY	\$ -	\$ 7,055	\$ 5,507	\$ 12,562	33.08.01.01	
				backfill clean cover	644 CY	\$ 113	\$ 2,433	\$ 629	\$ 3,175	"	
				backfill, hauled fill	1991 CY	\$ 7,237	\$ 3,104	\$ 4,003	\$ 14,344	"	
				load waste	1991 CY	\$ -	\$ 1,110	\$ 671	\$ 1,781	"	
				Dust suppressant	9227 SY	\$ -	\$ 145	\$ 74	\$ 219	"	
				Waste Pile cover	11863 SF	\$ 1,201	\$ 345	\$ 2	\$ 1,548	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 1,091	\$ -	\$ -	\$ 1,091	"	
OU-1	East trench	150	6	Excavation Total					\$ 18,649		
				Excavator	1237 CY	\$ -	\$ 3,731	\$ 2,912	\$ 6,643	33.08.01.01	
				backfill clean cover	353 CY	\$ 62	\$ 1,333	\$ 345	\$ 1,740	"	
				backfill, hauled fill	1022 CY	\$ 3,715	\$ 1,593	\$ 2,055	\$ 7,363	"	
				load waste	1022 CY	\$ -	\$ 570	\$ 345	\$ 914	"	
				Dust suppressant	5186 SY	\$ -	\$ 81	\$ 42	\$ 123	"	
				Waste Pile cover	6668 SF	\$ 675	\$ 194	\$ 1	\$ 870	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 578	\$ -	\$ -	\$ 578	"	
OU-1	East trench-2 trench is located on the eastern border of Landfill #2.	75	10	Excavation Total					\$ 11,402		
				Excavator	745 CY	\$ -	\$ 2,239	\$ 1,747	\$ 3,986	33.08.01.01	
				backfill clean cover	211 CY	\$ 37	\$ 797	\$ 206	\$ 1,040	"	
				backfill, hauled fill	619 CY	\$ 2,250	\$ 965	\$ 1,245	\$ 4,460	"	
				load waste	619 CY	\$ -	\$ 345	\$ 209	\$ 554	"	
				Dust suppressant	3117 SY	\$ -	\$ 49	\$ 25	\$ 74	"	
				Waste Pile cover	4007 SF	\$ 406	\$ 117	\$ 1	\$ 523	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 348	\$ -	\$ -	\$ 348	"	

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU-1	DOE Box	10	10	Excavation Total					\$ 4,425		
				Excavator	296 CY	\$ -	\$ 950	\$ 741	\$ 1,691	33.08.01.01	
				backfill clean cover	159 CY	\$ 28	\$ 601	\$ 155	\$ 784	"	
				backfill, hauled fill	139 CY	\$ 505	\$ 217	\$ 279	\$ 1,001	"	
				load waste	139 CY	\$ -	\$ 78	\$ 47	\$ 124	"	
				Dust suppressant	1405 SY	\$ -	\$ 22	\$ 11	\$ 33	"	
				Waste Pile cover	1806 SF	\$ 183	\$ 53	\$ 0	\$ 235	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 138	\$ -	\$ -	\$ 138	"	
OU-1	Waste Holes	260	8	Excavation Total					\$ 30,698		
				Excavator	2051 CY	\$ -	\$ 6,173	\$ 4,819	\$ 10,992	33.08.01.01	
				backfill clean cover	580 CY	\$ 2,191	\$ 567	\$ 102	\$ 2,859	"	
				backfill, hauled fill	1710 CY	\$ 6,215	\$ 2,666	\$ 3,438	\$ 12,320	"	
				load waste	1710 CY	\$ -	\$ 954	\$ 576	\$ 1,530	"	
				Dust suppressant	8462 SY	\$ -	\$ 133	\$ 68	\$ 201	"	
				Waste Pile cover	10880 SF	\$ 1,101	\$ 317	\$ 2	\$ 1,420	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 959	\$ -	\$ -	\$ 959	"	
OU-2	Radium tren	91	3	Excavation Total					\$ 25,267		
				14' dee Excavator	1096 CY	\$ -	\$ 7,887	\$ 6,157	\$ 14,043	33.08.01.01	Model applied to minimum 10' wide trench.
				backfill clean cover	243 CY	\$ 56	\$ 919	\$ 238	\$ 1,212	"	Costs prorated to real trench 3' wide a bottom
				backfill, hauled fill	1710 CY	\$ 3,458	\$ 1,483	\$ 1,913	\$ 6,855	"	with side slope 1:1.
				load waste	1710 CY	\$ -	\$ 954	\$ 576	\$ 1,530	"	
				Dust suppressant	3639 SY	\$ -	\$ 57	\$ 29	\$ 87	"	For segregation the bucket factor should have been .10
				Waste Pile cover	10880 SF	\$ 474	\$ 136	\$ 1	\$ 611	"	and cycle time 27 sec. Model was run with .16 factor.
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	Excavation labor and equipment is corrected manually.
				OVA rental	1 WK	\$ 512	\$ -	\$ -	\$ 512	"	
OU-2	Radium drywells	5' diam 40' dee	Excavation Total (3wells)						\$ 38,996		
				Excavation (each)					\$ 12,999		
				Clamshell	29 CY	\$ -	\$ 721	\$ 614	\$ 1,335	33.03.97	Model applied to minimum size 10'x10'
				Sheeting, pull & recov	650 SF	\$ 3,813	\$ 3,805	\$ 1,354	\$ 8,972	33.08.01.01	Costs prorated to actual dimensions based to area of wall
				Sheeting, decon	1561 SF		\$ 1,399	\$ 443	\$ 1,842	"	
				backfill, hauled fill	36 CY	\$ 132	\$ 57	\$ 73	\$ 261	"	Costs prorated to actual dimensions based on volume.
				load waste	36 CY	\$ -	\$ 20	\$ 12	\$ 32	"	
				Dust suppressant	15 SY	\$ -	\$ 1	\$ 1	\$ 2	"	
				Waste Pile cover	333 SF	\$ 34	\$ 10	\$ 0	\$ 43	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
				OVA rental	1 WK	\$ 14	\$ -	\$ -	\$ 14		"
				concrete demolition	1.1 CY	\$ -	\$ 71	\$ 8	\$ 79	33.03.71.01	Concrete demolition modelled as sidewalk with same volume.

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU-2	Radium tank pipelines, and distribution box	30	6	Excavation Total					\$ 29,013		
				8' deep Tanks					\$ 17,317		
				Excavator	88 CY	\$ -	\$ 543	\$ 424	\$ 966	33.03.97	Model applied to minimum size 10'x10'
				Sheeting, pull & rec	1200 SF	\$ 3,999	\$ 3,916	\$ 2,461	\$ 10,376	33.08.01.01	
				Sheeting, decon	1541 SF	\$ -	\$ 1,381	\$ 437	\$ 1,818	"	
				backfill, clean cove	23 CY	\$ 4	\$ 87	\$ 22	\$ 113		
				backfill, hauled fill	84 CY	\$ 305	\$ 131	\$ 169	\$ 605	"	Costs prorated to actual dimensions based on volume.
				load waste	84 CY	\$ -	\$ 47	\$ 28	\$ 75		
				Dust suppressant	234 SY	\$ -	\$ 4	\$ 2	\$ 6	"	
				Waste Pile cover	940 SF	\$ 95	\$ 27	\$ 0	\$ 123	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 41	\$ -	\$ -	\$ 41	"	
				concrete demolition	11 CY	\$ -	\$ 779	\$ 93	\$ 872	33.03.71.01	Concrete demolition modelled as sidewalk with same volume.
				load concrete	14.7 CY	\$ -	\$ 54	\$ 20			
				haul concrete	14.7 CY	\$ -	\$ 67	\$ 67			
				pipng demolition	100 LF	\$ -	\$ 799	\$ 138	\$ 937	33.03.76.01	
				load, pipe	1 CY	\$ -	\$ 54	\$ 20	\$ 75	"	
				haul	1 CY	\$ -	\$ 168	\$ 168	\$ 336	"	
				soil compaction	66 CY	\$ -	\$ 337	\$ 10	\$ 347	"	
				Distribution box					\$ 3,418		
				Excavator	114 CY	\$ -	\$ 746	\$ 582	\$ 1,329	33.08.01.01	
				backfill, clean cove	43 CY	\$ 8	\$ 162	\$ 42	\$ 212		
				backfill, hauled fill	75 CY	\$ 273	\$ 117	\$ 151	\$ 540	"	
				load waste	75 CY	\$ -	\$ 42	\$ 25	\$ 67		
				Dust suppressant	712 SY	\$ -	\$ 11	\$ 6	\$ 17	"	
				Waste Pile cover	940 SF	\$ 93	\$ 27	\$ 0	\$ 119	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 31	\$ -	\$ -	\$ 31	"	
				concrete demolition	7.1 CY	\$ -	\$ 425	\$ 51	\$ 476	33.03.71.01	
				load concrete	9.5 CY	\$ -	\$ 54	\$ 20	\$ 75	"	
				haul concrete	9.5 CY	\$ -	\$ 67	\$ 67	\$ 134	"	

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU-2	Imhoff tanks, slab, and lea field			Strontium system Total					\$ 66,069		
		50	30	Leach Field					\$ 13,620		
		7' deep		Excavator	559 CY	\$ -	\$ 4,215	\$ 3,219	\$ 7,434	33.03.97	Model applied to minimum size 10'x10'
				backfill clean cover	278 CY	\$ 49	\$ 1,050	\$ 272	\$ 1,371	"	Costs prorated to actual dimensions based on volume.
				backfill, hauled fill	341 CY	\$ 1,239	\$ 532	\$ 686			Model assumed a .16 bucket factor. To be consistent
				load waste	341 CY	\$ -	\$ 190	\$ 115	\$ 305		
				Dust supressant	2438 SY	\$ -	\$ 82	\$ 42	\$ 124	"	as .10 factor should be used for segregation.
				Waste Pile cover	1568 SF	\$ 340	\$ 98	\$ 1	\$ 439	"	Excavation labor and equipment are prorated accordingly.
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 261	\$ -	\$ -	\$ 261	"	
				piping demolition	100 LF	\$ -	\$ 693	\$ 120	\$ 812		
		50	30	Imhoff tanks					\$ 51,497		
		10' dee		Excavator	555 CY		\$ 5,318	\$ 4,152	\$ 9,470	33.08.01.01	
				Steel sheeting, pull	2400 SF	\$ 7,997	\$ 13,832	\$ 4,922	\$ 26,752	"	
				Concrete tank demo	104 CY	\$ -	\$ 7,368	\$ 881	\$ 8,249	33.03.71.01	
				backfill, hauled fill	694 CY	\$ 2,523	\$ 1,082	\$ 1,395	\$ 5,000	33.08.01.01	
				dust supressant	3500 SY	\$ -	\$ 55	\$ 28	\$ 83	"	
				Waste pile cover	3100 SF	\$ 314	\$ 90	\$ 0	\$ 404	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	3 WK	\$ 1,122	\$ -	\$ -	\$ 1,122	"	
		30	20	slab demolition	12 CY	\$ -	\$ 850	\$ 102	\$ 952		
				6" thick							
OU-3	west dog pen	450	265	Excavation Total					\$ 69,906		
				6" deep Excavator	2208 CY	\$ -	\$ 4,171	\$ 4,131	\$ 8,302	33.08.01.01	
				backfill, hauled fill	2758 CY	\$ 20,049	\$ 8,600	\$ 11,091	\$ 39,739	"	
				load waste	2758 CY	\$ -	\$ 1,538	\$ 930	\$ 2,468		
				Dust supressant	92750 SY	\$ -	\$ 1,454	\$ 748	\$ 2,202	"	
				Waste Pile cover	120680 SF	\$ 12,213	\$ 3,514	\$ 18	\$ 15,745	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 MO	\$ 1,032	\$ -	\$ -	\$ 1,032	"	
	east dog pen	225	175	Excavation Total					\$ 24,588		
				6" deep Excavator	729 CY	\$ -	\$ 2,505	\$ 1,414	\$ 3,920	33.08.01.01	
				backfill, hauled fill	911 CY	\$ 6,622	\$ 2,841	\$ 3,663	\$ 13,126	"	
				load waste	911 CY	\$ -	\$ 508	\$ 307	\$ 815		
				Dust supressant	30625 SY	\$ -	\$ 480	\$ 247	\$ 727	"	
				Waste Pile cover	40175 SF	\$ 4,066	\$ 1,170	\$ 6	\$ 5,242	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	2 WK	\$ 341	\$ -	\$ -	\$ 341	"	

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU3	larger dog	570	230	Excavation Total					\$ 93,435		
	pens		18"	dee Excavator	7283 CY	\$ -	\$ 9,165	\$ 9,078	\$ 18,243	33.08.01.01	
				Envest model backfill, hauled fill	9095 CY	\$ 44,078	\$ 18,906	\$ 24,383	\$ 43,289	"	
				run was 2' load waste	9095 CY	\$ -	\$ 5,072	\$ 3,066	\$ 8,138	"	
				deep Dust supressant	101967 SY	\$ -	\$ 1,599	\$ 822	\$ 2,421	"	
				prorate excav, Waste Pile cover	134300 SF	\$ 13,591	\$ 3,911	\$ 20	\$ 17,522	"	
				and backfill Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
		0.75		OVA rental	2 WK	\$ 3,404	\$ -	\$ -	\$ 3,404	"	
OU3	larger dog	570	230	Excavation Total					\$ 50,145		
	pens		18"	dee Excavator	7283 CY	\$ -	\$ 9,165	\$ 9,078	\$ 18,243	33.08.01.01	
	(no backfill			rough grade "hole"	29167 SY	\$ -	\$ 4,200	\$ 7,187			
	level and			Envest model fine grade "hole"	29167 SY	\$ -	\$ 1,867	\$ 1,633			
	grade) run was 2'			load waste	9095 CY	\$ -	\$ 5,072	\$ 3,066	\$ 8,138		
				deep Dust supressant	101967 SY	\$ -	\$ 1,599	\$ 822	\$ 2,421	"	
				prorate excav, Waste Pile cover	134300 SF	\$ 13,591	\$ 3,911	\$ 20	\$ 17,522	"	
				and backfill Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
		0.75		OVA rental	2 WK	\$ 3,404	\$ -	\$ -	\$ 3,404	"	

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU-4	Septic tks #2-#6	Total for 5 tks							\$ 61,410		
		4	4	Tanks (each)					\$ 12,282		
		6' deep		Excavator	22 CY		\$ 136	\$ 106	\$ 242	33.08.01.01	
				Steel sheeting, pull	600 SF	\$ 1,999	\$ 3,548	\$ 1,230	\$ 6,778	"	
				sheeting, decon	579 SF	\$ -	\$ 519	\$ 164	\$ 683		
				Concrete tank demo	2 CY	\$ -	\$ 142	\$ 17	\$ 159	33.03.71.01	
				backfill, hauled fill	28 CY	\$ 102	\$ 44	\$ 56	\$ 202	33.08.01.01	
				load waste	28 CY	\$ -	\$ 16	\$ 9	\$ 25		
				dust supressant	78 SY	\$ -	\$ 1	\$ 1	\$ 2	"	
				Waste pile cover	340 SF	\$ 34	\$ 10	\$ 0	\$ 44	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 280	\$ -	\$ -	\$ 280	"	
				load concrete	2 CY	\$ -	\$ 54	\$ 20			
				haul concrete	2 CY	\$ -	\$ 67	\$ 67			
		30	21	Leach Field					\$ 3,241		
		3' deep		Excavator	70 CY	\$ -	\$ 543	\$ 424	\$ 966	33.03.97	Model applied to minimum size 10'x10'
				backfill clean cover	47 CY	\$ 8	\$ 178	\$ 46	\$ 232	"	Costs prorated to actual dimensions based on volume.
				backfill, hauled fill	30 CY	\$ 109	\$ 47	\$ 60			Model assumed a .16 bucket factor. To be consistent
				load waste	30 CY	\$ -	\$ 17	\$ 10	\$ 27		
				Dust supressant	490 SY	\$ -	\$ 8	\$ 4	\$ 12	"	as .10 factor should be used for segregation.
				Waste Pile cover	936 SF	\$ 95	\$ 27	\$ 0	\$ 122	"	Excavation labor and equipment are prorated accordingly.
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 33	\$ -	\$ -	\$ 33	"	
				pipng demolition	100 LF	\$ -	\$ 799	\$ 138	\$ 937		
				load, pipe	1 CY	\$ -	\$ 54	\$ 20	\$ 75	"	
				haul	1 CY	\$ -	\$ 34	\$ 34	\$ 67	"	
				soil compaction	26 CY	\$ -	\$ 133	\$ 4	\$ 137	"	

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU-4	Septic tks #1,#7	Total (each)							\$ 5,484		
		4	4	Tanks (each)					\$ 2,243		
		6' deep		Excavator	64 CY		\$ 407	\$ 318	\$ 725	33.08.01.01	
				Concrete tank demo	2 CY	\$ -	\$ 142	\$ 17	\$ 159	33.03.71.01	
				backfill, hauled fill	75 CY	\$ 273	\$ 117	\$ 151	\$ 540	33.08.01.01	
				load waste	75 CY	\$ -	\$ 42	\$ 25	\$ 67		
				dust supressant	501 SY	\$ -	\$ 8	\$ 4	\$ 12	"	
				Waste pile cover	644 SF	\$ 65	\$ 19	\$ 0	\$ 84	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 30	\$ -	\$ -	\$ 30	"	
				load concrete	2 CY	\$ -	\$ 54	\$ 20			
				haul concrete	2 CY	\$ -	\$ 67	\$ 67			
		30	21	Leach Field					\$ 3,241		
		3' deep		Excavator	70 CY	\$ -	\$ 543	\$ 424	\$ 966	33.03.97	Model applied to minimum size 10'x10'
				backfill clean cover	47 CY	\$ 8	\$ 178	\$ 46	\$ 232	"	Costs prorated to actual dimensions based on volume.
				backfill, hauled fill	30 CY	\$ 109	\$ 47	\$ 60			Use .10 bucket factor and 27 sec cycle time,
				load waste	30 CY	\$ -	\$ 17	\$ 10	\$ 27		
				Dust supressant	490 SY	\$ -	\$ 8	\$ 4	\$ 12	"	segregation parameters.
				Waste Pile cover	936 SF	\$ 95	\$ 27	\$ 0	\$ 122	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 WK	\$ 33	\$ -	\$ -	\$ 33	"	
				piping demolition	100 LF	\$ -	\$ 799	\$ 138	\$ 937		
				load, pipe	1 CY	\$ -	\$ 54	\$ 20	\$ 75	"	
				haul	1 CY	\$ -	\$ 34	\$ 34	\$ 67	"	
				soil compaction	26 CY	\$ -	\$ 133	\$ 4	\$ 137	"	

Unit	Site	dimensions		description	Cost Details					Reference	Comments
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total		
OU-5	Landfill #1	250	200	Excavation Total					\$ 223,889		
				Excavator	20515 CY	\$ -	\$ 5,088	\$ 18,927	\$ 24,015	33.08.01.01	
				backfill clean cover	4396 CY	\$ 772	\$ 16,605	\$ 4,296	\$ 21,673	"	
				backfill, hauled fill	20210 CY	\$ 73,458	\$ 31,508	\$ 40,635	\$ 145,601	"	
				load waste	20210 CY	\$ -	\$ 11,270	\$ 6,813	\$ 18,083	"	
				Dust suppressant	200078 SY	\$ -	\$ 3,137	\$ 1,613	\$ 4,751	"	
				Waste Pile cover	64311 SF	\$ 6,508	\$ 1,873	\$ 10	\$ 8,391	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental	1 MO	\$ 959	\$ -	\$ -	\$ 959	"	
OU-5	Landfill #2	320	300	Excavation Total					\$ 409,960		
				Excavator	38401 CY	\$ -	\$ 9,498	\$ 35,330	\$ 44,828	33.08.01.01	
				backfill clean cover	8052 CY	\$ 1,413	\$ 30,415	\$ 7,869	\$ 39,697	"	
				backfill, hauled fill	37859 CY	\$ 137,607	\$ 59,024	\$ 76,120	\$ 272,751	"	
				load waste	37859 CY	\$ -	\$ 21,111	\$ 12,764	\$ 33,875	"	
				Dust suppressant	384150 SY	\$ -	\$ 6,023	\$ 3,098	\$ 9,121	"	
				Waste Pile cover	57304 SF	\$ 5,799	\$ 1,669	\$ 9	\$ 7,476	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 1,794	\$ -	\$ -	\$ 1,794	"	
OU-5	Landfill #3	175	100	Excavation Total					\$ 82,739		
				Excavator	7794 CY	\$ -	\$ 2,035	\$ 5,226	\$ 7,261	33.08.01.01	
				backfill clean cover	1732 CY	\$ 304	\$ 6,542	\$ 1,693	\$ 8,539	"	
				backfill, hauled fill	7536 CY	\$ 27,391	\$ 11,749	\$ 15,152	\$ 54,292	"	
				load waste	7536 CY	\$ -	\$ 4,202	\$ 2,541	\$ 6,743	"	
				Dust suppressant	70027 SY	\$ -	\$ 1,098	\$ 565	\$ 1,663	"	
				Waste Pile cover	26511 SF	\$ 2,683	\$ 772	\$ 4	\$ 3,459	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 364	\$ -	\$ -	\$ 364	"	
OU-5	Combination Landfill 1&2 & neighboring sites	500	415	Excavation Total					\$ 881,279		
				Excavator	81008 CY	\$ -	\$ 20,013	\$ 74,446	\$ 94,459	33.08.01.01	
				backfill clean cover	16739 CY	\$ 2,938	\$ 63,228	\$ 16,358	\$ 82,524	"	
				backfill, hauled fill	80206 CY	\$ 291,528	#####	#####	\$ 577,836	"	
				load waste	80206 CY	\$ -	\$ 44,725	\$ 27,040	\$ 71,765	"	
				Dust suppressant	830324 SY	\$ -	\$ 13,019	\$ 6,696	\$ 19,715	"	
				Waste Pile cover	235893 SF	\$ 23,872	\$ 6,869	\$ 35	\$ 30,777	"	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"	
				OVA rental		\$ 3,785	\$ -	\$ -	\$ 3,785	"	

COST OF EXCAVATION WITH SEGREGATION

Unit	Site	dimensions		description	Material	Cost Details				Reference
		length	width			Material-\$	Labor-\$	Equip.-\$	sub-total	
OU-1	SW trenches	120	15	Excavation Total					\$ 30,941	
				Excavator	1357 CY	\$ -	\$ 9,769	\$ 7,625	\$ 17,394	33.08.01.01
				backfill clean cover	363 CY	\$ 64	\$ 1,371	\$ 355	\$ 1,790	"
				backfill, hauled fill	1186 CY	\$ 4,311	\$ 1,849	\$ 2,385	\$ 8,544	"
				load waste	1186 CY	\$ -	\$ 661	\$ 400	\$ 1,061	"
				Dust suppressant	10222 SY	\$ -	\$ 160	\$ 82	\$ 243	"
				Waste Pile cover	6572 SF	\$ 665	\$ 191	\$ 1	\$ 857	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 634	\$ -	\$ -	\$ 634	"
OU-1	South trench	270	10	Excavation Total					\$ 52,724	
				Excavator	2334 CY	\$ -	\$ 16,932	\$ 13,217	\$ 30,149	33.08.01.01
				backfill clean cover	644 CY	\$ 113	\$ 2,433	\$ 629	\$ 3,175	"
				backfill, hauled fill	1991 CY	\$ 7,237	\$ 3,104	\$ 4,003	\$ 14,344	"
				load waste	1991 CY	\$ -	\$ 1,110	\$ 671	\$ 1,781	"
				Dust suppressant	9227 SY	\$ -	\$ 145	\$ 74	\$ 219	"
				Waste Pile cover	11863 SF	\$ 1,201	\$ 345	\$ 2	\$ 1,548	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 1,091	\$ -	\$ -	\$ 1,091	"
OU-1	East trench	150	6	Excavation Total					\$ 27,950	
				Excavator	1237 CY	\$ -	\$ 8,954	\$ 6,989	\$ 15,943	33.08.01.01
				backfill clean cover	353 CY	\$ 62	\$ 1,333	\$ 345	\$ 1,740	"
				backfill, hauled fill	1022 CY	\$ 3,715	\$ 1,593	\$ 2,055	\$ 7,363	"
				load waste	1022 CY	\$ -	\$ 570	\$ 345	\$ 914	"
				Dust suppressant	5186 SY	\$ -	\$ 81	\$ 42	\$ 123	"
				Waste Pile cover	6668 SF	\$ 675	\$ 194	\$ 1	\$ 870	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 578	\$ -	\$ -	\$ 578	"
OU-1	East trench-2 trench is located on the eastern border of Landfill #2.	75	10	Excavation Total					\$ 16,983	
				Excavator	745 CY	\$ -	\$ 5,374	\$ 4,193	\$ 9,566	33.08.01.01
				backfill clean cover	211 CY	\$ 37	\$ 797	\$ 206	\$ 1,040	"
				backfill, hauled fill	619 CY	\$ 2,250	\$ 965	\$ 1,245	\$ 4,460	"
				load waste	619 CY	\$ -	\$ 345	\$ 209	\$ 554	"
				Dust suppressant	3117 SY	\$ -	\$ 49	\$ 25	\$ 74	"
				Waste Pile cover	4007 SF	\$ 406	\$ 117	\$ 1	\$ 523	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 348	\$ -	\$ -	\$ 348	"
OU-1	DOE Box	10	10	Excavation Total					\$ 6,074	
				Excavator	185 CY	\$ -	\$ 2,279	\$ 1,779	\$ 4,059	33.08.01.01
				backfill clean cover	59 CY	\$ 10	\$ 223	\$ 58	\$ 291	"
				backfill, hauled fill	128 CY	\$ 465	\$ 200	\$ 257	\$ 922	"
				load waste	128 CY	\$ -	\$ 71	\$ 43	\$ 115	"
				Dust suppressant	958 SY	\$ -	\$ 15	\$ 8	\$ 23	"
				Waste Pile cover	1232 SF	\$ 125	\$ 36	\$ 0	\$ 161	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 86	\$ -	\$ -	\$ 86	"

Unit	Site	dimensions		description	Material	Cost Details				Reference
		length	width			Material-\$	Labor-\$	Equip.-\$	sub-total	
OU-1	Waste Holes	260	8	Excavation Total					\$ 46,086	
				Excavator	2051 CY	\$ -	\$ 14,815	\$ 11,566	\$ 26,381	33.08.01.01
				backfill clean cover	580 CY	\$ 2,191	\$ 567	\$ 102	\$ 2,859	
				backfill, hauled fill	1710 CY	\$ 6,215	\$ 2,666	\$ 3,438	\$ 12,320	
				load waste	1710 CY	\$ -	\$ 954	\$ 576	\$ 1,530	
				Dust suppressant	8462 SY	\$ -	\$ 133	\$ 68	\$ 201	
				Waste Pile cover	10880 SF	\$ 1,101	\$ 317	\$ 2	\$ 1,420	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental		\$ 959	\$ -	\$ -	\$ 959	
OU-2	Radium trench	91	3	Excavation Total					\$ 46,922	
				Excavator	1096 CY	\$ -	\$ 18,928	\$ 14,776	\$ 33,704	33.08.01.01
				backfill clean cover	243 CY	\$ 56	\$ 919	\$ 238	\$ 1,212	
				backfill, hauled fill	1710 CY	\$ 3,458	\$ 1,483	\$ 1,913	\$ 6,855	
				load waste	1710 CY	\$ -	\$ 954	\$ 576	\$ 1,530	
				Dust suppressant	3639 SY	\$ -	\$ 57	\$ 29	\$ 87	
				Waste Pile cover	10880 SF	\$ 474	\$ 136	\$ 1	\$ 611	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	1 WK	\$ 2,506	\$ -	\$ -	\$ 2,506	
OU-2	Radium drywells	5' diam	40' deep	Excavation Total (3wells)					\$ 44,762	
				Excavation (each)					\$ 14,921	
				Clamshell	29 CY	\$ -	\$ 1,731	\$ 1,474	\$ 3,205	33.03.97
				Sheeting, pull & recover	650 SF	\$ 3,813	\$ 3,805	\$ 1,354	\$ 8,972	33.08.01.01
				Sheeting, decon	1561 SF	\$ -	\$ 1,399	\$ 443	\$ 1,842	
				backfill, hauled fill	36 CY	\$ 132	\$ 57	\$ 73	\$ 261	
				load waste	36 CY	\$ -	\$ 20	\$ 12	\$ 32	
				Dust suppressant	15 SY	\$ -	\$ 1	\$ 1	\$ 2	
				Waste Pile cover	333 SF	\$ 34	\$ 10	\$ 0	\$ 43	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	1 WK	\$ 66	\$ -	\$ -	\$ 66	
				concrete demolition	1.1 CY	\$ -	\$ 71	\$ 8	\$ 79	33.03.71.01
OU-2	Radium tanks, pipelines, and distribution box	30	8' deep	Excavation Total					\$ 35,735	
				Tanks					\$ 18,830	
				Excavator	88 CY	\$ -	\$ 1,303	\$ 1,017	\$ 2,319	33.03.97
				Sheeting, pull & recover	1200 SF	\$ 3,999	\$ 3,916	\$ 2,461	\$ 10,376	33.08.01.01
				Sheeting, decon	1541 SF	\$ -	\$ 1,381	\$ 437	\$ 1,818	
				backfill, clean cover	23 CY	\$ 4	\$ 87	\$ 22	\$ 113	
				backfill, hauled fill	84 CY	\$ 305	\$ 131	\$ 169	\$ 605	
				load waste	84 CY	\$ -	\$ 47	\$ 28	\$ 75	
				Dust suppressant	234 SY	\$ -	\$ 4	\$ 2	\$ 6	
				Waste Pile cover	940 SF	\$ 95	\$ 27	\$ 0	\$ 123	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	1 WK	\$ 201	\$ -	\$ -	\$ 201	
				concrete demolition	11 CY	\$ -	\$ 779	\$ 93	\$ 872	33.03.71.01
				load concrete	14.7 CY	\$ -	\$ 54	\$ 20		
				haul concrete	14.7 CY	\$ -	\$ 67	\$ 67		
				piping demolition	100 LF	\$ -	\$ 799	\$ 138	\$ 937	33.03.76.01
				load, pipe	1 CY	\$ -	\$ 54	\$ 20	\$ 75	
				haul	1 CY	\$ -	\$ 168	\$ 168	\$ 336	
				soil compaction	66 CY	\$ -	\$ 337	\$ 10	\$ 347	
				Distribution box					\$ 5,331	

Model applied to minimum 10'wide trench.
Costs prorated to real trench 3' wide a bottom
with side slope 1:1.

For segregation the bucket factor should have been .10
and cycle time 27 sec. Model was run with .16 factor.
Excavation labor and equipment is corrected manually.

Model applied to minimum size 10'x10'
Costs prorated to actual dimensions based to area of wall
Costs prorated to actual dimensions based on volume.

Concrete demolition modelled as sidewalk with same volume.

Model applied to minimum size 10'x10'

Costs prorated to actual dimensions based on volume.

Concrete demolition modelled as sidewalk with same volume.

Unit	Site	dimensions		description	Cost Details					Reference
		length	width		Material	Material-\$	Labor-\$	Equip.-\$	sub-total	
OU-2	Imhoff tanks, slab, and leach field	50	30	Excavator	114 CY	\$ -	\$ 1,791	\$ 1,398	\$ 3,189	33.08.01.01
				backfill, clean cover	43 CY	\$ 8	\$ 162	\$ 42	\$ 212	
				backfill, hauled fill	75 CY	\$ 273	\$ 117	\$ 151	\$ 540	
				Dust suppressant	712 SY	\$ -	\$ 11	\$ 6	\$ 17	
				Waste Pile cover	940 SF	\$ 93	\$ 27	\$ 0	\$ 119	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	1 WK	\$ 151	\$ -	\$ -	\$ 151	
				concrete demolition	7.1 CY	\$ -	\$ 425	\$ 51	\$ 476	33.03.71.01
				load concrete	9.5 CY	\$ -	\$ 54	\$ 20	\$ 75	
				haul concrete	9.5 CY	\$ -	\$ 67	\$ 67	\$ 134	
				Strontium system Total					\$ 95,119	
				Leach Field					\$ 25,045	
				7' deep Excavator	559 CY	\$ -	\$ 10,116	\$ 7,726	\$ 17,842	33.03.97
				backfill clean cover	278 CY	\$ 49	\$ 1,050	\$ 272	\$ 1,371	
				backfill, hauled fill	341 CY	\$ 1,239	\$ 532	\$ 686		
				load waste	341 CY	\$ -	\$ 190	\$ 115	\$ 305	
				Dust suppressant	2438 SY	\$ -	\$ 82	\$ 42	\$ 124	
				Waste Pile cover	1568 SF	\$ 340	\$ 98	\$ 1	\$ 439	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	1 WK	\$ 1,278	\$ -	\$ -	\$ 1,278	
				piping demolition	100 LF	\$ -	\$ 693	\$ 120	\$ 812	
				Imhoff tanks					\$ 69,122	
OU-3	west dog pens	450	265	Excavator	555 CY	\$ -	\$ 12,764	\$ 9,964	\$ 22,728	33.08.01.01
				Steel sheeting, pull	2400 SF	\$ 7,997	\$ 13,832	\$ 4,922	\$ 26,752	
				Concrete tank demol.	104 CY	\$ -	\$ 7,368	\$ 881	\$ 8,249	33.03.71.01
				backfill, hauled fill	694 CY	\$ 2,523	\$ 1,082	\$ 1,395	\$ 5,000	33.08.01.01
				dust suppressant	3500 SY	\$ -	\$ 55	\$ 28	\$ 83	
				Waste pile cover	3100 SF	\$ 314	\$ 90	\$ 0	\$ 404	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	3 WK	\$ 5,488	\$ -	\$ -	\$ 5,488	
				slab demolition	12 CY	\$ -	\$ 850	\$ 102	\$ 952	
				6" thick						
				Excavation Total					\$ 85,546	
				6" deep Excavator	2208 CY	\$ -	\$ 10,010	\$ 9,915	\$ 19,925	33.08.01.01
				backfill, hauled fill	2758 CY	\$ 20,049	\$ 8,600	\$ 11,091	\$ 39,739	
				load waste	2758 CY	\$ -	\$ 1,538	\$ 930	\$ 2,468	
				Dust suppressant	92750 SY	\$ -	\$ 1,454	\$ 748	\$ 2,202	
OU-3	east dog pens	225	175	Waste Pile cover	120680 SF	\$ 12,213	\$ 3,514	\$ 18	\$ 15,745	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	1 MO	\$ 5,049	\$ -	\$ -	\$ 5,049	
				Excavation Total					\$ 31,402	
				6" deep Excavator	729 CY	\$ -	\$ 6,013	\$ 3,395	\$ 9,407	33.08.01.01
				backfill, hauled fill	911 CY	\$ 6,822	\$ 2,841	\$ 3,663	\$ 13,126	
				load waste	911 CY	\$ -	\$ 508	\$ 307	\$ 815	
				Dust suppressant	30825 SY	\$ -	\$ 480	\$ 247	\$ 727	
				Waste Pile cover	40175 SF	\$ 4,066	\$ 1,170	\$ 6	\$ 5,242	
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	
				OVA rental	2 WK	\$ 1,667	\$ -	\$ -	\$ 1,667	
				Total for 5 tks					\$ 75,960	
OU-4	Septic tks									

Model applied to minimum size 10'x10'
Costs prorated to actual dimensions based on volume.
Model assumed a .16 bucket factor. To be consistent
as .10 factor should be used for segregation.
Excavation labor and equipment are prorated accordingly.

Unit	Site	dimensions length width	description	Material	Material-\$	Cost Details Labor-\$ Equip.-\$	sub-total	Reference
#2-#6		4	4 Tanks (each)				\$ 15,192	
			6' deep	Excavator	22 CY	\$ 326 \$ 254	\$ 580	33.08.01.01
				Steel sheeting, pull	600 SF	\$ 1,999 \$ 3,548	\$ 6,778	
				sheeting, decon	579 SF	\$ - \$ 519	\$ 683	
				Concrete tank demol.	2 CY	\$ - \$ 142	\$ 159	33.03.71.01
				backfill, hauled fill	28 CY	\$ 102 \$ 44	\$ 202	33.08.01.01
				load waste	28 CY	\$ - \$ 16	\$ 25	
				dust suppressant	78 SY	\$ - \$ 1	\$ 2	
				Waste pile cover	340 SF	\$ 34 \$ 10	\$ 44	
				Equipment decon		\$ - \$ 385	\$ 418	
				OVA rental	1 WK	\$ 1,372 \$ -	\$ 1,372	
				load concrete	2 CY	\$ - \$ 54	\$ 20	
				haul concrete	2 CY	\$ - \$ 67	\$ 67	
			30 21 Leach Field				\$ 4,721	
			3' deep	Excavator	70 CY	\$ - \$ 1,303	\$ 1,017	33.03.97
				backfill clean cover	47 CY	\$ 8 \$ 178	\$ 46	
				backfill, hauled fill	30 CY	\$ 109 \$ 47	\$ 60	
				load waste	30 CY	\$ - \$ 17	\$ 10	
				Dust suppressant	490 SY	\$ - \$ 8	\$ 4	
				Waste Pile cover	936 SF	\$ 95 \$ 27	\$ 0	
				Equipment decon		\$ - \$ 385	\$ 32	
				OVA rental	1 WK	\$ 160 \$ -	\$ 160	
				pipng demolition	100 LF	\$ - \$ 799	\$ 138	
				load, pipe	1 CY	\$ - \$ 54	\$ 20	
				haul	1 CY	\$ - \$ 34	\$ 34	
				soil compaction	26 CY	\$ - \$ 133	\$ 4	
OU-4	Septic tks #1, #7	4	Total (each)				\$ 8,095	
			4 Tanks (each)				\$ 3,374	
			6' deep	Excavator	64 CY	\$ 977 \$ 763	\$ 1,739	33.08.01.01
				Concrete tank demol.	2 CY	\$ - \$ 142	\$ 17	33.03.71.01
				backfill, hauled fill	75 CY	\$ 273 \$ 117	\$ 151	33.08.01.01
				load waste	75 CY	\$ - \$ 42	\$ 25	
				dust suppressant	501 SY	\$ - \$ 8	\$ 4	
				Waste pile cover	644 SF	\$ 65 \$ 19	\$ 0	
				Equipment decon		\$ - \$ 385	\$ 32	
				OVA rental	1 WK	\$ 146 \$ -	\$ 146	
				load concrete	2 CY	\$ - \$ 54	\$ 20	
				haul concrete	2 CY	\$ - \$ 67	\$ 67	
			30 21 Leach Field				\$ 4,721	
			3' deep	Excavator	70 CY	\$ - \$ 1,303	\$ 1,017	33.03.97
				backfill clean cover	47 CY	\$ 8 \$ 178	\$ 46	
				backfill, hauled fill	30 CY	\$ 109 \$ 47	\$ 60	
				load waste	30 CY	\$ - \$ 17	\$ 10	
				Dust suppressant	490 SY	\$ - \$ 8	\$ 4	
				Waste Pile cover	936 SF	\$ 95 \$ 27	\$ 0	
				Equipment decon		\$ - \$ 385	\$ 32	
				OVA rental	1 WK	\$ 160 \$ -	\$ 160	
				pipng demolition	100 LF	\$ - \$ 799	\$ 138	
				load, pipe	1 CY	\$ - \$ 54	\$ 20	
				haul	1 CY	\$ - \$ 34	\$ 34	
				soil compaction	26 CY	\$ - \$ 133	\$ 4	

Model applied to minimum size 10'x10'

Costs prorated to actual dimensions based on volume.

Model assumed a .16 bucket factor. To be consistent

as .10 factor should be used for segregation.

Excavation labor and equipment are prorated accordingly.

Model applied to minimum size 10'x10'

Costs prorated to actual dimensions based on volume.

Use .10 bucket factor and 27 sec cycle time,

segregation parameters.

Unit	Site	dimensions		description	Material	Cost Details				Reference
		length	width			Material-\$	Labor-\$	Equip.-\$	sub-total	
OU-5	Landfill #1	250	175	Excavation Total					\$ 230,965	
				Excavator	18182 CY	\$ -	\$ 12,211	\$ 45,425	\$ 57,636	33.08.01.01
				backfill clean cover	3897 CY	\$ 684	\$ 14,720	\$ 3,808	\$ 19,212	"
				backfill, hauled fill	17805 CY	\$ 64,716	\$ 27,759	\$ 35,799	\$ 128,274	"
				load waste	17805 CY	\$ -	\$ 9,929	\$ 6,003	\$ 15,931	"
				Dust suppressant	44570 SY	\$ -	\$ 699	\$ 359	\$ 1,058	"
				Waste Pile cover	57304 SF	\$ 5,799	\$ 1,669	\$ 9	\$ 7,476	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 959	\$ -	\$ -	\$ 959	"
OU-5	Landfill #2	320	300	Excavation Total					\$ 466,150	
				Excavator	38401 CY	\$ -	\$ 22,794	\$ 84,792	\$ 107,587	33.08.01.01
				backfill clean cover	8052 CY	\$ 1,413	\$ 30,415	\$ 7,869	\$ 39,696.8	"
				backfill, hauled fill	37859 CY	\$ 137,607	\$ 59,024	\$ 76,120	\$ 272,751	"
				load waste	37859 CY	\$ -	\$ 21,111	\$ 12,764	\$ 33,875	"
				Dust suppressant	97799 SY	\$ -	\$ 1,533	\$ 789	\$ 2,322	"
				Waste Pile cover	57304 SF	\$ 5,799	\$ 1,669	\$ 9	\$ 7,476	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 2,025	\$ -	\$ -	\$ 2,025	"
OU-5	Landfill #3	175	100	Excavation Total					\$ 91,711	
				Excavator	7794 CY	\$ -	\$ 4,884	\$ 12,542	\$ 17,427	33.08.01.01
				backfill clean cover	1732 CY	\$ 304	\$ 6,542	\$ 1,693	\$ 8,539	"
				backfill, hauled fill	7536 CY	\$ 27,391	\$ 11,749	\$ 15,152	\$ 54,292	"
				load waste	7536 CY	\$ -	\$ 4,202	\$ 2,541	\$ 6,743	"
				Dust suppressant	17828 SY	\$ -	\$ 280	\$ 144	\$ 423	"
				Waste Pile cover	26511 SF	\$ 2,683	\$ 772	\$ 4	\$ 3,459	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 411	\$ -	\$ -	\$ 411	"
OU-5	Combinations Landfill 1&2 & neighboring sites	500	415	Excavation Total					\$ 999,311	
				Excavator	81008 CY	\$ -	\$ 48,031	\$ 178,670	\$ 226,700	33.08.01.01
				backfill clean cover	16739 CY	\$ 2,938	\$ 63,228	\$ 16,358	\$ 82,524	"
				backfill, hauled fill	80206 CY	\$ 291,528	\$ 125,044	\$ 161,264	\$ 577,836	"
				load waste	80206 CY	\$ -	\$ 44,725	\$ 27,040	\$ 71,765	"
				Dust suppressant	211389 SY	\$ -	\$ 3,315	\$ 1,705	\$ 5,019	"
				Waste Pile cover	235893 SF	\$ 23,872	\$ 6,869	\$ 35	\$ 30,777	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental		\$ 4,271	\$ -	\$ -	\$ 4,271	"

HOTSPOT EXCAVATION COSTS

Estimate cost for "Hot Spot" Remo

Basis: Estimated areas of Hot Spots are: Landfill #1--10%, 5000ft2, in 4 digs
Landfill #2--25%, 24000ft2, in 2 digs
Landfill #3--10%, 1750 ft2, in 2 digs

Assume the "hot spots" are excavated with nearly vertical walls which have to be stabilized with sheeting.

Assume the "hot spots" are excavated using productivity factors like segregation, i.e. bucket fill=.10 of a 1CY bucket, cycle time=27 sec.

Unit	Site	dimensions		description	Material	Cost Details			sub-total	Reference
		length	width			Material-\$	Labor-\$	Equip.-\$		
OU-5	Landfill #1 hot spot	50	25	Total for 4 "hot spots"	1848				\$ 46,407	
				1 Excavation Total					\$ 11,602	
				Excavator	462 CY	\$ -	\$ 3,324	\$ 2,595	\$ 5,919	33.08.01.01
				Sheeting, pull & salv.	2250 SF	\$ 7,498	\$ 12,968	\$ 4,614		
				Sheeting, decon	3609 SF	\$ -	\$ 3,234	\$ 1,024		
				backfill clean cover	93 CY	\$ 16	\$ 351	\$ 91	\$ 458	"
				backfill, hauled fill	463 CY	\$ 1,683	\$ 722	\$ 931	\$ 3,336	"
				load waste	463 CY	\$ -	\$ 258	\$ 156	\$ 414	
				Dust supressant	44570 SY	\$ 16	\$ 351	\$ 91	\$ 458	"
				Waste Pile cover	2750 SF	\$ 278	\$ 80	\$ 0	\$ 359	"
				Equipment decon	1 EA	\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental	1 WK	\$ 240	\$ -	\$ -	\$ 240	"
OU-5	Landfill #2 hot spot	120	100	Total for 2 "hot spots"					\$ 212,493	
				1 Excavation Total					\$ 106,246	
				Excavator	4444 CY	\$ -	\$ 31,953	\$ 24,941	\$ 56,894	33.08.01.01
				Sheeting, pull & salv.	6600 SF	\$ 21,993	\$ 38,039	\$ 13,535		
				Sheeting, decon	10585 SF	\$ -	\$ 9,484	\$ 3,003		
				backfill, hauled fill	5550 CY	\$ 20,173	\$ 8,653	\$ 11,159	\$ 39,984	"
				load waste	5550 CY	\$ -	\$ 3,095	\$ 1,871	\$ 4,966	
				Dust supressant	37334 SY	\$ -	\$ 585	\$ 301	\$ 887	"
				Waste Pile cover	16400 SF	\$ 1,660	\$ 478	\$ 2	\$ 2,140	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental	1 MO	\$ 959	\$ -	\$ -	\$ 959	"
OU-5	Landfill #3 hot spot	35	25	Total for 2 "hot spots"					\$ 16,468	
				1 Excavation Total					\$ 8,234	
				Excavator	324 CY	\$ -	\$ 2,374	\$ 1,853	\$ 4,228	33.08.01.01
				Sheeting, pull & salv.	1800 SF	\$ 5,998	\$ 10,374	\$ 3,691		"
				Sheeting, decon	2887 SF	\$ -	\$ 2,587	\$ 819		"
				backfill clean cover	65 CY	\$ 11	\$ 246	\$ 64	\$ 320	"
				backfill, hauled fill	324 CY	\$ 1,178	\$ 505	\$ 651	\$ 2,334	"
				load waste	324 CY	\$ -	\$ 181	\$ 211	\$ 391	
				Dust supressant	1362 SY	\$ -	\$ 21	\$ 11	\$ 32	"
				Waste Pile cover	2075 SF	\$ 210	\$ 60	\$ 0	\$ 271	"
				Equipment decon		\$ -	\$ 385	\$ 32	\$ 418	"
				OVA rental	1 WK	\$ 240	\$ -	\$ -	\$ 240	"

ONSITE LANDFILL CONSTRUCTION AND OPERATION COSTS

Trial and error solution for "pit" volume:

Basis: Bottom of clay liner is 20' below grade (can't be deeper or can get ground water intrusion)
 Bottom of waste volume is 20'-2' (clay)-1' (sand)-6" (cover)=16.5' below grade.
 The bottom of the landfill has a 2% slope
 The sides of the landfill has a 3:1 slope.
 The horizontal run of the bottom slope is: a
 The horizontal run of the side slope is: b Actual dimension is 2*(a+b)
 The total contained volume of the landfill (to grade) should be 70,000CY.
 The landfill footprint is a square with a side length 2*(a+b)

Therefore: $70,000 \text{ CY} = 2a \cdot 2a \cdot (16.5 - .02a) + 1/2 \cdot b \cdot 1/3b \cdot \text{perimeter} + 1/3 \cdot 2a \cdot 2a \cdot (.02 \cdot a)$
 $16.5 = .02 \cdot a + 1/3 \cdot b$

Solve by trial and error:

a	b	volume	depth
100	20	24840	8.67
200	40	100938	17.33
150*	30	56333	13.00
175	30	73386	13.50
175	40	81262	16.83
170	40	77532	16.73
165	40	73874	16.63
165	35	69775	14.97
160	40	70289	16.53
155	40	66779	16.43
Pick 160	40	70289	16.53

Estimate the landfill as 400 ft.x 400 ft x 16.5 deep:

Use Envest capping model to estimate the materials necessary for a 400 x 400 cap (upside down)

The cap layers are (from bottom up): 6" final cover (fill)
filter fabric
clay (only 24" is available)
liner
drainage layer-24"
soil cover--6"

The volumes calculated should correspond to the following land fill layers. Use the Envest unit rates

Cap	Land fill	to estimate the costs:
final cover volume	drainage layer cover	
filter fabric	filter fabric	
clay layer	2x sand volume	
liner	liner	
drainage layer	clay layer	
soil cover	bedding layer	

In addition a RCRA landfill requires draitile. Use Envest model to install 4" perforated pipe.

In total 6 runs each 320 ft long. The leachate then is pumped from a 6" line 250' long.

Envest estimates a 20 mil impervious liner. A RCRA landfill requires a min. 30 mil liner.

Use the labor, materials, and equipment rates from the 40 mil membrane installation as a top cover and use the liner area estimated for the impervious layer

6" leachate transfer pipe is estimated using Envest 4" default x 2 for materials and x 1.5 for labor and equipment.

Compaction of 24" lifts is estimated to be same as compacting 1 lift for an equivalent size parking lot (ref. 33.03.79.01)

Estimate 9 lifts to fill site.

Estimate the landfill as 400 ft.x 400 ft x 16.5 deep:

Unit	dimensions			description	Material	Cost Details				Reference
	length	width	depth			Material-	Labor-\$	Equip.-\$	sub-total	
RCRA landfill	320	320	16.5	Total Capital					\$ 1,804,547	
				Excavation of site	109629 CY				\$ 369,338	
				excavator	109629 CY	\$ -	\$ 25,547	\$ 139,599		33.08.01.01
				load fill	138000 CY	\$ -	\$ 13,885	\$ 46,715		
				haul to backfill pile	138000 CY	\$ -	\$ 25,478	\$ 90,313		
				dust suppression	617659 SY	\$ -	\$ 4,842	\$ 3,736		33.08.01.01
				grading	19600 SY	\$ -	\$ 4,077	\$ 5,927		33.03.79.01 prorated on SY basis (rough and fine grading)
				compaction (rolled)	19600 SY	\$ -	\$ 6,586	\$ 2,634		" "
				Construction of "pit"					\$ 397,392	
				6" bedding under clay	4156 CY	\$ 730	\$ 5,856	\$ 12,364		33.08.05.02
				separation fabric	22353 SY	\$ 16,452	\$ 7,453	\$ 546		33.08.05.03
				24" clay liner	14902 CY	\$ 53,342	\$ 57,334	\$ 54,091		33.08.05.05
				40 mil PVC liner	197462 SF	\$ 67,216	\$ 4,676	\$ 619		33.08.05.01
				anchor trench	1680 LF	\$ 49	\$ 692	\$ 256		
				12" sand drainage lay	8458 CY	\$ 40,780	\$ 6,630	\$ 12,067		33.08.05.06
				separation fabric	19936 SY	\$ 14,673	\$ 6,647	\$ 487		33.08.05.06
				6" cover fill	7552 CY	\$ 1,326	\$ 10,640	\$ 22,467		33.08.05.08
				Leachate collection					\$ 35,467	
				pipe trenching	1392 LF	\$ -	\$ 207	\$ 185		33.06.96.01
				rock around pipe	720 CY	\$ 4,730	\$ 2,340	\$ 295		"
				compacting	720 CY	\$ -	\$ 2,625	\$ 81		"
				6" perforated pipe	1392 LF	\$ 1,325	\$ 5,724	\$ 2,382		"
				6" transfer pipe	250 LF	\$ 672	\$ 1,500	\$ 206		"
				transfer pump	1 EA	\$ 322	\$ 388	\$ 59		"
				water tank	1 EA	\$ 3,864	\$ 606	\$ 10		"
				concrete pad and wall	1 EA	\$ 1,816	\$ 2,823	\$ 186		"
				water level switch	1 EA	\$ 791	\$ -	\$ -		"
				water lift station	1 EA	\$ 1,127	\$ 1,388	\$ 697		"
				air compressor	1 EA	\$ 2,530	\$ 687	\$ 11		"
				Fill landfill site					\$ 169,360	
				load	86000 CY	\$ -	\$ 17,287	\$ 38,775		33.03.87.01
				haul waste to new site	86000 CY	\$ -	\$ 31,755	\$ 75,042		"
				compaction (24" lifts)	86000 CY	\$ -	\$ 2,800	\$ 3,700		
				Final Cap					\$ 715,150	
				1' final cover in 6" lifts	8407 CY	\$ 1,476	\$ 16,922	\$ 25,010		33.08.05.08
				Impervious layer					\$ 412,319	
				2' clay in 6" lifts	18830 CY	\$ 67,403	\$ 103,494	\$ 68,349		33.08.05.06 Liner unit costs:
				herbicide	4.25 acre	\$ 189	\$ 470	\$ 230		" labor equip material
				20 mil VLDPE liner	218871 SF	\$ 32,218	\$ 104,208	\$ 8,310		" \$ 0.48 \$ 0.02 \$ 0.74
				80 mil liner	22193 SY	\$ 16,334	\$ 10,571	\$ 542		"
				Drainage layer					\$ 91,418	
				1' sand in 6" lifts	8252 CY	\$ 39,787	\$ 9,240	\$ 11,773		33.08.05.05

Estimate the landfill as 400 ft.x 400 ft x 16.5 deep:

80 mil geo textile filter	24756 SY	\$ 18,220	\$ 11,792	\$ 604	33.08.05.03
Soil Cap					
18" soil in 6" lifts	13818 CY	\$ 2,426	\$ 27,813	\$ 41,108	33.08.05.02
6" top soil	4689 CY	\$ 60,394	\$ 22,445	\$ 7,045	33.08.05.01
seeding	4.64 acre	\$ 4,463	\$ 447	\$ 289	"
watering	19 acre	\$ -	\$ 1,022	\$ 556	"
Toe Drain					
Excavation	2022 CY	\$ -	\$ 4,244	\$ 4,119	33.03.97.01 used .16 loading factor to represent a 4 ft3 bucket excavat
Crushed rock	2311 CY	\$ 15,181	\$ 7,511	\$ 946	"
Compacting	2506 CY	\$ -	\$ 8,425	\$ 260	"
20 mil liner	52056 SF	\$ 38,313	\$ 24,785	\$ 1,271	33.08.05.08 replace area of geotextile sheeting w/20mil VDPL liner;
6" perf. PVC pipe	1820 LF	\$ 1,256	\$ 7,752	\$ 2,258	33.06.96.01 times per unit costs for liner from cap installation
4" PVC pipe to creek	200 LF	\$ 269	\$ 1,143	\$ 110	"
Total yearly O&M					
Yearly O&M (toe drain)					
pipe cleaning					
(1/yr@ 8hr)	8 HR	\$	416		assume labor rate @\$20/hr w/ a \$52 /hr charge out
Yearly O&M (cap)					
30 Year O&M totals					
reseeding	9.3 acre	\$ 8,945	\$ 895	\$ 579	33.08.05.99
mowing	12 /yr	\$ -	\$ 38,335	\$ 5,717	"
fertilizing	1 /yr	\$ 3,366	\$ 4,045	\$ 3,959	"
Yearly O&M (leachate)					
30 Year O&M totals					
pump electricity	1515.5 MWhr	\$ 69,713	\$ -	\$ -	33.06.96.99
maint.		\$ -	\$ 17,515	\$ 2,920	"

OFFSITE DISPOSAL COSTS

Site	Cleanup Strategy	Excavated Volume	Treatment type	Treatment Cost	OffSite Disposal Cost
OU1-49 Waste Holes	Removal / Disposal	2051	None	0	
Waste is completely removed and disposed without treatment or segregation.		0 Return	None	0	0
		0 Municipal	None	0	96
		0 Hazardous	None	0	155
		0 LL Soil	None	0	358
		0 LL Debris	None	0	601
		0 Mixed Soil	None	0	1222
		2051 Mixed Debris	None	0	1762
		0 Class C	None	0	2401
		Total Volume 2051	Total Treatment Cost	0	3613862
				0	2401
				0	3613862

Site	Cleanup Strategy	Excavated Volume	Treatment type	Treatment Cost	OffSite Disposal Cost
OU1-49 Waste Holes	Complete Remove/Treat/Dispose	2051	Segregation at \$1/m^3	2051	
The excavated waste has 80 cu yd of debris; the rest is soil. The waste is carefully excavated and 75% of the soil may be disposed as LL Soil. The remaining material is further segregated into soil and debris. A small portion is Class C waste.		0 Return	None	0	0
		0 Municipal	None	0	96
		0 Hazardous	None	0	155
	75% of soil fraction	1478 LL Soil	None	0	358
		0 LL Debris	None	0	601
	50% of remaining	286 Mixed Soil	None	0	1222
	40% of remaining	230 Mixed Debris	None	0	1762
	10% of remaining	57 Class C	None	0	2401
		Total Volume 2051	Total Treatment Cost	2051	136857
				2051	1420733
				2051	1420733

Site	Cleanup Strategy	Excavated Volume	Treatment type	Treatment Cost	OffSite Disposal Cost
OU1-49 Waste Holes	Capping/Hot Spot Removal/Disposal	0	None	0	
A percentage of the waste is removed as hot spots and disposed as mixed waste debris. There was no data to support a hot spot removal senario.		0 Return	None	0	0
		0 Municipal	None	0	96
		0 Hazardous	None	0	155
		0 LL Soil	None	0	358
		0 LL Debris	None	0	601
		0 Mixed Soil	None	0	1222
		0 Mixed Debris	None	0	1762
		0 Class C	None	0	2401
		Total Volume 0	Total Treatment Cost	0	0
				0	0
				0	0

Site	Cleanup Strategy	Excavated Volume	Treatment type	Treatment Cost	OffSite Disposal Cost
OU1-Solid Waste Trenches	Complete Remove/Treat/Dispose	4316	Segregation at \$1/yd^3	4316	
Material is 50% debris. All the excavated material is segregated. The soil fraction is washed and 75% is returned.		1618 Return	Soil Washing at (132/yd^3)	213576	0
		0 Municipal	None	0	96
		0 Hazardous	None	0	155
	75% of a 50% soil fraction	540 LL Soil	Soil Washing at (132/yd^3)	71280	358
		0 LL Debris	None	0	601
		0 Mixed Soil	None	0	1222
	25% of a 50% soil fraction	2158 Mixed Debris	None	0	1762
		0 Class C	None	0	2401
	50% of excavated volume	Total Volume 4316	Total Treatment Cost	289172	3995716
				289172	3995716
				289172	3995716

Site	Cleanup Strategy	Excavated Volume	Treatment type	Treatment Cost	OffSite Disposal Cost
OU1-Solid Waste Trenches	Capping/Hot Spot Removal/Disposal	0	None	0	
A percentage of the waste is removed as hot spots and		0 Return	None	0	0
				0	0
				0	0

A percentage of the waste is removed as hot spots and disposed as mixed waste debris. There was no data to support a hot spot removal scenario.

0	Municipal	None	0	96	0
0	Hazardous	None	0	155	0
0	LL Soil	None	0	358	0
0	LL Debris	None	0	601	0
0	Mixed Soil	None	0	1222	0
0	Mixed Debris	None	0	1762	0
0	Class C	None	0	2401	0
0	Total Treatment Cost		0	Total Disposal Costs	0

Site
OU1-SW Trenches
Material is 50% debris. All the excavated material is segregated. The soil fraction is washed and 75% is returned to the site.

75% of a 50% soil fraction

25% of a 50% soil fraction

50% of excavated volume

Excavated Volume		Treatment type	Treatment Cost	OffSite Disposal Cost	
1357		Segregation at \$1/yd^3	1357		
509	Return	Soil Washing at (132/yd^3)	67188	0	0
0	Municipal	None	0	96	0
0	Hazardous	None	0	155	0
170	LL Soil	Soil Washing at (132/yd^3)	22440	358	60860
0	LL Debris	None	0	601	0
0	Mixed Soil	None	0	1222	0
678	Mixed Debris	None	0	1762	1194636
0	Class C	None	0	2401	0
Total Volume	1357	Total Treatment Cost	90985	Total Disposal Costs	1255496

Site
OU1-SW Trenches
A percentage of the waste is removed as hot spots and disposed as mixed waste debris. There was no data to support a hot spot removal scenario.

Excavated Volume		Treatment type	Treatment Cost	OffSite Disposal Cost	
0		None	0		
	0 Return	None	0	0	0
	0 Municipal	None	0	96	0
	0 Hazardous	None	0	155	0
	0 LL Soil	None	0	358	0
	0 LL Debris	None	0	601	0
	0 Mixed Soil	None	0	1222	0
	0 Mixed Debris	None	0	1762	0
	0 Class C	None	0	2401	0
Total Volume	0	Total Treatment Cost	0	Total Disposal Costs	0

Site
OU1-DOE Disposal Box
Box and soils are removed and disposed without segregation or treatment.

Cleanup Strategy Removal / Disposal	Excavated Volume	Treatment type	Treatment Cost	OffSite Disposal Cost
	296	None	0	
	0 Return	None	0	0
	0 Municipal	None	0	96
	0 Hazardous	None	0	155
	0 LL Soil	None	0	358
	0 LL Debris	None	0	601
	0 Mixed Soil	None	0	1222
	296 Mixed Debris	None	0	1762
	0 Class C	None	0	2401
	Total Volume	296	Total Treatment Cost	0
				Total Disposal Costs
				521552

Site
OU2-Radium Leach Fields
Waste is completely removed and disposed without treatment.

Excavated Volume	Treatment type	Treatment Cost	OffSite Disposal Cost
1327	None	0	
0 Return	None	0	0
0 Municipal	None	0	96
0 Hazardous	None	0	155
0 LL Soil	None	0	358
1327 LL Debris	None	0	601
0 Mixed Soil	None	0	1222
0 Mixed Debris	None	0	1762

Site
OU2-Radium Leach Fields
Material is 20% debris. All the excavated material is segregated. The soil fraction is washed and 75% is returned to the site.

Cleanup Strategy
Complete Remove/Treat/Dispose

Total Volume	0 Class C	None	0	2401	0
	1327	Total Treatment Cost	0	Total Disposal Costs	797527
Excavated Volume		Treatment type	Treatment Cost	OffSite Disposal Cost	
	1327	Segregation at \$1/yd^3	1327		
	796 Return	Soil Washing at (132/yd^3)	105072	0	0
	0 Municipal	None	0	96	0
	0 Hazardous	None	0	155	0
	266 LL Soil	Soil Washing at (132/yd^3)	35112	358	95228
	265 LL Debris	None	0	601	159265
	0 Mixed Soil	None	0	1222	0
	0 Mixed Debris	None	0	1762	0
	0 Class C	None	0	2401	0
Total Volume	1327	Total Treatment Cost	141511	Total Disposal Costs	254493

Site
OU2-Strontium Leach Fields
Waste is completely removed and disposed without treatment.

Cleanup Strategy
Removal / Disposal

Excavated Volume		Treatment type	Treatment Cost	OffSite Disposal Cost	
	1126	None	0		
	0 Return	None	0	0	0
	0 Municipal	None	0	96	0
	0 Hazardous	None	0	155	0
	0 LL Soil	None	0	358	0
	1126 LL Debris	None	0	601	676726
	0 Mixed Soil	None	0	1222	0
	0 Mixed Debris	None	0	1762	0
	0 Class C	None	0	2401	0
Total Volume	1126	Total Treatment Cost	0	Total Disposal Costs	676726

Site
OU2-Strontium Leach Fields
Material is 20% debris. All the excavated material is segregated. The soil fraction is washed and 75% is returned to the site.

Cleanup Strategy
Complete Remove/Treat/Dispose

Excavated Volume		Treatment type	Treatment Cost	OffSite Disposal Cost	
	1126	Segregation at \$1/yd^3	1357		
	676 Return	Soil Washing at (132/yd^3)	89232	0	0
	0 Municipal	None	0	96	0
	0 Hazardous	None	0	155	0
	225 LL Soil	Soil Washing at (132/yd^3)	29700	358	80550
	225 LL Debris	None	0	601	135225
	0 Mixed Soil	None	0	1222	0
	0 Mixed Debris	None	0	1762	0
	0 Class C	None	0	2401	0
Total Volume	1126	Total Treatment Cost	120289	Total Disposal Costs	215775

Site
OU3-Dog Pens
Waste is completely removed and disposed without treatment.

Cleanup Strategy
Removal / Disposal

Excavated Volume		Treatment type	Treatment Cost	OffSite Disposal Cost	
	2950	None	0		
	0 Return	None	0	0	0
	0 Municipal	None	0	96	0
	0 Hazardous	None	0	155	0
	0 LL Soil	None	0	358	0
	2950 LL Debris	None	0	601	1772950
	0 Mixed Soil	None	0	1222	0
	0 Mixed Debris	None	0	1762	0
	0 Class C	None	0	2401	0
Total Volume	2950	Total Treatment Cost	0	Total Disposal Costs	1772950

Site
OU4-Soils
Waste is completely removed

Cleanup Strategy
Removal / Disposal

Excavated Volume		Treatment type	Treatment Cost	OffSite Disposal Cost	
	420	None	0		

Waste is completely removed and disposed without treatment.

0 Return	None	0	0	0
0 Municipal	None	0	96	0
420 Hazardous	None	0	155	65100
0 LL Soil	None	0	358	0
0 LL Debris	None	0	601	0
0 Mixed Soil	None	0	1222	0
0 Mixed Debris	None	0	1762	0
0 Class C	None	0	2401	0
Total Volume	420	Total Treatment Cost	0	Total Disposal Costs 65100

Site
OU4-Structures
Cleanup Strategy
Removal / Disposal

Waste is completely removed and disposed without treatment.

Excavated Volume	12	Treatment type	Treatment Cost	OffSite Disposal Cost
		None	0	
		0 Return	0	0
		0 Municipal	0	96
		12 Hazardous	0	155 1860
		0 LL Soil	0	358
		0 LL Debris	0	601
		0 Mixed Soil	0	1222
		0 Mixed Debris	0	1762
		0 Class C	0	2401
Total Volume	12	Total Treatment Cost	0	Total Disposal Costs 1860

Site
OU5-Landfill 1
Cleanup Strategy
Removal / Disposal

Waste is completely removed and disposed without treatment.

Excavated Volume	18182	Treatment type	Treatment Cost	OffSite Disposal Cost
		None		
		0 Return	0	0
		0 Municipal	0	96
		18182 Hazardous	0	155 2818210
		0 LL Soil	0	358
		0 LL Debris	0	601
		0 Mixed Soil	0	1222
		0 Mixed Debris	0	1762
		0 Class C	0	2401
Total Volume	18182	Total Treatment Cost	0	Total Disposal Costs 2818210

Site
OU5-Landfill 1
Cleanup Strategy
Selective Remove/Treat/Dispose

10% of the waste is removed as hot spots and disposed as hazardous waste. The 10% included any required overdig. Excavated material is treated and 50% is returned to the site.

Excavated Volume	1850	Treatment type	Treatment Cost	OffSite Disposal Cost
		Soil Washing at (132/yd^3)	244200	
		925 Return	0	0
		0 Municipal	0	96
		925 Hazardous	0	155 143375
		0 LL Soil	0	358
		0 LL Debris	0	601
		0 Mixed Soil	0	1222
		0 Mixed Debris	0	1762
		0 Class C	0	2401
Total Volume	1850	Total Treatment Cost	244200	Total Disposal Costs 143375

Site
OU5-Landfill 2
Cleanup Strategy
Removal / Disposal

Waste is completely removed and disposed without treatment.

Excavated Volume	38401	Treatment type	Treatment Cost	OffSite Disposal Cost
		None		
		0 Return	0	0
		0 Municipal	0	96
		38401 Hazardous	0	155 5952155
		0 LL Soil	0	358
		0 LL Debris	0	601
		0 Mixed Soil	0	1222

Site
OU5-Landfill 2
25 % of the waste is removed as hot spots and disposed as hazardous waste. 25% includes any required overdig. Excavated material is treated and 50% is returned to the site.

Cleanup Strategy
Selective Remove/Treat/Dispose

0 Mixed Debris	None	0	1762	0
0 Class C	None	0	2401	0
Total Volume	38401	Total Treatment Cost	0 Total Disposal Costs	5952155

Excavated Volume	8890	Treatment type	Treatment Cost	OffSite Disposal Cost
		Soil Washing at (132/yd^3)	1173480	
4445 Return	None		0	0
0 Municipal	None		96	0
4445 Hazardous	None		155	688975
0 LL Soil	None		358	0
0 LL Debris	None		601	0
0 Mixed Soil	None		1222	0
0 Mixed Debris	None		1762	0
0 Class C	None		2401	0
Total Volume	8890	Total Treatment Cost	0 Total Disposal Costs	688975

Site
OU5-Landfill 3
Waste is completely removed and disposed without treatment.

Cleanup Strategy
Removal / Disposal

Excavated Volume	7794	Treatment type	Treatment Cost	OffSite Disposal Cost
		None	0	
0 Return	None		0	0
0 Municipal	None		96	0
7794 Hazardous	None		155	1208070
0 LL Soil	None		358	0
0 LL Debris	None		601	0
0 Mixed Soil	None		1222	0
0 Mixed Debris	None		1762	0
0 Class C	None		2401	0
Total Volume	7794	Total Treatment Cost	0 Total Disposal Costs	1208070

Site
OU5-Landfill 3
10% of the waste is removed as hot spots and disposed as hazardous waste. The 10% includes any required overdig. Excavated material is treated and 50% is returned to the site.

Cleanup Strategy
Selective Remove/Treat/Dispose

Excavated Volume	650	Treatment type	Treatment Cost	OffSite Disposal Cost
		Soil Washing at (132/yd^3)	85800	
325 Return	None		0	0
0 Municipal	None		96	0
325 Hazardous	None		155	50375
0 LL Soil	None		358	0
0 LL Debris	None		601	0
0 Mixed Soil	None		1222	0
0 Mixed Debris	None		1762	0
0 Class C	None		2401	0
Total Volume	650	Total Treatment Cost	0 Total Disposal Costs	50375

APPENDIX D - CHARACTERIZATION TECHNOLOGIES AND COST BASIS

This appendix provides background information on selected characterization technologies to be used as part of the remedial alternatives, assumptions made in application of these technologies, and the basis used to estimate costs. A listing of these technologies and the operable unit (OU) in which they may be applied for any of the presumptive alternatives is summarized in Table D.1.

Table D.1. Summary of Characterization Technologies Used for Presumptive Alternatives

Characterization Technology	OU1	OU2	OU3	OU4	OU5
Surface geophysical survey	x	x		x	x
Soil-gas sampling	x		x		x
Surface radiation survey	x				x
Subsurface soil sampling (soil borings)	x	x		x	x
Trenching/back-hoe exploration				x	
Concrete coring		x			

D.1 SURFACE GEOPHYSICAL SURVEY

Standard surface geophysical survey methods such as metal detection, electromagnetic (EM), and ground penetrating radar (GPR), will be used to locate features in the subsurface. Surveys are generally done in a grid pattern.

D.1.1 Technology Description

EM surveys measure the electrical conductivity of the subsurface. Electrical conductivity varies with lithology, fluid composition, and saturation. It can also be used to locate buried metal objects.

GPR is an electromagnetic technique in which a single low-power broadband impulse of 1- to 6-second nanosecond duration is transmitted into the earth. The transmission is followed by a listening interval of 20,000 nanoseconds. The impulses are directed into the ground through a moving antenna that has an extremely wide viewing angle. Return times of these impulses are then used to generate a two-dimensional subsurface profile. It can be used to detect buried objects, define the boundary between disturbed vs. undisturbed areas, and define subsurface stratigraphy or natural subsurface features (buried stream channels, caves/voids, etc.).

D.1.2 Assumptions

Surface geophysical surveys have been performed at selected areas at LEHR. Additional geophysical surveys will be needed for particular presumptive alternatives at the OUs shown in Table D.1.

D.1.3 Cost Basis

Geophysical survey costs (labor and equipment) are assumed to be \$220/hr based on past experience at the LEHR site. Analysis and report preparation is assumed to be 40 hrs @ \$70/hr per site (\$2.8K).

D.2 SOIL-GAS SAMPLING

Soil-gas sampling involves the collection of soil-gas samples for the purpose of detecting volatile organic compounds (VOCs). Samples are usually collected aerially in a grid pattern.

D.2.1 Technology Description

To collect soil gas samples, reusable probes with retractable tips are driven into the ground. The probe tip is retracted, a vacuum is applied to the probe, and a soil-gas sample is collected which is analyzed by a onsite gas chromatograph.

D.2.2 Assumptions

Soil-gas samples have been collected at selected locations at LEHR. Additional soil-gas samples will be needed for particular presumptive alternatives at the OUs shown in Table D.1.

D.2.3 Cost Basis

Soil-gas sampling costs (labor and equipment) are assumed to be \$300/hr based on past experience at the LEHR site. It is assumed that 1.5 grid points can be analyzed per hour.

D.3 SURFACE RADIATION SURVEY

A surface radiation survey will be conducted to detect surface/near-surface radionuclides.

D.3.1 Technology Description

Two surveys will be performed: 1) using a germanium detector to measure for gamma radiation, including ^{60}Co and ^{226}Ra , and 2) using a beta scintillation sensor that can detect ^{90}Sr and provide real-time results. Results of these surveys will be used to help identify locations for subsurface soil sampling. For both types of surveys, counts will be made at selected grid locations. Both of the above detectors were developed by PNL and have been successfully used at other sites (e.g., Schilk et al. 1995).

D.3.2 Assumptions

Surface radiation surveys will be needed for particular presumptive alternatives at the OUs shown in Table D.1.

D.3.3 Cost Basis

It is assumed that approximately 1 germanium survey grid point can be measured per hour and approximately 2 beta scintillation grid points can be measured per hour. This time estimate

includes data tabulation and reporting. Cost for crew and equipment is assumed to be \$200/hr based on previous experience.

D.3.4 References

Schilk, A. J., K. H. Abel, and R. W. Perkins. 1995. "Characterization of Uranium Contamination in Surface Soils." *J. Environmental Radioactivity* 26:147-156.

D.4 SOIL BORINGS

Soil borings will be drilled to collect subsurface soil samples.

D.4.1 Technology Description

Soil borings can be drilled with a variety of technologies including hollow-stem auger, air-rotary, and sonic drilling techniques. Boreholes will be drilled to a depth of approximately 12 ft (or 2 ft deeper than the deepest identifiable waste level). Because of the shallow boring depth, hollow-stem auger drilling is probably adequate and is probably the most cost-effective method.

Continuous core samples will be collected. All core samples will be surveyed with portable instruments (Geiger-Muller detector, portable alpha meter, and photoionization detector).

D.4.2 Assumptions

Soil borings have been recently drilled at selected locations at LEHR. Additional soil-gas samples will be needed for particular presumptive alternatives at the OUs shown in Table D.1.

D.4.3 Cost Basis

Drilling costs are estimated to be \$36/ft (based on recent onsite experience). Standby time is estimated at 7% of the total drilling cost. Mobilization is estimated at \$9000, which includes decontamination between boreholes, and demobilization.

D.5 TRENCHING/BACKHOE EXPLORATION

Trenching/backhoe exploration will be used for locating buried structures and for shallow soil sampling.

D.5.1 Technology Description

Trenching is commonly done using heavy equipment such as a backhoe, clamshell, trackhoe, or trencher excavator. Such excavations are generally not practical at depths greater than 15 ft. All excavations that are deeper than 4 ft must be stabilized prior to entry into the excavation.

D.5.2 Assumptions

Trenching/backhoe exploration is applicable for particular presumptive alternatives at the OUs shown in Table D.1.

D.5.3 Cost Basis

Based on past experience at the LEHR site, trenching/backhoe exploration costs are assumed to be \$95/hr plus \$40/hr for a laborer.

D.6 CONCRETE CORING

Collection of concrete cores from buried tanks for chemical and radiological analysis.

D.6.1 Technology Description

A coring machine is used to cut a core sample through a buried tank. This machine is also capable of collecting sludge samples and soil samples immediately below the tank.

D.6.2 Assumptions

Collection of concrete cores is only necessary from the Ra-226 tanks (OU2).

D.6.3 Cost Basis

Concrete coring costs are estimated to be \$90/hr based on past experience.

APPENDIX E - OPERABLE UNIT 1 COST SHEETS

OU-1 Summary

Genral Response Action	Component	Disposal Method	Characterization Costs	Remediation Costs				Total
				Capitail	Annual O&M	30 Yr. (5%) Present Worth O&M Costs	30 Yr. (5%) Present Worth Remediation Costs	
Hotspot Removal & Cap	SW Trenches	Onsite	\$70,283	\$146,663	\$1,287	\$19,786	\$166,449	\$236,732
		Offsite	\$70,283	\$952,660	\$599	\$9,208	\$961,868	\$1,032,151
	49 Waste Holes	Onsite	\$116,029	\$849,285	\$7,778	\$119,572	\$968,858	\$1,084,887
		Offsite	\$116,029	\$7,468,751	\$599	\$9,208	\$7,477,959	\$7,593,988
	Solid Waste Trenches	Onsite	\$109,014	\$929,456	\$8,225	\$126,438	\$1,055,894	\$1,164,908
		Offsite	\$109,014	\$5,713,992	\$4,140	\$63,648	\$5,777,640	\$5,886,654
Remove & Dispose	DOE Disposal Box	Onsite	\$16,217	\$78,471	\$937	\$14,403	\$92,875	\$109,092
		Offsite	\$16,217	\$1,175,999	\$0	\$0	\$1,175,999	\$1,192,216
	49 Waste Holes	Onsite	\$31,973	\$438,032	\$11,302	\$173,741	\$611,773	\$643,746
		Offsite	\$31,973	\$13,676,963	\$0	\$0	\$13,676,963	\$13,708,936
Remove, Segregate & Dispose	SW Trenches	Onsite	\$22,545	\$102,220	\$1,376	\$21,155	\$123,374	\$145,919
		Offsite	\$22,545	\$1,462,476	\$0	\$0	\$1,462,476	\$1,485,020
	Solid Waste Trenches	Onsite	\$31,973	\$381,077	\$8,169	\$125,579	\$506,657	\$538,630
		Offsite	\$31,973	\$8,455,790	\$0	\$0	\$8,455,790	\$8,487,763
Remove, Segregate, Treat, & Dispose	SW Trenches	Onsite	\$22,545	\$210,303	\$860	\$13,222	\$223,525	\$246,069
		Offsite	\$22,545	\$1,054,170	\$0	\$0	\$1,054,170	\$1,076,714
	Solid Waste Trenches	Onsite	\$31,973	\$740,665	\$4,185	\$64,334	\$804,999	\$836,971
		Offsite	\$31,973	\$6,347,745	\$0	\$0	\$6,347,745	\$6,379,718
	49 Waste Holes (no segregation)	Onsite	\$31,973	\$1,177,045	\$4,661	\$71,657	\$1,248,702	\$1,280,675
		Offsite	\$31,973	\$4,565,105	\$0	\$0	\$4,565,105	\$4,597,078

OU-1

Southwest Trenches

Hotspot Removal with Onsite Disposal and Capping

Description:

Hotspot removal and capping involves the excavation and removal of hotspots. The hotspot excavations would be backfilled with clean soils before capping the entire source area. The cap would consist of eight layers, combine natural and synthetic materials, and meet RCRA standards. Contaminated debris and soils would be disposed of onsite, without segregation or treatment.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwest Trenches is estimated to be 470 yd³. Approximately 50 percent of this volume is assumed to be excavated during hotspot removal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; soil borings; and chemical sampling and analysis. The surveys would be used to delineate the hotspots, with borings and sampling and analysis as confirmation. Stockpiled wastes will be characterized for disposal. Backhoe exploration and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
SW Trenches (*2)	125	5	10	12500	470	359

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$767
Ground Penetrating Radar	3	HR	155	D&M	\$465	
Electromagnetics		HR	135	D&M	\$0	
Mobilization			15%	D&M	\$70	
Analysis and Report Prep.			50%	D&M	\$233	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$5,280
Germanium detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Beta scintillation detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Mobilization			15%	D&M	\$480	
Analysis and Report Prep.			50%	D&M	\$1,600	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis						\$33,209
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (5" x 12')	60	FT	36	D&M	\$2,160	
Standby			7%	D&M	\$151	
Geologist Labor	20	HR	60		\$1,200	
PPE	3	DY	100	D&M	\$300	
Investigative Waste Management	2	DR	35	ENVEST	\$70	
Contractor Overhead Adjustment			22%	ENVEST	\$15	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	5	EA	2195	D&M	\$10,973	
Partial Suite	5	EA	1868	D&M	\$9,340	
Physical Testing (Not Required)						\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$48,892
Mobilization and General Requirements			15%			\$7,334
CHARACTERIZATION COSTS SUBTOTAL						\$56,226
Contingencies			20%			\$11,245
Administrative			5%			\$2,811
CHARACTERIZATION COSTS TOTAL						\$70,283
REMEDIALTION CAPITAL						
Hotspot Removal and Onsite Disposal						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	235	CY	18.69	ENVEST		\$4,393
Material					\$983	
Labor					\$1,504	
Equipment					\$1,114	
Contractor Overhead Adjustment	\$3,601		22%		\$792	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$7,741
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	235	CY	27	ENVEST	\$6,345	
Contractor Overhead Adjustment	\$6,345		22%		\$1,396	
Capping						\$47,398
Cap	1	EA		ENVEST	\$20,064	
Toe Drain	1	EA		ENVEST	\$18,787	
Contractor Overhead Adjustment	\$38,851		22%		\$8,547	
CONSTRUCTION COST SUBTOTAL						\$73,932
Mobilization and General Requirements			15%			\$11,090
CONSTRUCTION COST SUBTOTAL						\$85,022
Contingencies						
Bid Contingency			10%			\$8,502
Scope Contingency			20%			\$17,004
Other Costs						
Administrative			5%			\$4,251
Services During Construction			10%			\$8,502
Legal			5%			\$4,251
IMPLEMENTATION COST TOTAL						\$127,533
Engineering/Design			15%			\$19,130
CAPITAL COST TOTAL						\$146,663
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	235	CY	2	ENVEST	\$564	\$688
Contractor Overhead Adjustment	\$564		22%		\$124	
Maintenance of Cap						\$599
Maintenance of Cap	1	EA	NA	ENVEST	\$75	
Maintenance of Toe Drain	1	EA	NA	ENVEST	\$416	
Contractor Overhead Adjustment	\$491		22%		\$108	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$1,287

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$25,228
Assuming annual O&M cost for	30	YR	5%			\$19,786
Assuming annual O&M cost for	30	YR	10%			\$12,133
ESTIMATED CHARACTERIZATION						\$70,283
ESTIMATED CAPITAL COST (from above)						\$146,663
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$242,173
Assuming 30 years @ 5%						\$236,732
Assuming 30 years @ 10%						\$229,079

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

APPENDIX F - OPERABLE UNIT 2 COST SHEETS

OU-2 Summary

General Response Action	Media	Characterization Costs	Remediation Costs				Total
			Capital	Annual O&M	30 Yr. (5%) Present Worth O&M Costs	30 Yr. (5%) Present Worth Remediation Costs	
No Action	Structures	\$153,683	\$0	\$0	\$0	\$0	\$153,683
	Soils and Cobbles	\$266,501	\$0	\$0	\$0	\$0	\$266,501
	TOTAL	\$420,184	\$0	\$0	\$0	\$0	\$420,184
In Situ Treatment	Structures	\$150,504	\$209,158	\$0	\$0	\$209,158	\$359,662
	Soils and Cobbles	\$279,988	\$1,104,076	\$0	\$0	\$1,104,076	\$1,384,064
	TOTAL	\$430,492	\$1,313,234	\$0	\$0	\$1,313,234	\$1,743,726
Removal and Onsite Disposal	Structures	\$6,788	\$125,969	\$964	\$14,826	\$140,794	\$147,582
	Soils and Cobbles	\$6,788	\$498,016	\$5,097	\$78,349	\$576,365	\$583,153
	TOTAL	\$13,575	\$623,985	\$6,061	\$93,174	\$717,159	\$730,735
Removal and Off Site Disposal	Structures	\$6,788	\$491,075	\$0	\$0	\$491,075	\$497,863
	Soils and Cobbles	\$6,788	\$1,872,090	\$0	\$0	\$1,872,090	\$1,878,877
	TOTAL	\$13,575	\$2,363,165	\$0	\$0	\$2,363,165	\$2,376,740
Removal, Treatment, and On Site Disposal	Structures	\$34,340	\$252,282	\$672	\$10,329	\$262,611	\$296,951
	Soils and Cobbles	\$8,149	\$1,138,913	\$1,554	\$23,896	\$1,162,809	\$1,170,958
	TOTAL	\$42,489	\$1,391,195	\$2,226	\$34,226	\$1,425,420	\$1,467,909
Removal, Treatment, and Off Site Disposal	Structures	\$34,340	\$559,771	\$0	\$0	\$559,771	\$594,111
	Soils and Cobbles	\$8,149	\$1,481,129	\$0	\$0	\$1,481,129	\$1,489,278
	TOTAL	\$42,489	\$2,040,900	\$0	\$0	\$2,040,900	\$2,083,389

OU2 - Radium and Strontium Treatment and Leach Systems

Structures

No Action

Description:

No remedial action will be taken, however, characterization will be performed to justify leaving the structures in place. Characterization will include a literature review and geophysical survey to locate the distribution box, piping, and leach fields. Backhoe exploration will allow for direct sampling of soils and cobbles in the radium trench and leach fields, and along the pipelines, as described in the work plan. Soil borings will be installed adjacent to the structures, the number and location dependent on analysis results of the wipe samples and concrete cores. Physical testing of soil samples will not be needed.

Basis/Assumptions:

Structures refer primarily to concrete material composing the tanks, distribution box, pipes, and dry wells. It is assumed that the soil borings will be drilled to about 2 ft below the structures and bottom of the leach fields or to the maximum downward extent of contamination (i.e., drilling will be stopped when clean soil beneath the structures and leach fields has been encountered), whichever depth is greater.

The RI/FS work plan was used as a guideline for selecting the types of characterization needed. It is assumed that a limited field investigation is sufficient to characterize the site.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review	40	HR	60	D&M	\$2,400	\$2,400
Geophysical Survey (Not Required)						\$135
Ground Penetrating Radar		HR	155	D&M	\$0	
Backhoe Exploration & Sampling						\$33,232
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	
Sample Analyses						
Full Suite	3	EA	2195	D&M	\$6,584	
Partial Suite	14	EA	1807	D&M	\$25,298	
Concrete Coring & Analysis						\$10,199
Coring and Sawing	18	HR	88	D&M	\$1,575	
Standby time			37%	D&M	\$583	
Sample Analysis	11	EA	731	D&M	\$8,041	
Wipe Samples						\$10,965
Chemical Analysis	15	EA	731	D&M	\$10,965	
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$28,980
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
Sample Analyses						
Full Suite	1	EA	2195	D&M	\$2,195	
Partial Suite	14	EA	1865	D&M	\$26,110	
Concrete Coring & Analysis						\$9,839
Coring and Sawing	15	HR	88	D&M	\$1,313	
Standby time			37%	D&M	\$486	
Sample Analysis	11	EA	731	D&M	\$8,041	
Wipe Samples						\$10,965
Chemical Analysis	15	EA	731	D&M	\$10,965	
Tech memo prep. for both systems						\$4,800
Geologist time	80	HR	60	D&M	\$4,800	
CHARACTERIZATION COST SUBTOTAL						\$111,770
Mobilization and General Requirements			10%			\$11,177

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COST SUBTOTAL						\$122,947
Contingencies				20%		\$24,589
Administrative				5%		\$6,147
CHARACTERIZATION COST TOTAL						\$153,683
REMEDATION CAPITAL						
None Required					\$0	\$0
CONSTRUCTION COST SUBTOTAL						\$0
Mobilization and General Requirements				15%		\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						
Bid Contingency				10%		\$0
Scope Contingency				20%		\$0
Other Costs						
Administrative				5%		\$0
Services During Construction				10%		\$0
Legal				5%		\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design @15%				15%		\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required					\$0	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR		3%		\$0
Assuming annual O&M cost for	30	YR		5%		\$0
Assuming annual O&M cost for	30	YR		10%		\$0
ESTIMATED CHARACTERIZATION						\$153,683
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR		3%		\$153,683
Assuming 30 Years at 3%	30	YR		5%		\$153,683
Assuming 30 Years at 3%	30	YR		10%		\$153,683

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU2 - Radium and Strontium Treatment and Leach Systems**Soils and Cobbles****No Action****Description:**

No remedial action will be taken, however, characterization will be performed to justify leaving the soils, and cobbles in place. Characterization will include a literature review and geophysical survey to locate the distribution box, piping, and leach fields. Backhoe exploration will allow for direct sampling of soils and cobbles in the radium trench and leach fields, and along the pipelines, as described in the work plan. Soil borings will be installed adjacent to the structures, the number and location dependent on analysis results of the wipe samples and concrete cores. Physical testing of soil samples will not be needed.

Basis/Assumptions:

Soils refer to soil material within approximately 2 ft adjacent to and beneath the structures and in the strontium leach fields, radium trench, and dry wells. Cobbles refer to the seepage trenches and three dry wells. It is assumed that the soil borings will be drilled to about 2 ft below the structures and bottom of the leach fields or to the maximum downward extent of contamination (i.e., drilling will be stopped when clean soil beneath the structures and leach fields has been encountered), whichever depth is greater.

The RI/FS work plan was used as a guideline for selecting the types of characterization needed. It is assumed that a limited field investigation is sufficient to characterize the site.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (performed with structures)		HR	60		\$0	\$0
Geophysical Survey (performed with structures)						\$0
Backhoe Exploration & Sampling (performed with structures)						\$0
Soil Borings, Sampling, and Analysis						\$122,126
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (6)	180	FT	36	D&M	\$6,480	
Standby			7%	D&M	\$454	
Geologist Labor	48	HR	60		\$2,880	
PPE	6	DY	100	D&M	\$600	
Investigative Waste Management	13	DR	35	ENVEST	\$455	
Contractor Overhead Adjustment			22%	ENVEST	\$100	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	6	EA	2195	D&M	\$13,167	
Full Suite - bacterial count	25	EA	2150	D&M	\$53,750	
Partial Suite	20	EA	1762	D&M	\$35,240	
Physical Testing (Not Required)						\$0
Survey Locations						\$1,220
Field survey	8	HR	145	D&M	\$1,160	
Data Reduction/Reporting	1	HR	60	D&M	\$60	
Strontium-90 Imhoff Treatment System						
Literature Review (performed with structures)		HR	60		\$0	\$0
Geophysical Survey (performed with structures)						\$0
Backhoe Exploration & Sampling (performed with structures)						\$0
Soil Borings, Sampling, and Analysis						\$70,473
Mobilization (included earlier)		EA	9000	D&M	\$0	
Borehole installation (6)	120	FT	36	D&M	\$4,320	
Standby			7%	D&M	\$302	
Geologist Labor	48	HR	60		\$2,880	
PPE	6	DY	100	D&M	\$600	
Investigative Waste Management	9	DR	35	ENVEST	\$315	
Contractor Overhead Adjustment			22%	ENVEST	\$69	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	7	EA	2195	D&M	\$15,362	
Full Suite - bacterial count	25	EA	1865	D&M	\$46,625	
Tech memo prep. (performed with structures)						\$0
CHARACTERIZATION COST SUBTOTAL						\$193,819

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Mobilization and General Requirements			10%			\$19,382
CHARACTERIZATION COST SUBTOTAL						\$213,201
Contingencies			20%			\$42,640
Administrative			5%			\$10,660
CHARACTERIZATION COST TOTAL						\$266,501
REMEDICATION CAPITAL						
None Required					\$0	\$0
CONSTRUCTION COST SUBTOTAL						\$0
Mobilization and General Requirements			15%			\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design @15%			15%			\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required					\$0	\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$266,501
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$266,501
Assuming 30 Years at 3%	30	YR	5%			\$266,501
Assuming 30 Years at 3%	30	YR	10%			\$266,501

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU2 - Radium and Strontium Treatment System

Structures

In Situ Treatment (Solidification)

Description:

Contaminants in the radium and strontium leach fields and tank structures would be stabilized in a solidified waste form to effectively immobilize them. Techniques would include injection and jet grouting to emplace the solidifying agent. Verification samples would be collected during treatment to analyze for leachability of contaminants. Characterization is similar to the No Action alternative.

Basis/Assumptions:

The contaminants, primarily radium and strontium, have low diffusion coefficients in a cement matrix. Injection using high pressure pumps to drive solidification agents would be used for the tanks and other structures. Jet grouting would be applied at the leach fields to solidify large volumes of soil and cobbles. Mobilization and decontamination costs for treatment equipment are assumed to be the same as those for drilling equipment.

Assumed Volumes

Structure	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks		14400 gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Strontium-90 Structures						
Imhof Tank		46000 gal. cap.		6150	228	174
Total Structure Volume				8893	329	252

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$223
Electromagnetics	1	HR	135	D&M	\$135	
Mobilization			15%	D&M	\$20	
Analysis and Report Prep.			50%	D&M	\$68	
Backhoe Exploration & Sampling						\$33,232
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	
Sample Analyses						
Full Suite	3	EA	2195	D&M	\$6,584	
Partial Suite	14	EA	1807	D&M	\$25,298	
Concrete Coring & Analysis						\$10,199
Coring and Sawing	18	HR	88	D&M	\$1,575	
Standby time			37%	D&M	\$583	
Sample Analysis	11	EA	731	D&M	\$8,041	
Wipe Samples						\$10,965
Chemical Analysis	15	EA	731	D&M	\$10,965	
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$28,980
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
Sample Analyses						
Full Suite	1	EA	2195	D&M	\$2,195	
Partial Suite	14	EA	1865	D&M	\$26,110	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Concrete Coring & Analysis						\$9,839
Coring and Sawing	15	HR	88	D&M	\$1,313	
Standby time			37%	D&M	\$486	
Sample Analysis	11	EA	731	D&M	\$8,041	
Wipe Samples						\$10,965
Chemical Analysis	15	EA	731	D&M	\$10,965	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COST SUBTOTAL						\$109,457
Mobilization and General Requirements			10%			\$10,946
CHARACTERIZATION COST SUBTOTAL						\$120,403
Contingencies			20%			\$24,081
Administrative			5%			\$6,020
CHARACTERIZATION COST TOTAL						\$150,504
REMEDIALTION CAPITAL						
Treatability Testing						\$840
Soil/Sample Preparation	8	HR	70	PNL past exp.	\$560	
Reporting	4	HR	70	PNL past exp.	\$280	
Grouting						\$90,849
Mobilization (incl. equip. decon.)	1	EA	9000	D&M	\$9,000	
Injection Grouting	252	M ³	325	Appendix B	\$81,849	
Verification Sampling						\$13,747
Mobilization (incl. decon.)	1	EA	9000	D&M	\$9,000	
Drilling (2 borehole to 10' - 4 samples)	20	FT	36	D&M	\$720	
Geologist Labor	8	HR	60	D&M	\$480	
PPE	1	DY	100	D&M	\$100	
Investigative Waste Management	1	DR	35	ENVEST	\$35	
Contractor Overhead Adjustment			22%	ENVEST	\$8	
TCLP Analysis	4	EA	851	OHM	\$3,404	
CONSTRUCTION COST SUBTOTAL						\$105,436
Mobilization and General Requirements			15%			\$15,815
CONSTRUCTION COST SUBTOTAL						\$121,251
Contingencies						
Bid Contingency			10%			\$12,125
Scope Contingency			20%			\$24,250
Other Costs						
Administrative			5%			\$6,063
Services During Construction			10%			\$12,125
Legal			5%			\$6,063
IMPLEMENTATION COST TOTAL						\$181,877
Engineering/Design @15%			15%			\$27,282
CAPITAL COST TOTAL						\$209,158
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ESTIMATED CHARACTERIZATION						\$150,504
ESTIMATED CAPITAL COST (from above)						\$209,158
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$359,662
Assuming 30 Years at 3%	30	YR	5%			\$359,662
Assuming 30 Years at 3%	30	YR	10%			\$359,662

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination and physical properties are unknown and this will influence in situ treatment costs.

OU2 - Radium and Strontium Treatment System
Soils and Cobbles
In Situ Treatment (Solidification)

Description:

Contaminants in the radium and strontium leach fields and tank structures would be stabilized in a solidified waste form to effectively immobilize them. Techniques would include injection and jet grouting to emplace the solidifying agent. Verification samples would be collected during treatment to analyze for leachability of contaminants. Characterization is similar to No Action alternative except that some physical analyses will be performed.

Basis/Assumptions:

The contaminants, primarily radium and strontium, have low diffusion coefficients in a cement matrix. Injection using high pressure pumps to drive solidification agents would be used for the tanks and other structures. Jet grouting would be applied at the leach fields to solidify large volumes of soil and cobbles. Mobilization and decontamination costs for treatment equipment is assumed to be similar to that of drilling equipment.

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Strontium-90 Structures						
Imhof Tank	46000	gal. cap.		6150	228	174
Volume of Structures				8893	329	252
Volume of soil, cobble, and structures						
Radium-226 tanks, drywells and trench					1327	1015
Strontium-90 Imhoff Tank and leachfields					1126	861
Total Volume					2453	1876
Total of Soil and Cobble only (Total - Volume of Structures)					2124	1624

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Soil Borings, Sampling, and Analysis						\$122,126
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (6)	180	FT	36	D&M	\$6,480	
Standby			7%	D&M	\$454	
Geologist Labor	48	HR	60	D&M	\$2,880	
PPE	6	DY	100	D&M	\$600	
Investigative Waste Management	13	DR	35	ENVEST	\$455	
Contractor Overhead Adjustment			22%	ENVEST	\$100	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	6	EA	2195	D&M	\$13,167	
Full Suite - bacterial count	25	EA	2150	D&M	\$53,750	
Partial Suite	20	EA	1762	D&M	\$35,240	
Physical Testing						\$4,300
Soil Physics Analyses	65	EA	66	D&M	\$4,300	
Survey Locations						\$1,220
Field survey	8	HR	145	D&M	\$1,160	
Data Reduction/Reporting	1	HR	60	D&M	\$60	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Strontium-90 Imhoff Treatment System						
Soil Borings, Sampling, and Analysis						\$70,473
Borehole installation (6)	120	FT	36	D&M	\$4,320	
Standby			7%	D&M	\$302	
Geologist Labor	48	HR	60		\$2,880	
PPE	6	DY	100	D&M	\$600	
Investigative Waste Management	9	DR	35	ENVEST	\$315	
Contractor Overhead Adjustment			22%	ENVEST	\$69	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	7	EA	2195	D&M	\$15,362	
Full Suite - bacterial count	25	EA	1865	D&M	\$46,625	
Physical Testing						\$3,109
Soil Physics Analyses	47	EA	66	D&M	\$3,109	
CHARACTERIZATION COST SUBTOTAL						\$203,628
Mobilization and General Requirements			10%			\$20,363
CHARACTERIZATION COST SUBTOTAL						\$223,990
Contingencies			20%			\$44,798
Administrative			5%			\$11,200
CHARACTERIZATION COST TOTAL						\$279,988
REMEDIALTION CAPITAL						
Treatability Testing						\$840
Soil/Sample Preparation	8	HR	70	PNL	\$560	
Reporting	4	HR	70	PNL	\$280	
Grouting						\$536,709
Mobilization (incl. equip. decon.)	1	EA	9000	D&M	\$9,000	
Jet Grouting	1624	M ³	325	Appendix B	\$527,709	
Verification Sampling						\$19,011
Mobilization (incl. decon.)	1	EA	9000	D&M	\$9,000	
Drilling (4 borehole to 18' - 8 samples)	52	FT	36	D&M	\$1,872	
Geologist Labor	16	HR	60	D&M	\$960	
PPE	2	DY	100	D&M	\$200	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
TCLP Analysis	8	EA	851	OHM	\$6,808	
CONSTRUCTION COST SUBTOTAL						\$556,560
Mobilization and General Requirements			15%			\$83,484
CONSTRUCTION COST SUBTOTAL						\$640,044
Contingencies						
Bid Contingency			10%			\$64,004
Scope Contingency			20%			\$128,009
Other Costs						
Administrative			5%			\$32,002
Services During Construction			10%			\$64,004
Legal			5%			\$32,002
IMPLEMENTATION COST TOTAL						\$960,066
Engineering/Design @15%			15%			\$144,010
CAPITAL COST TOTAL						\$1,104,076
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$279,988
ESTIMATED CAPITAL COST (from above)						\$1,104,076
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$1,384,064
Assuming 30 Years at 3%	30	YR	5%			\$1,384,064
Assuming 30 Years at 3%	30	YR	10%			\$1,384,064

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination and physical properties are unknown and this will influence in situ treatment costs.

OU2 - Radium and Strontium Treatment System

Structures

Remove and On Site Disposal

Description:

OU2 consists of the radium and strontium treatment and leach field systems. Structures at OU2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Concrete slab demolition will be required. All structural material would be disposed of on site in a RCRA-designed landfill.

Characterization will be limited to literature review and geophysical survey to locate the distribution box, pipelines, and strontium leachfields.

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Total excavated volume for disposal is 2453 cu yds (1327 cu yds for radium system and 1126 cu yds for strontium system). Cost for building landfill included in unit cost. Permit not needed for landfill. Landfill design is as if permitted. Waste stabilization won't be necessary.

The assumed dimensions for excavation are:

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Strontium-90 Structures						
Imhoff Tank	46000	gal. cap.		6150	228	174
Volume of Structures				11637	431	330
Volume of soil, cobble, and structures						
Radium-226 tanks, drywells and trench					1327	1015
Strontium-90 Imhoff Tank and leachfields					1126	861
Total Volume					2453	1876
Total of Soil and Cobble only (Total - Volume of Structures)					2022	1546

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
CHARACTERIZATION COST SUBTOTAL						\$4,937
Mobilization and General Requirements			10%			\$494
CHARACTERIZATION COST SUBTOTAL						\$5,430
Contingencies			20%			\$1,086
Administrative			5%			\$272
CHARACTERIZATION COST TOTAL						\$6,788
REMEDIATION CAPITAL						
Radium Treatment and Leach Field System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	102	CY	74.87	ENVEST		\$7,608
Material	0.07	EA	21324	ENVEST	\$1,564	
Labor	0.07	EA	42045	ENVEST	\$3,085	
Equipment	0.07	EA	21628	ENVEST	\$1,587	
Contractor Overhead Adjustment			22%	ENVEST	\$1,372	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$3,347
(incl. capital for RCRA landfill + \$1/yd ³ for transport)	102	CY	27	ENVEST	\$2,744	
Contractor Overhead Adjustment			22%	ENVEST	\$604	
Strontium-90 Imhoff Treatment System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	228	CY	71.31	ENVEST		\$16,243
Material	0.20	EA	13845	ENVEST	\$2,831	
Labor	0.20	EA	35376	ENVEST	\$7,233	
Equipment	0.20	EA	15896	ENVEST	\$3,250	
Contractor Overhead Adjustment			22%	ENVEST	\$2,929	
Waste Classification Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$7,503
(incl. capital for RCRA landfill + \$1/yd ³ for transport)	228	CY	27	ENVEST	\$6,150	
Contractor Overhead Adjustment			22%	ENVEST	\$1,353	
CONSTRUCTION COST SUBTOTAL						\$63,500
Mobilization and General Requirements			15%			\$9,525
CONSTRUCTION COST SUBTOTAL						\$73,025
Contingencies						
Bid Contingency			10%			\$7,303
Scope Contingency			20%			\$14,605
Other Costs						
Administrative			5%			\$3,651
Services During Construction			10%			\$7,303
Legal			5%			\$3,651
IMPLEMENTATION COST TOTAL						\$109,538
Engineering/Design @15%			15%			\$16,431
CAPITAL COST TOTAL						\$125,969

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	329	CY	2	ENVEST	\$791	\$964
Contractor Overhead Adjustment			22%	ENVEST	\$174	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$964

PRESENT WORTH COSTS

PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS

Assuming annual O&M cost for	30	YR	3%			\$18,903
Assuming annual O&M cost for	30	YR	5%			\$14,826
Assuming annual O&M cost for	30	YR	10%			\$9,092

ESTIMATED CHARACTERIZATION

\$6,788

ESTIMATED CAPITAL COST (from above)

\$125,969

TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST

Assuming 30 Years at 3%	30	YR	3%			\$147,582
Assuming 30 Years at 3%	30	YR	5%			\$147,582
Assuming 30 Years at 3%	30	YR	10%			\$141,848

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs.

OU2 - Radium and Strontium Treatment System

Soil and Cobble

Remove and On Site Disposal

Description:

OU-2 consists of the radium and strontium treatment and leach field systems. Structures at OU2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Cobbles in trenches and dry wells would also be dug up. All soils and cobbles would be disposed of on site in a RCRA-designed landfill.

Characterization will be limited to literature review and geophysical survey to locate the distribution box, pipelines, and strontium leachfields.

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Total excavated volume for disposal is 2453 yd³ (1327 yd³ for radium system and 1126 yd³ for strontium system). The soil volume estimate assumes that contamination has not migrated more than 2 ft from structures and leachfield. Also, a 10% overdig is assumed. The strontium leachfields will be excavated as one unit.

Cost for building landfill included in unit cost. Permit not needed for landfill. Landfill design is as if permitted. Waste stabilization won't be necessary.

The assumed dimensions for excavation are:

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Strontium-90 Structures						
Imhoff Tank	46000	gal. cap.		6150	228	174
Volume of Structures				11637	431	330
Volume of soil, cobble, and structures						
Radium-226 tanks, drywells and trench					1327	1015
Strontium-90 Imhoff Tank and leachfields					1126	861
Total Volume					2453	1876
Total of Soil and Cobble only (Total - Volume of Structures)					2022	1546

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
CHARACTERIZATION COST SUBTOTAL						\$4,937
Mobilization and General Requirements			10%			\$494
CHARACTERIZATION COST SUBTOTAL						\$5,430
Contingencies			20%			\$1,086
Administrative			5%			\$272
CHARACTERIZATION COST TOTAL						\$6,788
REMEDIATION CAPITAL						
Radium Treatment and Leach Field System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	1225	CY	64.81	ENVEST		\$79,412
Material	0.88	EA	21324	ENVEST	\$18,867	
Labor	0.88	EA	42045	ENVEST	\$37,200	
Equipment	0.88	EA	21628	ENVEST	\$19,136	
Contractor Overhead Adjustment			22%	ENVEST	\$4,210	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$40,364
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	1225	CY	27	ENVEST	\$33,085	
Contractor Overhead Adjustment			22%	ENVEST	\$7,279	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Strontium-90 Imhoff Treatment System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	898	CY	61.59	ENVEST		\$55,324
Material	0.81	EA	13845	ENVEST	\$11,163	
Labor	0.81	EA	35376	ENVEST	\$28,524	
Equipment	0.81	EA	15896	ENVEST	\$12,817	
Contractor Overhead Adjustment			22%	ENVEST	\$2,820	
Waste Classification Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$29,588
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	898	CY	27	ENVEST	\$24,252	
Contractor Overhead Adjustment			22%	ENVEST	\$5,335	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$251,048
Mobilization and General Requirements			15%			\$37,657
CONSTRUCTION COST SUBTOTAL						\$288,705
Contingencies						
Bid Contingency			10%			\$28,871
Scope Contingency			20%			\$57,741
Other Costs						
Administrative			5%			\$14,435
Services During Construction			10%			\$28,871
Legal			5%			\$14,435

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
IMPLEMENTATION COST TOTAL						\$433,058
Engineering/Design @15%			15%			\$64,959
CAPITAL COST TOTAL						\$498,016
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	2124	CY	2	ENVEST	\$5,097	\$6,218
Contractor Overhead Adjustment			22%	ENVEST	\$1,121	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$5,097
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$99,897
Assuming annual O&M cost for	30	YR	5%			\$78,349
Assuming annual O&M cost for	30	YR	10%			\$48,046
ESTIMATED CHARACTERIZATION						\$6,788
ESTIMATED CAPITAL COST (from above)						\$498,016
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$583,153
Assuming 30 Years at 3%	30	YR	5%			\$583,153
Assuming 30 Years at 3%	30	YR	10%			\$552,850

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs.

OU2 - Radium and Strontium Treatment System

Structures

Remove and Offsite Disposal

Description:

OU-2 consists of the radium and strontium treatment and leach field systems. Structures at OU-2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Concrete slab demolition will be required. All structural material would be disposed of offsite to the Envirocare Facility in Utah.

Characterization will be limited to literature review and geophysical survey to locate the distribution box, pipelines, and strontium leachfields.

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Total excavated volume for disposal is 2453 yd³ (1327 yd³ for radium system and 1126 yd³ for strontium system). Waste stabilization won't be necessary. Travel distance to Envirocare is 625 miles. Waste will be disposed as low-level radioactive debris.

The assumed dimensions for excavation are:

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Strontium-90 Structures						
Imhoff Tank	46000	gal. cap.		6150	228	174
Volume of Structures				11637	431	330
Volume of soil, cobble, and structures						
Radium-226 tanks, drywells and trench					1327	1015
Strontium-90 Imhoff Tank and leachfields					1126	861
Total Volume					2453	1876
Total of Soil and Cobble only (Total - Volume of Structures)					2022	1546

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
CHARACTERIZATION COST SUBTOTAL						\$4,937
Mobilization and General Requirements			10%			\$494
CHARACTERIZATION COST SUBTOTAL						\$5,430
Contingencies			20%			\$1,086
Administrative			5%			\$272
CHARACTERIZATION COST TOTAL						\$6,788
REMEDIATION CAPITAL						
Radium Treatment and Leach Field System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	102	CY	66.96	ENVEST		\$6,804
Material	0.07	EA	21324	ENVEST	\$1,564	
Labor	0.07	EA	42045	ENVEST	\$3,220	
Equipment	0.07	EA	21628	ENVEST	\$1,656	
Contractor Overhead Adjustment			22%	ENVEST	\$364	
Waste Classification Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Transportation (625 miles to Envirocare in Utah)	102	CY	142	Tri-State	\$14,416	\$14,416
Offsite Disposal (to Envirocare as LLW debris)	102	CY	459	Envirocare	\$46,640	\$46,640
Strontium-90 Imhoff Treatment System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	228	CY	61.59	ENVEST		\$14,029
Material	0.20	EA	13845	ENVEST	\$2,831	
Labor	0.20	EA	35376	ENVEST	\$7,233	
Equipment	0.20	EA	15896	ENVEST	\$3,250	
Contractor Overhead Adjustment			22%	ENVEST	\$715	
Waste Classification Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Transportation (625 miles to Envirocare in Utah)	228	CY	142	Tri-State	\$32,315	\$32,315
Offsite Disposal (to Envirocare as LLW debris)	228	CY	459	Envirocare	\$104,545	\$104,545
CONSTRUCTION COST SUBTOTAL						\$247,549
Mobilization and General Requirements			15%			\$37,132
CONSTRUCTION COST SUBTOTAL						\$284,681
Contingencies						
Bid Contingency			10%			\$28,468
Scope Contingency			20%			\$56,936
Other Costs						
Administrative			5%			\$14,234
Services During Construction			10%			\$28,468
Legal			5%			\$14,234
IMPLEMENTATION COST TOTAL						\$427,022
Engineering/Design @15%			15%			\$64,053
CAPITAL COST TOTAL						\$491,075

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ANNUAL OPERATIONS & MAINTENANCE COST						
None Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$6,788
ESTIMATED CAPITAL COST (from above)						\$491,075
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$497,863
Assuming 30 Years at 3%	30	YR	5%			\$497,863
Assuming 30 Years at 3%	30	YR	10%			\$497,863

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs. Waste classification will also influence disposal costs.

OU2 - Radium and Strontium Treatment System

Soil and Cobble

Remove and Dispose Offsite

Description:

OU2 consists of the radium and strontium treatment and leach field systems. Structures at OU2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Cobbles in trenches and dry wells would also be dug up. All soils and cobbles would be classified as low-level radioactive soil and disposed of at the Envirocare Facility in Utah.

Characterization will be limited to literature review and geophysical survey to locate the distribution box, pipelines, and strontium leachfields

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Total excavated volume for disposal is 2453 yd³ (1327 yd³ for radium system and 1126 yd³ for strontium system). The soil volume estimate assumes that contamination has not migrated more than 2 ft from structures and leachfield. Also, a 10% overdig is assumed. The strontium leachfields will be excavated as one unit.

The assumed dimensions for excavation are:

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Strontium-90 Structures						
Imhoff Tank	46000	gal. cap.		6150	228	174
Volume of Structures				11637	431	330
Volume of soil, cobble, and structures						
Radium-226 tanks, drywells and trench					1327	1015
Strontium-90 Imhoff Tank and leachfields					1126	861
Total Volume					2453	1876
Total of Soil and Cobble only (Total - Volume of Structures)					2022	1546

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
CHARACTERIZATION COST SUBTOTAL						\$4,937
Mobilization and General Requirements			10%			\$494
CHARACTERIZATION COST SUBTOTAL						\$5,430
Contingencies			20%			\$1,086
Administrative			5%			\$272
CHARACTERIZATION COST TOTAL						\$6,788
REMEDIALTION CAPITAL						
Radium Treatment and Leach Field System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	1225	CY	66.96	ENVEST		\$82,052
Material	0.88	EA	21324	ENVEST	\$18,861	
Labor	0.88	EA	42045	ENVEST	\$38,826	
Equipment	0.88	EA	21628	ENVEST	\$19,971	
Contractor Overhead Adjustment			22%	ENVEST	\$4,394	
Waste Classification Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Transportation (625 miles to Envirocare in Utah)	1225	CY	142	Tri-State	\$173,852	\$173,852
Offsite Disposal (to Envirocare as LLW soil)	1225	CY	216	Envirocare	\$264,684	\$264,684
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Strontium-90 Imhoff Treatment System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	898	CY	61.58	ENVEST		\$55,310
Material	0.806104	EA	13845	ENVEST	\$11,161	
Labor	0.806104	EA	35376	ENVEST	\$28,517	
Equipment	0.806104	EA	15896	ENVEST	\$12,814	
Contractor Overhead Adjustment			22%	ENVEST	\$2,819	
Waste Classification Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Transportation (625 miles to Envirocare in Utah)	898	CY	142	Tri-State	\$127,437	\$127,437
Offsite Disposal (to Envirocare as LLW soil)	898	CY	216	Envirocare	\$194,018	\$194,018
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$943,713
Mobilization and General Requirements			15%			\$141,557
CONSTRUCTION COST SUBTOTAL						\$1,085,269
Contingencies						
Bid Contingency			10%			\$108,527
Scope Contingency			20%			\$217,054
Other Costs						
Administrative			5%			\$54,263
Services During Construction			10%			\$108,527
Legal			5%			\$54,263
IMPLEMENTATION COST TOTAL						\$1,627,904
Engineering/Design @15%			15%			\$244,186
CAPITAL COST TOTAL						\$1,872,090

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ANNUAL OPERATIONS & MAINTENANCE COST						
None Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$6,788
ESTIMATED CAPITAL COST (from above)						\$1,872,090
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$1,878,877
Assuming 30 Years at 3%	30	YR	5%			\$1,878,877
Assuming 30 Years at 3%	30	YR	10%			\$1,878,877

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs. Waste classification will also influence disposal costs.

OU2 - Radium and Strontium Treatment System

Structures

Remove, Treat, and Dispose Onsite

Description:

OU2 consists of the radium and strontium treatment and leach field systems. Structures at OU2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Concrete demolition will be required. All structural material will be treated by mechanical screening to separate debris from soils. Fine (soil/cobble) fraction (20%) would be treated by wet soil washing. Clean materials (75% of the soil fraction) would be returned to the site. Remaining material (debris, and contaminated soil fraction) would be disposed of on site in a RCRA-design landfill.

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Assume tanks are empty. Total excavated volume for disposal is 2453 yd³ (1327 yd³ for radium system and 1126 yd³ for strontium system). Assume 20% of excavated material would be soil washed; 75% of this would be returned to the site. Waste stabilization won't be necessary. Waste will be disposed of on site.

The assumed dimensions for excavation are:

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Mechanical Screening						
Resulting debris fraction (80%)				2195	81	62
Resulting soil fraction (20%)				549	20	16
Soil Washing						
Resulting clean fraction (75%)				412	15	12
Resulting contaminated fraction (25%)				137	5	4
Strontium-90 Structures						
Imhoff Tank	46000	gal. cap.		6150	228	174
Mechanical Screening						
Resulting debris fraction (80%)				4920	182	139
Resulting soil fraction (20%)				1230	46	35
Soil Washing						
Resulting clean fraction (75%)				4612	171	131
Resulting contaminated fraction (25%)				1537	57	44
Volume of Structures				14929	553	423

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	
Concrete Coring & Analysis						\$10,199
Coring and Sawing	18	HR	88	D&M	\$1,575	
Standby time			37%	D&M	\$583	
Sample Analysis	11	EA	731	D&M	\$8,041	
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
Concrete Coring & Analysis						\$9,839
Coring and Sawing	15	HR	88	D&M	\$1,313	
Standby time			37%	D&M	\$486	
Sample Analysis	11	EA	731	D&M	\$8,041	
CHARACTERIZATION COST SUBTOTAL						\$24,974
Mobilization and General Requirements			10%			\$2,497
CHARACTERIZATION COST SUBTOTAL						\$27,472
Contingencies			20%			\$5,494
Administrative			5%			\$1,374
CHARACTERIZATION COST TOTAL						\$34,340
REMEDICATION CAPITAL						
Radium Treatment and Leach Field System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	102	CY	64.81	ENVEST		\$6,585
Material	0.07	EA	21324	ENVEST	\$1,564	
Labor	0.07	EA	42045	ENVEST	\$3,085	
Equipment	0.07	EA	21628	ENVEST	\$1,587	
Contractor Overhead Adjustment			22%	ENVEST	\$349	
Treatment						\$3,374
Mechanical Screening	102	CY	1	Appendix B	\$102	
Soil Washing	20	CY	132	ENVEST	\$2,683	
Contractor Overhead Adjustment			22%	ENVEST	\$590	
Waste Classification Sampling						\$43,200
Sample Analyses (Composite)	12	EA	3600	OHM	\$43,200	
Onsite Disposal						\$2,845
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	86	CY	27	ENVEST	\$2,332	
Contractor Overhead Adjustment			22%	ENVEST	\$513	
Strontium-90 Imhoff Treatment System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	228	CY	61.59	ENVEST		\$14,029
Material	0.20	EA	13845	ENVEST	\$2,831	
Labor	0.20	EA	35376	ENVEST	\$7,233	
Equipment	0.20	EA	15896	ENVEST	\$3,250	
Contractor Overhead Adjustment			22%	ENVEST	\$715	
Treatment						\$7,564
Mechanical Screening	228	CY	1	Appendix B	\$228	
Soil Washing	46	CY	132	ENVEST	\$6,013	
Contractor Overhead Adjustment			22%	ENVEST	\$1,323	
Waste Classification Sampling						\$43,200
Sample Analyses (Composite)	12	EA	3600	OHM	\$43,200	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Onsite Disposal (incl. capital for RCRA landfill + \$1/yd ³ for transport)	194	CY	27	ENVEST	\$5,227	\$6,377
Contractor Overhead Adjustment			22%	ENVEST	\$1,150	
CONSTRUCTION COST SUBTOTAL						\$127,174
Mobilization and General Requirements			15%			\$19,076
CONSTRUCTION COST SUBTOTAL						\$146,250
Contingencies						
Bid Contingency			10%			\$14,625
Scope Contingency			20%			\$29,250
Other Costs						
Administrative			5%			\$7,313
Services During Construction			10%			\$14,625
Legal			5%			\$7,313
IMPLEMENTATION COST TOTAL						\$219,375
Engineering/Design @15%			15%			\$32,906
CAPITAL COST TOTAL						\$252,282
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	280	CY	2	ENVEST	\$672	\$820
Contractor Overhead Adjustment			22%	ENVEST	\$148	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$672
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$13,170
Assuming annual O&M cost for	30	YR	5%			\$10,329
Assuming annual O&M cost for	30	YR	10%			\$6,334
ESTIMATED CHARACTERIZATION						\$34,340
ESTIMATED CAPITAL COST (from above)						\$252,282
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$296,951
Assuming 30 Years at 3%	30	YR	5%			\$296,951
Assuming 30 Years at 3%	30	YR	10%			\$292,956

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs. Waste classification will also influence disposal costs.

OU2 - Radium and Strontium Treatment System

Soil and Cobble

Remove, Treat, and Dispose Onsite

Description:

OU-2 consists of the radium and strontium treatment and leach field systems. Structures at OU2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Cobbles in trenches and dry wells would also be dug up. All soils will be treated by mechanical screening and wet soil washing. Clean materials (75%) would be returned to the site. Remaining material (contaminated soil fraction) would be disposed of onsite.

Characterization will be limited to literature review and geophysical survey to locate the distribution box, pipelines, and strontium leachfields

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Total excavated volume for disposal is 2453 yd³ (1327 yd³ for radium system and 1126 yd³ for strontium system). The soil volume estimate assumes that contamination has not migrated more than 2 ft from structures and leachfield. Also, a 10% overdig is assumed. The strontium leachfields will be excavated as one unit. Assumes 75% of the soils would be returned to the site. Waste stabilization won't be necessary. Waste will be disposed of onsite in a RCRA-design landfill.

The assumed dimensions for excavation are:

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Strontium-90 Structures						
Imhoff Tank	46000	gal. cap.		6150	228	174
Volume of Structures				11637	431	330
Volume of soil, cobble, and structures						
Radium-226 tanks, drywells and trench					1327	1015
Strontium-90 Imhoff Tank and leachfields					1126	861
Total Volume					2453	1876
Total of Soil and Cobble only (Total - Volume of Structures)					2022	1546

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	
Physical Testing						\$660
Soil Physics Analyses	10	EA	66	D&M	\$660	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
Physical Testing						\$330
Soil Physics Analyses	5	EA	66	D&M	\$330	
CHARACTERIZATION COST SUBTOTAL						\$5,927
Mobilization and General Requirements			10%			\$593
CHARACTERIZATION COST SUBTOTAL						\$6,519
Contingencies			20%			\$1,304
Administrative			5%			\$326
CHARACTERIZATION COST TOTAL						\$8,149
REMEDIALTION CAPITAL						
Radium Treatment and Leach Field System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	1225	CY	66.96	ENVEST		\$82,052
Material	0.88	EA	21324	ENVEST	\$18,861	
Labor	0.88	EA	42045	ENVEST	\$38,826	
Equipment	0.88	EA	21628	ENVEST	\$19,971	
Contractor Overhead Adjustment			22%	ENVEST	\$4,394	
Treatment						\$198,562
Mechanical Screening	1225	CY	1	Appendix B	\$1,225	
Soil Washing	1225	CY	132	ENVEST	\$161,751	
Contractor Overhead Adjustment			22%	ENVEST	\$35,585	
Waste Classification Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Onsite Disposal						\$10,091
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	306	CY	27	ENVEST	\$8,271	
Contractor Overhead Adjustment			22%	ENVEST	\$1,820	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Strontium-90 Imhoff Treatment System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	898	CY	61.58	ENVEST		\$55,310
Material	0.806104	EA	13845	ENVEST	\$11,161	
Labor	0.806104	EA	35376	ENVEST	\$28,517	
Equipment	0.806104	EA	15896	ENVEST	\$12,814	
Contractor Overhead Adjustment			22%	ENVEST	\$2,819	
Treatment						\$145,550
Mechanical Screening	898	CY	1	Appendix B	\$898	
Soil Washing	898	CY	132	ENVEST	\$118,567	
Contractor Overhead Adjustment			22%	ENVEST	\$26,085	
Waste Classification Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Onsite Disposal						\$7,397
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	225	CY	27	ENVEST	\$6,063	
Contractor Overhead Adjustment			22%	ENVEST	\$1,334	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$574,121
Mobilization and General Requirements			15%			\$86,118

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CONSTRUCTION COST SUBTOTAL						\$660,239
Contingencies						
Bid Contingency			10%			\$66,024
Scope Contingency			20%			\$132,048
Other Costs						
Administrative			5%			\$33,012
Services During Construction			10%			\$66,024
Legal			5%			\$33,012
IMPLEMENTATION COST TOTAL						\$990,359
Engineering/Design @15%			15%			\$148,554
CAPITAL COST TOTAL						\$1,138,913
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	531	CY	2	ENVEST	\$1,274	\$1,554
Contractor Overhead Adjustment			22%	ENVEST	\$280	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$1,554
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$30,469
Assuming annual O&M cost for	30	YR	5%			\$23,896
Assuming annual O&M cost for	30	YR	10%			\$14,654
ESTIMATED CHARACTERIZATION						\$8,149
ESTIMATED CAPITAL COST (from above)						\$1,138,913
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$1,170,958
Assuming 30 Years at 3%	30	YR	5%			\$1,170,958
Assuming 30 Years at 3%	30	YR	10%			\$1,161,716

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs. Waste classification will also influence disposal costs.

OU2 - Radium and Strontium Treatment System

Structures

Remove, Treat, and Dispose Offsite

Description:

OU2 consists of the radium and strontium treatment and leach field systems. Structures at OU2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Concrete demolition will be required. All structural material will be treated by mechanical screening to separate debris from soils. Fine (soil/cobble) fraction (20%) would be treated by wet soil washing. Clean materials (75% of the soil fraction) would be returned to the site. Remaining material (debris, and contaminated soil fraction) would be disposed of at the Envirocare Facility in Utah, as low-level waste debris.

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Assume tanks are empty. Total excavated volume for disposal is 2453 yd³ (1327 yd³ for radium system and 1126 yd³ for strontium system). Assume 20% of excavated material would be soil washed; 75% of this would be returned to the site. Waste stabilization won't be necessary. Travel distance to Envirocare is 625 miles. Waste will be disposed as either low-level radioactive debris or low-level soil.

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Mechanical Screening						
Resulting debris fraction (80%)				2195	81	62
Resulting soil fraction (20%)				549	20	16
Soil Washing						
Resulting clean fraction (75%)				412	15	12
Resulting contaminated fraction (25%)				137	5	4
Strontium-90 Structures						
Imhof Tank	46000	gal. cap.		6150	228	174
	39.5	19.5	8			
Mechanical Screening						
Resulting debris fraction (80%)				4920	182	139
Resulting soil fraction (20%)				1230	46	35
Soil Washing						
Resulting clean fraction (75%)				4612	171	131
Resulting contaminated fraction (25%)				1537	57	44
Volume of Structures				14929	553	423

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	
Concrete Coring & Analysis						\$10,199
Coring and Sawing	18	HR	88	D&M	\$1,575	
Standby time			37%	D&M	\$583	
Sample Analysis	11	EA	731	D&M	\$8,041	
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
Concrete Coring & Analysis						\$9,839
Coring and Sawing	15	HR	88	D&M	\$1,313	
Standby time			37%	D&M	\$486	
Sample Analysis	11	EA	731	D&M	\$8,041	
CHARACTERIZATION COST SUBTOTAL						\$24,974
Mobilization and General Requirements			10%			\$2,497
CHARACTERIZATION COST SUBTOTAL						\$27,472
Contingencies			20%			\$5,494
Administrative			5%			\$1,374
CHARACTERIZATION COST TOTAL						\$34,340

REMEDIALTION CAPITAL

Radium Treatment and Leach Field System

Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	102	CY	64.81	ENVEST		\$6,585
Material	0.07	EA	21324	ENVEST	\$1,564	
Labor	0.07	EA	42045	ENVEST	\$3,085	
Equipment	0.07	EA	21628	ENVEST	\$1,587	
Contractor Overhead Adjustment			22%	ENVEST	\$349	
Treatment						\$3,374
Mechanical Screening	102	CY	1	Appendix B	\$102	
Soil Washing	20	CY	132	ENVEST	\$2,683	
Contractor Overhead Adjustment			22%	ENVEST	\$590	
Waste Classification Sampling						\$43,200
Sample Analyses (Composite)	12	EA	3600	OHM	\$43,200	
Transportation (625 miles to Envirocare in Utah)	86	CY-M	142	Tri-State	\$12,254	\$12,254
Off-Site Disposal (to Envirocare)						\$38,409
Low-Level Debris Disposal	81	CY	459	Envirocare	\$37,312	
Low-Level Soil Disposal	5	CY	216	Envirocare	\$1,097	
Confirmatory Sampling						\$0
Sample Analyses	0	EA	2195	D&M	\$0	

Strontium-90 Imhoff Treatment System

Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	228	CY	61.59	ENVEST		\$14,029
Material	0.20	EA	13845	ENVEST	\$2,831	
Labor	0.20	EA	35376	ENVEST	\$7,233	
Equipment	0.20	EA	15896	ENVEST	\$3,250	
Contractor Overhead Adjustment			22%	ENVEST	\$715	
Treatment						\$7,564
Mechanical Screening	228	CY	1	Appendix B	\$228	
Soil Washing	46	CY	132	ENVEST	\$6,013	
Contractor Overhead Adjustment			22%	ENVEST	\$1,323	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Waste Classification Sampling						\$43,200
Sample Analyses (Composite)	12	EA	3600	OHM	\$43,200	
Transportation (625 miles to Envirocare in Utah)	194	CY-M	142	Tri-State	\$27,467	\$27,467
Off-Site Disposal (to Envirocare)						\$86,096
Low-Level Debris Disposal	182	CY	459	Envirocare	\$83,636	
Low-Level Soil Disposal	11	CY	216	Envirocare	\$2,460	
CONSTRUCTION COST SUBTOTAL						\$282,178
Mobilization and General Requirements			15%			\$42,327
CONSTRUCTION COST SUBTOTAL						\$324,505
Contingencies						
Bid Contingency			10%			\$32,450
Scope Contingency			20%			\$64,901
Other Costs						
Administrative			5%			\$16,225
Services During Construction			10%			\$32,450
Legal			5%			\$16,225
IMPLEMENTATION COST TOTAL						\$486,757
Engineering/Design @15%			15%			\$73,014
CAPITAL COST TOTAL						\$559,771
ANNUAL OPERATIONS & MAINTENANCE COST						
None Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$34,340
ESTIMATED CAPITAL COST (from above)						\$559,771
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$594,111
Assuming 30 Years at 3%	30	YR	5%			\$594,111
Assuming 30 Years at 3%	30	YR	10%			\$594,111

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs. Waste classification will also influence disposal costs.

OU2 - Radium and Strontium Treatment System

Soil and Cobble

Remove, Treat, and Dispose Offsite

Description:

OU-2 consists of the radium and strontium treatment and leach field systems. Structures at OU2, including Imhoff tanks, radium treatment tanks, manholes, distribution box, and pipelines, would be removed and disposed of by excavating surrounding soil for access and then removing the structures. Cobbles in trenches and dry wells would also be dug up. All soils will be treated by mechanical screening and wet soil washing. Clean materials (75%) would be returned to the site. Remaining material (contaminated soil fraction) would be disposed of at the Envirocare Facility in Utah, as low-level radioactive soils.

Characterization will be limited to literature review and geophysical survey to locate the distribution box, pipelines, and strontium leachfields.

Assumptions:

Assume that Imhoff building has been removed to gain access to Imhoff tanks. Total excavated volume for disposal is 2453 yd³ (1327 yd³ for radium system and 1126 yd³ for strontium system). The soil volume estimate assumes that contamination has not migrated more than 2 ft from structures and leachfield. Also, a 10% overdig is assumed. The strontium leachfields will be excavated as one unit. Assumes 75% of the soils would be returned to the site. Waste stabilization won't be necessary. Travel distance to Envirocare is 625 miles. Waste will be disposed as either low-level radioactive debris or low-level soil.

The assumed dimensions for excavation are:

Ra-226 Treatment System

Tanks: 30 ft x 6 ft x 8 ft

Trench: 91 ft x 3 ft x 14 ft

Dry wells: 3 ft-dia. x 40 ft each

Sr-90 Treatment System

Imhoff tanks: 50 ft x 30 ft x 10 ft

Leach field: 50 ft x 30 ft x 7 ft

Concrete Slab: 30 ft x 20 ft

Assumed Volumes

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
Radium-226 Structures						
Radium Dry Wells (*3)	3	dia	8	170	6	5
Ra Septic Tanks	14400	gal. cap.		1925	71	55
Distribution Box	10	8	8	640	24	18
Piping	0.333333	dia.	100	9	0	0
Volume of Radium Structures				2744	102	78
Strontium-90 Structures						
Imhoff Tank	46000	gal. cap.		6150	228	174
Volume of Structures				11637	431	330
Volume of soil, cobble, and structures						
Radium-226 tanks, drywells and trench					1327	1015
Strontium-90 Imhoff Tank and leachfields					1126	861
Total Volume					2453	1876
Total of Soil and Cobble only (Total - Volume of Structures)					2022	1546

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Radium Treatment and Leach Field System						
Literature Review (for both sites)	40	HR	60		\$2,400	\$2,400
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$1,350
Backhoe exploration	10	HR	95	D&M	\$950	
Laborer	10	HR	40	D&M	\$400	
Physical Testing						\$660
Soil Physics Analyses	10	EA	66	D&M	\$660	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Strontium-90 Imhoff Treatment System						
Geophysical Survey						\$256
Ground Penetrating Radar	1	HR	155	D&M	\$155	
Mobilization			15%	D&M	\$23	
Analysis and Report Prep.			50%	D&M	\$78	
Backhoe Exploration & Sampling						\$675
Backhoe exploration	5	HR	95	D&M	\$475	
Laborer	5	HR	40	D&M	\$200	
Physical Testing						\$330
Soil Physics Analyses	5	EA	66	D&M	\$330	
CHARACTERIZATION COST SUBTOTAL						\$5,927
Mobilization and General Requirements			10%			\$593
CHARACTERIZATION COST SUBTOTAL						\$6,519
Contingencies			20%			\$1,304
Administrative			5%			\$326
CHARACTERIZATION COST TOTAL						\$8,149
REMEDIALTION CAPITAL						
Radium Treatment and Leach Field System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	1225	CY	66.96	ENVEST		\$82,052
Material	0.88	EA	21324	ENVEST	\$18,861	
Labor	0.88	EA	42045	ENVEST	\$38,826	
Equipment	0.88	EA	21628	ENVEST	\$19,971	
Contractor Overhead Adjustment			22%	ENVEST	\$4,394	
Treatment						\$198,562
Mechanical Screening	1225	CY	1	Appendix B	\$1,225	
Soil Washing	1225	CY	132	ENVEST	\$161,751	
Contractor Overhead Adjustment			22%	ENVEST	\$35,585	
Waste Classification Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Transportation (625 miles to Envirocare in Utah)	306	CY	142	Tri-State	\$43,463	\$43,463
Off-Site Disposal (to Enivorcare)						\$66,171
Low-Level Soil Disposal	306	CY	216	Envirocare	\$66,171	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Strontium-90 Imhoff Treatment System						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc.)	898	CY	61.58	ENVEST		\$55,310
Material	0.806104	EA	13845	ENVEST	\$11,161	
Labor	0.806104	EA	35376	ENVEST	\$28,517	
Equipment	0.806104	EA	15896	ENVEST	\$12,814	
Contractor Overhead Adjustment			22%	ENVEST	\$2,819	
Treatment						\$145,550
Mechanical Screening	898	CY	1	Appendix B	\$898	
Soil Washing	898	CY	132	ENVEST	\$118,567	
Contractor Overhead Adjustment			22%	ENVEST	\$26,085	
Waste Classification Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Transportation (625 miles to Envirocare in Utah)	225	CY	142	Tri-State	\$31,859	\$31,859
Off-Site Disposal (to Enivorcare)						\$48,505
Low-Level Soil Disposal	225	CY	216	Envirocare	\$48,505	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$746,631
Mobilization and General Requirements			15%			\$111,995

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CONSTRUCTION COST SUBTOTAL						\$858,626
Contingencies						
Bid Contingency			10%			\$85,863
Scope Contingency			20%			\$171,725
Other Costs						
Administrative			5%			\$42,931
Services During Construction			10%			\$85,863
Legal			5%			\$42,931
IMPLEMENTATION COST TOTAL						\$1,287,938
Engineering/Design @15%			15%			\$193,191
CAPITAL COST TOTAL						\$1,481,129
ANNUAL OPERATIONS & MAINTENANCE COST						
None Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$8,149
ESTIMATED CAPITAL COST (from above)						\$1,481,129
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 Years at 3%	30	YR	3%			\$1,489,278
Assuming 30 Years at 3%	30	YR	5%			\$1,489,278
Assuming 30 Years at 3%	30	YR	10%			\$1,489,278

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

Extent of contamination is unknown. This will influence excavation and disposal costs. Waste classification will also influence disposal costs.

APPENDIX G - OPERABLE UNIT 3 COST SHEETS

OU-3 Summary

General Response Action	Media	Characterization Costs	Remediation Costs				Total
			Capital	Annual O&M	30 Yr. (5%) Present Worth O&M Costs	30 Yr. (5%) Present Worth Remediation Costs	
No Action	Soil	\$46,052	\$0	\$0	\$0	\$0	\$46,052
Removal and On Site Disposal	Soil	\$0	\$833,360	\$20,415	\$313,823	\$1,147,183	\$1,147,183
Removal and Off Site Disposal	Soil	\$0	\$17,277,693	\$0	\$0	\$17,277,693	\$17,277,693

OU3 - Western Dog Pens

Soil

No Action

Description:

No remedial action is taken, however, characterization is performed to justify leaving the soils in place.

Basis/Assumptions:

It is assumed that all surface structures, including the top surface cover of gravel has been removed as part of D&D efforts.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review						\$2,400
Geologist Labor	40	HR	60	D&M	\$2,400	
Soil Borings	17					\$31,092
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (15 borings to 6 ft; 2 to 20 ft)	130	FT	20	D&M	\$2,600	
Geologist Labor	16	HR	60	D&M	\$960	
PPE	2	DY	100	D&M	\$200	
Investigative Waste Management	9	DR	35	ENVEST	\$315	
Contractor Overhead Adjustment			22%	ENVEST	\$69	
Chemical Sample Analysis (2/boring; incl. bottle prep.)						
Nitrate, Diesel/Kerosene, Pesticides	28	EA	304	D&M	\$8,512	
Gross Alpha & Beta, Ra-226, Sr-90	28	EA	337	D&M	\$9,436	
Survey Locations						\$640
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting	1	HR	60	D&M	\$60	
Tech memo prep.						\$960
Geologist time	16	HR	60	D&M	\$960	
CHARACTERIZATION COST SUBTOTAL						\$33,492
Mobilization and & Gen'l Req'm'ts			10%			\$3,349
CHARACTERIZATION COST SUBTOTAL						\$36,842
Contingencies			20%			\$7,368
Administrative			5%			\$1,842
CHARACTERIZATION COST TOTAL						\$46,052
REMEDIATION CAPITAL						
None Required						\$0
CONSTRUCTION SUBTOTAL						\$0
Mobilization and & Gen'l Req'm'ts			15%			\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design			15%			\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$46,052

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$46,052
Assuming	30	YR	5%			\$46,052
Assuming	30	YR	10%			\$46,052

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The nature and extent of contamination is uncertain. The amount of characterization acceptable to the public, to support a no action alternative is also uncertain. Thus, additional characterization may be necessary, which will increase these costs.

OU3 - Western Dog Pens

Soil

Removal and Onsite Disposal

Description:

Removal and disposal involves excavation, waste classification, and disposal of all soils beneath the gravel surface cover, to a depth of 18 inches. Essentially no characterization will be performed. That portion of the old dog pen area currently beneath the Cellular Biology Laboratory will not be excavated. Soil samples will be collected from stockpiled soils for waste designation purposes, and confirmatory soil samples will be collected from the base of the excavation to ensure that it meets the preliminary remediation goals. Disposal would be to an onsite RCRA-designed landfill.

Basis/Assumptions:

It is assumed that all above ground facilities including the top surface cover of gravel has been removed as part of the D&D efforts, at that there are no underground utilities to be concerned with. The area beneath the Cellular Biology Laboratory will not be excavated. The volume of soil to be excavated is calculated below. This includes at 10 ft wide corridor on all sides of the assumed dog pen boundaries. The disposal costs were estimated by dividing the estimated cost for construction of a RCRA designed landfill, by its cubic yard capacity to get a capital cost on a per cubic yard basis. Annual operating costs were estimated in a similar fashion.

Area	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)
Western Dog Pens	570	230	1.5	196650	7283
Cellular Bio. Lab	80	70	1.5	8400	311
Total (= Pens - Lab)				188250	6972

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
CHARACTERIZATION COST SUBTOTAL						\$0
Mobilization and & Gen'l Req'm'ts			10%			\$0
CHARACTERIZATION COST SUBTOTAL						\$0
Contingencies			20%			\$0
Administrative			5%			\$0
CHARACTERIZATION COST TOTAL						\$0
REMEDIALATION CAPITAL						
Excavation (incl. labor, equipment & material)	6972	CY	18.93	ENVEST		\$161,054
Material	1	EA	61073	ENVEST	\$58,630	
Labor	1	EA	39038	ENVEST	\$37,476	
Equipment	1	EA	37401	ENVEST	\$35,905	
Contractor Overhead Adjustment			22%	ENVEST	\$29,043	
Geologist Labor	40	HR	60	D&M	\$2,400	\$2,400
Waste Designation Soil Sampling						\$18,000
Chemical Sample Analysis (with bottle prep.)	5	EA	3600		\$18,000	
Confirmatory Soil Sampling						\$8,974
Chemical Sample Analysis (with bottle prep.)	14	EA	641	D&M	\$8,974	
Onsite Disposal (incl. capital for RCRA landfill + \$1/yd ³ for transport)	6972	CY	27	ENVEST	\$188,250	\$229,665
Contractor Overhead Adjustment			22%	ENVEST	\$41,415	
CONSTRUCTION SUBTOTAL						\$420,093
Mobilization and & Gen'l Req'm'ts			15%			\$63,014
CONSTRUCTION COST SUBTOTAL						\$483,107
Contingencies						
Bid Contingency			10%			\$48,311
Scope Contingency			20%			\$96,621
Other Costs						
Administrative			5%			\$24,155
Services During Construction			10%			\$48,311
Legal			5%			\$24,155
IMPLEMENTATION COST TOTAL						\$724,661
Engineering/Design			15%			\$108,699
CAPITAL COST TOTAL						\$833,360

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	6972	CY	2	ENVEST	\$16,733	\$20,415
Contractor Overhead Adjustment			22%	ENVEST	\$3,681	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$20,415

PRESENT WORTH COSTS

PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$400,136
Assuming annual O&M cost for	30	YR	5%			\$313,823
Assuming annual O&M cost for	30	YR	10%			\$192,447
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$833,360
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$1,147,183
Assuming	30	YR	5%			\$1,147,183
Assuming	30	YR	10%			\$1,025,807

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The nature and extent of contamination at these facilities is uncertain. This can greatly affect the estimated volumes to be excavated and disposed. Hence the costs are highly uncertain.

OU3 - Western Dog Pens

Soil

Removal and Offsite Disposal

Description:

Removal and disposal involves excavation, waste classification, and disposal of all soils beneath the gravel surface cover, to a depth of 18". Essentially no characterization will be performed. That portion of the old dog pen area currently beneath the Cellular Biology Lab. will not be excavated. Soil samples will be collected from stockpiled soils for waste designation purposes, and confirmatory soil samples will be collected from the base of the excavation to ensure that it meets the preliminary remediation goals. Disposal would be to the Envirocare Disposal Facility in Utah.

Basis/Assumptions:

It is assumed that all above ground facilities including the top surface cover of gravel has been removed as part of the D&D efforts, at that there are no underground utilities to be concerned with. The area beneath the Cellular Biology Laboratory will not be excavated. The volume of soil to be excavated is calculated below. This includes at 10 ft wide corridor on all sides of the assumed dog pen boundaries. The disposal cost were estimated by assuming the soils would meet the Waste Acceptance Criteria for mixed low-level waste soils, and would be transported to and disposed at the Envirocare Facility in Utah.

Area	Length (ft)	Width (ft)	Depth (ft)	Volume (ft³)	Volume (yd³)
Western Dog Pens	570	230	1.5	196650	7283
Cellular Bio. Lab	80	70	1.5	8400	311
Total (Pens - Lab)				188250	6972

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
CHARACTERIZATION COST SUBTOTAL						\$0
Mobilization and & Gen'l Reqm'ts			10%			\$0
CHARACTERIZATION COST SUBTOTAL						\$0
Contingencies			20%			\$0
Administrative			5%			\$0
CHARACTERIZATION COST TOTAL						\$0
REMEDIALATION CAPITAL						
Excavation (incl. labor, equipment & material)	6972	CY	18.93	ENVEST		\$161,054
Material	1	EA	61073	ENVEST	\$58,630	
Labor	1	EA	39038	ENVEST	\$37,476	
Equipment	1	EA	37401	ENVEST	\$35,905	
Contractor Overhead Adjustment			22%	ENVEST	\$29,043	
Geologist Labor	40	HR	60	D&M	\$2,400	\$2,400
Waste Designation Soil Sampling						\$18,000
Chemical Sample Analysis (incl. bottle prep.)	5	EA	3600	D&M	\$18,000	
Confirmatory Soil Sampling						\$8,974
Chemical Sample Analysis (incl. bottle prep.)	14	EA	641	D&M	\$8,974	
Transportation (625 miles to Envirocare in Utah)	6972	CY	142	Tri-State	\$989,184	\$989,184
Offsite Disposal (to Envirocare as RMW soil)	6972	CY	1080	Envirocare	\$7,530,000	\$7,530,000
CONSTRUCTION SUBTOTAL						\$8,709,612
Mobilization and & Gen'l Reqm'ts			15%			\$1,306,442
CONSTRUCTION COST SUBTOTAL						\$10,016,054
Contingencies						
Bid Contingency			10%			\$1,001,605
Scope Contingency			20%			\$2,003,211
Other Costs						
Administrative			5%			\$500,803
Services During Construction			10%			\$1,001,605
Legal			5%			\$500,803
IMPLEMENTATION COST TOTAL						\$15,024,081
Engineering/Design			15%			\$2,253,612
CAPITAL COST TOTAL						\$17,277,693
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$17,277,693
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$17,277,693
Assuming	30	YR	5%			\$17,277,693
Assuming	30	YR	10%			\$17,277,693

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The nature and extent of contamination at these facilities is uncertain. This can greatly affect the estimated volumes to be excavated and disposed. Hence the costs are highly uncertain.

APPENDIX H - OPERABLE UNIT 4 COST SHEETS

OU-4 Summary

General Response Action	Media	Characterization n Costs	Remediation Costs				Total
			Capital	Annual O&M	30 Yr. (5%) Present Worth O&M Costs	30 Yr. (5%) Present Worth Remediation Costs	
No Action	Soil	\$103,758	\$0	\$0	\$0	\$0	\$103,758
	Structures	\$120,502	\$0	\$0	\$0	\$0	\$120,502
In Situ Treatment	Soil	\$106,563	\$272,708	\$0	\$0	\$272,708	\$379,271
	Structures	\$114,302	\$28,301	\$0	\$0	\$28,301	\$142,603
Removal and On Site Disposal	Soil	\$0	\$69,573	\$1,230	\$18,904	\$88,477	\$88,477
	Structures	\$67,596	\$139,881	\$317	\$4,870	\$144,751	\$212,348
Removal and Off Site Disposal	Soil	\$0	\$103,187	\$0	\$0	\$103,187	\$103,187
	Structures	\$67,596	\$203,936	\$0	\$0	\$203,936	\$271,533

OU4 - Domestic Septic Systems

Structures

No Action

Description:

No remedial action is taken, however, characterization is performed to justify leaving the structures, and soils in place. Characterization will include a literature review and geophysical survey to identify the location of buried tanks, piping, and leach fields. Backhoe exploration will confirm the location and allow access and sampling of the septic tank contents. Effluent lines and distribution boxes will be physically located, and smear samples collected. The work plan calls for 3 soil borings to be installed at the septic systems to collect soil samples beneath and/or adjacent to the structures and within the leach fields. However, the actual number and location of soil borings used will be dependent on access and the results of the structure sampling. All samples will be analyzed for the chemical and radiological parameters listed in the work plan. Soil analyses will include TCLP testing. Physical testing of the soil samples is not necessary.

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the tilefield and associated distributor piping. It is also assumed that the headend of each tilefield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review						\$2,400
Geologist Labor	40	HR	60	D&M	\$2,400	
Geophysical Survey						\$3,069
Ground Penetrating Radar	12	HR	155	D&M	\$1,860	
Mobilization			15%	D&M	\$279	
Analysis and Report Prep.			50%	D&M	\$930	
Backhoe Exploration & Sampling						\$41,850
Backhoe exploration	24	HR	95	D&M	\$2,280	
Laborer	24	HR	40	D&M	\$960	
Chemical Sample Analysis	18	EA	2145	D&M	\$38,610	
Soil Borings & Sampling						\$39,099
Mobilization (incl. soil char.)	1	EA	9000	D&M	\$9,000	
Drilling (1 borehole to 10' - 2 samples)	60	FT	36	D&M	\$2,160	
Geologist Labor	24	HR	60	D&M	\$1,440	
PPE	0	DY	100	D&M	\$0	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
Chemical Sample Analysis (incl. bottle prep.)	12	EA	2194	D&M	\$26,328	
Survey Locations (incl. soil char.)						\$1,220
Field survey	8	HR	145	D&M	\$1,160	
Data Reduction/Reporting	1	HR	60	D&M	\$60	
Tech memo prep. (incl. soil char.)						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COST SUBTOTAL						\$87,638
Mobilization and & Gen'l Reqm'ts			10%			\$8,764
CHARACTERIZATION COST SUBTOTAL						\$96,402
Contingencies			20%			\$19,280
Administrative			5%			\$4,820
CHARACTERIZATION COST TOTAL						\$120,502
REMEDIAL CAPITAL						
None Required						\$0
CONSTRUCTION SUBTOTAL						\$0
Mobilization and & Gen'l Reqm'ts			15%			\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						\$0
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design			15%			\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$120,502
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$120,502
Assuming	30	YR	5%			\$120,502
Assuming	30	YR	10%			\$120,502

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

OU4 - Domestic Septic Systems

Soils

No Action

Description:

No remedial action is taken, however, characterization is performed to justify leaving the structures, and soils in place. Characterization will include a literature review and geophysical survey to identify the location of buried tanks, piping, and leach fields. Backhoe exploration will confirm the location and allow access and sampling of the septic tank contents. Effluent lines and distribution boxes will be physically located, and smear samples collected. The work plan calls for 3 soil borings to be installed at the septic systems to collect soil samples beneath and/or adjacent to the structures and within the leach fields. However, the actual number and location of soil borings used will be dependent on access and the results of the structure sampling. All samples will be analyzed for the chemical and radiological parameters listed in the work plan. Soil analyses will include TCLP testing. Physical testing of the soil samples is not necessary.

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the tilefield and associated distributor piping. It is also assumed that the headend of each tilefield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review (incl. with Tanks)						\$0
Geologist Labor	0	HR	60	D&M	\$0	
Soil Sampling (in concert w/tank borings)						\$75,461
Mobilization (incl. in tank char. costs).	0	EA	9000	D&M	\$0	
Drilling (2 boreholes [10' & 25'] / leachfield)	210	FT	36	D&M	\$7,560	
Geologist Labor	24	HR	60	D&M	\$1,440	
PPE	0	DY	100	D&M	\$0	
Investigative Waste Management	15	DR	35	ENVEST	\$525	
Contractor Overhead Adjustment			22%	ENVEST	\$116	
Chemical Sample Analysis (5 samples/leachfield; incl. bottle prep.)	30	EA	2194	D&M	\$65,820	
CHARACTERIZATION COST SUBTOTAL						\$75,461
Mobilization and & Gen'l Reqm'ts			10%			\$7,546
CHARACTERIZATION COST SUBTOTAL						\$83,007
Contingencies			20%			\$16,601
Administrative			5%			\$4,150
CHARACTERIZATION COST TOTAL						\$103,758
REMEDIAL CAPITAL						
None Required						\$0
CONSTRUCTION SUBTOTAL						\$0
Mobilization and & Gen'l Reqm'ts			15%			\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design			15%			\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST						

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$103,758
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$103,758
Assuming	30	YR	5%			\$103,758
Assuming	30	YR	10%			\$103,758

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

OU4 - Domestic Septic Systems**Structures****In Situ Treatment****Description:**

In situ treatment involves solidification/stabilization of soils and grouting of the buried structures for the purpose of immobilizing the contaminants in place. Possible techniques for solidifying soils in place include: mixing with conventional mechanical equipment, shallow soil mixing (SSM), injection grouting, and jet grouting. It is not possible to assess the potential effectiveness of the solidification technologies without better chemical characterization. However, it is assumed that typical solidification agents can be used to successfully immobilize the contaminants. Since the leach fields are near or under buildings they will likely need to be treated with injection or jet grouting techniques. The close proximity to buildings and the presence of pipes tanks and other debris indicates that these solidification jobs will be fairly difficult and more costly. Implementation will require treatability testing and TCLP testing of verification samples.

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the leachfield and associated distributor piping. It is also assumed that the headend of each leachfield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

The soil volume for each leachfield is assumed to be 70 yd³ (30' * 21' * 3'). The volume of the septic tank is assumed to be 400 gals, with an available void space of 40%. The void space in the pipelines and diversion box volume is assumed to be on this same order (2 yd³).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review						\$2,400
Geologist Labor	40	HR	60	D&M	\$2,400	
Geophysical Survey						\$3,069
Ground Penetrating Radar	12	HR	155	D&M	\$1,860	
Mobilization			15%	D&M	\$279	
Analysis and Report Prep.			50%	D&M	\$930	
Backhoe Exploration & Sampling						\$41,850
Backhoe exploration	24	HR	95	D&M	\$2,280	
Laborer	24	HR	40	D&M	\$960	
Chemical Sample Analysis	18	EA	2145	D&M	\$38,610	
Soil Borings & Sampling						\$39,099
Mobilization (incl. soil char. cost).	1	EA	9000	D&M	\$9,000	
Drilling (1 borehole to 10' - 2 samples)	60	FT	36	D&M	\$2,160	
Geologist Labor	24	HR	60	D&M	\$1,440	
PPE	0	DY	100	D&M	\$0	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
Chemical Sample Analysis (incl. bottle prep.)	12	EA	2194	D&M	\$26,328	
Survey Locations (incl. soil char. cost)						\$1,220
Field survey	8	HR	145	D&M	\$1,160	
Data Reduction/Reporting	1	HR	60	D&M	\$60	
Tech memo prep. (incl. soil char. cost)						\$960
Geologist time	16	HR	60	D&M	\$960	
CHARACTERIZATION COST SUBTOTAL						\$83,129
Mobilization and & Gen'l Req'm'ts			10%			\$8,313
CHARACTERIZATION COST SUBTOTAL						\$91,442
Contingencies			20%			\$18,288
Administrative			5%			\$4,572
CHARACTERIZATION COST TOTAL						\$114,302

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
REMEDICATION CAPITAL						
Grouting						\$14,915
Mobilization & Decontamination	1	EA	9000	D&M	\$9,000	
Injection Grouting	18	CM	325	Appendix B	\$5,915	
CONSTRUCTION SUBTOTAL						\$14,915
Mobilization and & Gen'l Reqm'ts			15%			\$2,237
CONSTRUCTION COST SUBTOTAL						\$17,152
Contingencies						
Bid Contingency			10%			\$1,492
Scope Contingency			20%			\$2,983
Other Costs						
Administrative			5%			\$746
Services During Construction			10%			\$1,492
Legal			5%			\$746
IMPLEMENTATION COST TOTAL						\$24,610
Engineering/Design			15%			\$3,691
CAPITAL COST TOTAL						\$28,301
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$114,302
ESTIMATED CAPITAL COST (from above)						\$28,301
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$142,603
Assuming	30	YR	5%			\$142,603
Assuming	30	YR	10%			\$142,603

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

OU4 - Domestic Septic Systems

Soils

In Situ Treatment

Description:

In situ treatment involves solidification/stabilization of soils and grouting of the buried structures for the purpose of immobilizing the contaminants in place. Possible techniques for solidifying soils in place include: mixing with conventional mechanical equipment, shallow soil mixing (SSM), injection grouting, and jet grouting. It is not possible to assess the potential effectiveness of the solidification technologies without better chemical characterization. However, it is assumed that typical solidification agents can be used to successfully immobilize the contaminants. Since the leach fields are near or under buildings they will likely need to be treated with injection or jet grouting techniques. The close proximity to buildings and the presence of pipes tanks and other debris indicates that these solidification jobs will be fairly difficult and more costly. Implementation will require treatability testing and TCLP testing of verification samples.

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the leachfield and associated distributor piping. It is also assumed that the headend of each leachfield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

The soil volume for each leachfield is assumed to be 70 yd³ (30' * 21' * 3'). The volume of the septic tank is assumed to be 400 gals, with an available void space of 40%. The void space in the pipelines and diversion box volume is assumed to be on this same order (2 yd³).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review (incl. with Tanks)						\$0
Geologist Labor	0	HR	60	D&M	\$0	
Soil Sampling						\$77,501
Mobilization (incl. with Tanks).	0	EA	9000	D&M	\$0	
Drilling (2 boreholes [10' & 25'] / leachfield)	210	FT	36	D&M	\$7,560	
Geologist Labor	24	HR	60	D&M	\$1,440	
PPE	0	DY	100	D&M	\$0	
Investigative Waste Management	15	DR	35	ENVEST	\$525	
Contractor Overhead Adjustment			22%	ENVEST	\$116	
Chemical Sample Analysis (5 samples/leachfield; incl. bottle prep.)	30	EA	2194	D&M	\$65,820	
Physical Sample Analysis	6	EA	340	D&M	\$2,040	
CHARACTERIZATION COST SUBTOTAL						\$77,501
Mobilization and & Gen'l Reqm'ts			10%			\$7,750
CHARACTERIZATION COST SUBTOTAL						\$85,251
Contingencies			20%			\$17,050
Administrative			5%			\$4,263
CHARACTERIZATION COST TOTAL						\$106,563
REMEDIALATION CAPITAL						
Treatability Testing						\$1,120
Soil/Sample Preparation	8	HR	70	PNL	\$560	
Reporting	8	HR	70	PNL	\$560	
Jet Grouting						\$113,368
Mobilization and Decontamination	1	EA	9000	D&M	\$9,000	
Jet Grouting	321	M ³	325	Appendix B	\$104,368	
Verification Sampling						\$22,983
Mobilization (incl. with soil).	1	EA	9000	D&M	\$9,000	
Drilling (1 borehole to 10' - 2 samples)	60	FT	36	D&M	\$2,160	
Geologist Labor	24	HR	60	D&M	\$1,440	
PPE	0	DY	100	D&M	\$0	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
TCLP Analysis	12	EA	851	OHM	\$10,212	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CONSTRUCTION SUBTOTAL						\$137,471
Mobilization and & Gen'l Reqm'ts			15%			\$20,621
CONSTRUCTION COST SUBTOTAL						\$158,091
Contingencies						
Bid Contingency			10%			\$15,809
Scope Contingency			20%			\$31,618
Other Costs						
Administrative			5%			\$7,905
Services During Construction			10%			\$15,809
Legal			5%			\$7,905
IMPLEMENTATION COST TOTAL						\$237,137
Engineering/Design			15%			\$35,571
CAPITAL COST TOTAL						\$272,708
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$106,563
ESTIMATED CAPITAL COST (from above)						\$272,708
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$379,271
Assuming	30	YR	5%			\$379,271
Assuming	30	YR	10%			\$379,271

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

OU4 - Domestic Septic Systems**Structures****Remove and Dispose Onsite****Description:**

Removal and disposal involves excavation, waste classification, and disposal of both the septic tank structures and the leachfield soils. The close proximity to buildings and the presence of other buried pipelines and utilities make the removal job fairly difficult and more costly. Characterization is limited to finding the septic tank and system, and some backhoe exploration. Soil sampling will be performed during the course of excavation, primarily for waste designation.

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the leachfield and associated distributor piping. It is also assumed that the headend of each leachfield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

The soil volume for each leachfield is assumed to be 70 yd³ (30' * 21' * 3'). The volume of the septic tank is assumed to be 400 gals, with an available void space of 40%. The void space in the pipelines and diversion box volume is assumed to be on this same order (2 yd³). The volume to be excavated during removal of the structures is assumed to be 22 yd³. It is also assumed that some concrete demolition will be required to remove the tank.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review						\$2,400
Geologist Labor (incl. w/soil)	40	HR	60	D&M	\$2,400	
Geophysical Survey						\$3,069
Ground Penetrating Radar	12	HR	155	D&M	\$1,860	
Mobilization			15%	D&M	\$279	
Analysis and Report Prep.			50%	D&M	\$930	
Backhoe Exploration & Sampling						\$42,732
Backhoe exploration	24	HR	95	D&M	\$2,280	
Laborer	24	HR	40	D&M	\$960	
Chemical Sample Analysis	18	EA	2194	D&M	\$39,492	
Data Reduction/Reporting	0	HR	60	D&M	\$0	
Tech memo prep.						\$960
Geologist time	16	HR	60	D&M	\$960	
CHARACTERIZATION COST SUBTOTAL						\$49,161
Mobilization and & Gen'l Req'm'ts			10%			\$4,916
CHARACTERIZATION COST SUBTOTAL						\$54,077
Contingencies			20%			\$10,815
Administrative			5%			\$2,704
CHARACTERIZATION COST TOTAL						\$67,596
REMEDIAL CAPITAL						
Excavation (incl. shoring, concrete demolition, transport, etc.)	132	CY	NA	ENVEST		\$66,165
Material	1.00	EA	14490	ENVEST	\$14,490	
Labor	1.00	EA	29532	ENVEST	\$29,532	
Equipment	1.00	EA	10212	ENVEST	\$10,212	
Contractor Overhead Adjustment			22%	ENVEST	\$11,931	
Onsite Disposal	132	CY	27	ENVEST	\$3,564	\$4,348
(incl. capital for RCRA landfill + \$1/yd ³ for transport)						
Contractor Overhead Adjustment			22%	ENVEST	\$784	
CONSTRUCTION SUBTOTAL						\$70,514
Mobilization and & Gen'l Req'm'ts			15%			\$10,577

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CONSTRUCTION COST SUBTOTAL						\$81,091
Contingencies						
Bid Contingency			10%			\$8,109
Scope Contingency			20%			\$16,218
Other Costs						
Administrative			5%			\$4,055
Services During Construction			10%			\$8,109
Legal			5%			\$4,055
IMPLEMENTATION COST TOTAL						\$121,636
Engineering/Design			15%			\$18,245
CAPITAL COST TOTAL						\$139,881
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	132	CY	2	ENVEST	\$317	\$317
Contractor Overhead Adjustment			22%	ENVEST	\$70	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$317
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$6,209
Assuming annual O&M cost for	30	YR	5%			\$4,870
Assuming annual O&M cost for	30	YR	10%			\$2,986
ESTIMATED CHARACTERIZATION						\$67,596
ESTIMATED CAPITAL COST (from above)						\$139,881
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$212,348
Assuming	30	YR	5%			\$212,348
Assuming	30	YR	10%			\$210,464

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

OU4 - Domestic Septic Systems

Soil

Remove and Dispose Onsite

Description:

Removal and disposal involves excavation, waste classification, and disposal of both the septic tank structures and the leachfield soils. The close proximity to buildings and the presence of other buried pipelines and utilities make the removal job fairly difficult and more costly. Characterization is limited to finding the septic tank and system, and some backhoe exploration. Soil sampling will be performed during the course of excavation, primarily for waste designation.

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the leachfield and associated distributor piping. It is also assumed that the headend of each leachfield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

The soil volume for each leachfield is assumed to be 70 yd³ (30' * 21' * 3'). The volume of the septic tank is assumed to be 400 gals, with an available void space of 40%. The void space in the pipelines and diversion box volume is assumed to be on this same order (2 yd³). The volume to be excavated during removal of the structures is assumed to be 22 yd³. It is also assumed that some concrete demolition will be required to remove the tank.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review (incl. with Tanks)						\$0
Geologist Labor	0	HR	60	D&M	\$0	
CHARACTERIZATION COST SUBTOTAL						\$0
Mobilization and & Gen'l Req'm'ts			10%			\$0
CHARACTERIZATION COST SUBTOTAL						\$0
Contingencies			20%			\$0
Administrative			5%			\$0
CHARACTERIZATION COST TOTAL						\$0
REMEDICATION CAPITAL						
Excavation (incl. labor, equipment & material)	420	CY	NA	ENVEST		\$23,731
Material	1.00	EA	1470	ENVEST	\$1,470	
Labor	1.00	EA	13350	ENVEST	\$13,350	
Equipment	1.00	EA	4632	ENVEST	\$4,632	
Contractor Overhead Adjustment			22%	ENVEST	\$4,279	
Onsite Disposal	420	CY	27	ENVEST	\$11,340	\$11,340
(incl. capital for RCRA landfill + \$1/yd ³ for transport)						
Contractor Overhead Adjustment			22%	ENVEST	\$2,495	
CONSTRUCTION SUBTOTAL						\$35,071
Mobilization and & Gen'l Req'm'ts			15%			\$5,261
CONSTRUCTION COST SUBTOTAL						\$40,332
Contingencies						
Bid Contingency			10%			\$4,033
Scope Contingency			20%			\$8,066
Other Costs						
Administrative			5%			\$2,017
Services During Construction			10%			\$4,033
Legal			5%			\$2,017
IMPLEMENTATION COST TOTAL						\$60,498
Engineering/Design			15%			\$9,075
CAPITAL COST TOTAL						\$69,573
ANNUAL OPERATIONS & MAINTENANCE COST						

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Maintenance of Onsite Landfill	420	CY	2	ENVEST	\$1,008	\$1,230
Contractor Overhead Adjustment			22%	ENVEST	\$222	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$1,230

PRESENT WORTH COSTS

PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS

Assuming annual O&M cost for	30	YR.	3%			\$24,104
Assuming annual O&M cost for	30	YR.	5%			\$18,904
Assuming annual O&M cost for	30	YR.	10%			\$11,593

ESTIMATED CHARACTERIZATION

\$0

ESTIMATED CAPITAL COST (from above)

\$69,573

TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST

Assuming	30	YR.	3%			\$88,477
Assuming	30	YR.	5%			\$88,477
Assuming	30	YR.	10%			\$81,166

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

OU4 - Domestic Septic Systems
Structures
Removal and Offsite Disposal

Description:

Removal and disposal involves excavation, waste classification, and disposal of both the septic tank structures and the leachfield soils. The close proximity to buildings and the presence of other buried pipelines and utilities make the removal job fairly difficult and more costly. Characterization is limited to finding the septic tank and system, and some backhoe exploration. Soil sampling will be performed during the course of excavation, primarily for waste designation.

Disposal is assumed to be to the nearest hazardous waste landfill (Kettleman, CA).

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the leachfield and associated distributor piping. It is also assumed that the headend of each leachfield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

The soil volume for each leachfield is assumed to be 70 yd³ (30' * 21' * 3'). The volume of the septic tank is assumed to be 400 gals, with an available void space of 40%. The void space in the pipelines and diversion box volume is assumed to be on this same order (2 yd³). The volume to be excavated during removal of the structures is assumed to be 22 yd³. It is also assumed that some concrete demolition will be required to remove the tank.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review						\$2,400
Geologist Labor	40	HR	60	D&M	\$2,400	
Geophysical Survey						\$3,069
Ground Penetrating Radar	12	HR	155	D&M	\$1,860	
Mobilization			15%	D&M	\$279	
Analysis and Report Prep.			50%	D&M	\$930	
Backhoe Exploration & Sampling						\$42,732
Backhoe exploration	24	HR	95	D&M	\$2,280	
Laborer	24	HR	40	D&M	\$960	
Chemical Sample Analysis	18	EA	2194	D&M	\$39,492	
Tech memo prep.						\$960
Geologist time	16	HR	60	D&M	\$960	
CHARACTERIZATION COST SUBTOTAL						\$49,161
Mobilization and & Gen'l Req'm'ts			10%			\$4,916
CHARACTERIZATION COST SUBTOTAL						\$54,077
Contingencies			20%			\$10,815
Administrative			5%			\$2,704
CHARACTERIZATION COST TOTAL						\$67,596
REMEDIAL CAPITAL						
Excavation (incl. shoring, concrete demolition, transport, etc.)	132	CY	NA	ENVEST	\$73,692	\$89,904
Contractor Overhead Adjustment			22%	ENVEST	\$16,212	
Transportation (220 miles to Kettleman City, CA)	220	CY	54	Chem. Waste	\$11,880	\$11,880
Offsite Disposal (Haz. Waste - Kettleman City, CA)	132	CY	101	Chem. Waste	\$13,332	\$13,332
CONSTRUCTION SUBTOTAL						\$115,116
Mobilization and & Gen'l Req'm'ts			15%			\$17,267
CONSTRUCTION COST SUBTOTAL						\$132,384
Contingencies						
Bid Contingency			10%			\$8,990
Scope Contingency			20%			\$17,981

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Other Costs						
Administrative			5%			\$4,495
Services During Construction			10%			\$8,990
Legal			5%			\$4,495
IMPLEMENTATION COST TOTAL						\$177,336
Engineering/Design			15%			\$26,600
CAPITAL COST TOTAL						\$203,936
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$67,596
ESTIMATED CAPITAL COST (from above)						\$203,936
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$271,533
Assuming	30	YR	5%			\$271,533
Assuming	30	YR	10%			\$271,533

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

OU4 - Domestic Septic Systems**Soils****Removal and Offsite Disposal****Description:**

Removal and disposal involves excavation, waste classification, and disposal of both the septic tank structures and the leachfield soils. The close proximity to buildings and the presence of other buried pipelines and utilities make the removal job fairly difficult and more costly.

Characterization is limited to finding the septic tank and system, and some backhoe exploration. Soil sampling will be performed during the course of excavation, primarily for waste designation.

Disposal is assumed to be to the nearest hazardous waste landfill (Kettleman City, CA).

Basis/Assumptions:

The soils part of the septic system is defined as that portion downstream of the septic tank, and consists of the leachfield and associated distributor piping. It is also assumed that the headend of each leachfield is accessible such that a shallow borehole can be installed. The cost of gaining access through asphalt or concrete is assumed to be negligible.

The soil volume for each leachfield is assumed to be 70 yd³ (30' * 21' * 3'). The volume of the septic tank is assumed to be 400 gals, with an available void space of 40%. The void space in the pipelines and diversion box volume is assumed to be on this same order (2 yd³). The volume to be excavated during removal of the structures is assumed to be 22 yd³. It is also assumed that some concrete demolition will be required to remove the tank.

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review						\$0
Geologist Labor	0	HR	60	D&M	\$0	
CHARACTERIZATION COST SUBTOTAL						\$0
Mobilization and & General Requirements			10%			\$0
CHARACTERIZATION COST SUBTOTAL						\$0
Contingencies			20%			\$0
Administrative			5%			\$0
CHARACTERIZATION COST TOTAL						\$0
REMEDIAL CAPITAL						
Excavation (incl. labor, equipment & material)	420	CY	NA	ENVEST	\$19,446	\$23,724
Contractor Overhead Adjustment			22%	ENVEST	\$4,278	
Transportation (220 miles to Kettleman City, CA)	220	CY	54	Chem. Waste	\$11,880	\$11,880
Offsite Disposal (Haz. Waste - Kettleman City, CA)	420	CY	101	Chem. Waste	\$42,420	\$42,420
CONSTRUCTION SUBTOTAL						\$78,024
Mobilization and & Gen'l Req'm'ts			15%			\$11,704
CONSTRUCTION COST SUBTOTAL						\$89,728
Contingencies						
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$89,728
Engineering/Design			15%			\$13,459
CAPITAL COST TOTAL						\$103,187

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ANNUAL OPERATIONS & MAINTENANCE COST						
No Action Required						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$103,187
TOTAL PRESENT WORTH OF CHARACTERIZATION, CAPITAL, AND O&M COST						
Assuming	30	YR	3%			\$103,187
Assuming	30	YR	5%			\$103,187
Assuming	30	YR	10%			\$103,187

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

UNCERTAINTIES/COST SENSITIVITY

The existence, location, and accessibility of the septic tanks and tilefields is highly uncertain. If the initial attempts to characterize these sites are not successful or access is difficult, additional characterization costs may be incurred. The nature and extent of contamination at these facilities is also highly uncertain. This can greatly affect the volumes to be excavated and the waste designation costs. Hence the excavation and disposal costs are highly uncertain.

APPENDIX I - OPERABLE UNIT 5 COST SHEETS

OU-5 LF01 Summary

General Response Action	Component	Disposal Method	Characterization Costs	Remediation Costs				Total
				Capital	Annual O&M	30 Yr. (5%) Present Worth O&M Costs	30 Yr. (5%) Present Worth Remediation Costs	
No Action	LF-01	NA	\$173,467	\$0	\$0	\$0	\$0	\$173,467
Capping	LF-01	NA	\$6,914	\$837,400	\$1,110	\$17,063	\$854,463	\$861,378
Hotspot Removal, Segregation, Treatment, and Capping	LF-01	On Site	\$171,190	\$1,540,821	\$4,063	\$62,452	\$1,603,273	\$1,774,463
		Off Site	\$171,190	\$1,775,697	\$1,354	\$20,817	\$1,796,514	\$1,967,705
Removal and Disposal	LF-01	On Site	\$0	\$1,775,510	\$53,237	\$818,382	\$2,593,891	\$2,593,891
		Off Site	\$0	\$6,178,036	\$0	\$0	\$6,178,036	\$6,178,036

OU-5 LF02 Summary

General Response Action	Component	Disposal Method	Characterization Costs	Remediation Costs				Total
				Capital	Annual O&M	30 Yr. (5%) Present Worth O&M Costs	30 Yr. (5%) Present Worth Remediation Costs	
No Action	LF-02	NA	\$288,790	\$0	\$0	\$0	\$0	\$288,790
Capping	LF-02	NA	\$12,003	\$1,426,560	\$2,036	\$31,301	\$1,457,861	\$1,469,864
Hotspot Removal, Segregation, Treatment, and Capping	LF-02	On Site	\$288,790	\$4,616,311	\$15,051	\$231,373	\$4,847,683	\$5,136,474
		Off Site	\$288,790	\$5,692,607	\$2,036	\$31,301	\$5,723,908	\$6,012,699
Removal and Disposal	LF-02	On Site	\$0	\$3,666,033	\$112,438	\$1,728,450	\$5,394,483	\$5,394,483
		Off Site	\$0	\$12,964,318	\$0	\$0	\$12,964,318	\$12,964,318

OU-5 LF03 Summary

General Response Action	Component	Disposal Method	Characterization Costs	Remediation Costs				Total
				Capital	Annual O&M	30 Yr. (5%) Present Worth O&M Costs	30 Yr. (5%) Present Worth Remediation Costs	
No Action	LF-03	NA	\$82,690	\$0	\$0	\$0	\$0	\$82,690
Capping	LF-03	NA	\$8,122	\$330,071	\$864	\$13,278	\$343,349	\$351,471
Hotspot Removal, Segregation, Treatment, and Capping	LF-03	On Site	\$77,055	\$614,647	\$1,644	\$25,269	\$639,916	\$716,971
		Off Site	\$77,055	\$697,171	\$864	\$13,278	\$710,449	\$787,505
Removal and Disposal	LF-02	On Site	\$0	\$1,666,027	\$22,821	\$350,812	\$2,016,839	\$2,016,839
		Off Site	\$0	\$3,553,239	\$0	\$0	\$3,553,239	\$3,553,239

OU5 - Landfill Unit #1 (LF01)

No Action

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume 8 boreholes total (based on geophys. anomalies)
Two of the 8 boreholes will be drilled between the goat buildings to characterize this area.
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 40 samples total)
- 2) Assume 4 hrs geologist labor per boring
- 3) Assume drill and sample 2.5 boreholes/day
- 4) Chloroform and chromium are the main hotspot constituents
- 5) Soil-gas sampling will be performed for VOCs using PID for analysis (up to 25 pts).
- 6) Analyses for soil samples includes the complete list from work plan Table 5.15

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for VOC						\$3,850
Labor, probes, and installation	24	HR	150	PNL past	\$3,600	
Equipment rental (LELO2and/or OVA)	1	wk	250	PNL past	\$250	
Surface Radiation Survey						\$9,504
Germanium detector (10 grid pts)	12	HR	200	PNL	\$2,400	
Beta scintillation detector (20 grid pts)	12	HR	200	PNL	\$2,400	
Mobilization			15%	D&M	\$720	
Analysis and Report Prep.			50%	D&M	\$2,400	
Geophysical survey over area between goat buildings for definition of sampling locations.	16	HR	60	D&M	\$960	\$1,584
Mobilization			15%	D&M	\$144	
Analysis and Report Prep.			50%	D&M	\$480	
Soil Sampling						\$100,775
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	96	FT	36	D&M	\$3,456	
Geologist Labor	32	HR	60	D&M	\$1,920	
PPE	3	DY	100	D&M	\$300	
Investigative Waste Management	7	DR	35	ENVEST	\$245	
Contractor Overhead Adjustment			22%	ENVEST	\$54	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	40	EA	2145	D&M	\$85,800	
Survey Locations						\$2,560
Field survey	16	HR	145	D&M	\$2,320	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$120,673
Mobilization and General Requirements			15%			\$18,101
CHARACTERIZATION COSTS SUBTOTAL						\$138,774
Contingencies			20%			\$27,755
Administrative			5%			\$6,939
CHARACTERIZATION COSTS TOTAL						\$173,467
REMEDICATION CAPITAL						
None Required						

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CONSTRUCTION COST SUBTOTAL						\$0
Mobilization and General Requirements			15%			\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design			15%			\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
None Required						
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$173,467
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$173,467
Assuming	30	YR	5%			\$173,467
Assuming	30	YR	10%			\$173,467

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #1 (LF01)

Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Soil-gas sampling will be required for characterization of methane in within the landfill to determine if venting of the cap will be necessary.

Capping Assumptions

- 1) Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- 2) Overall surface-water management is not included here, this will be handled on an site-wide basis
- 3) Vadose-zone monitoring will not be required as part of landfill operation
- 4) Cap will meet California seismic design standards
- 5) Buildings - cap would extend to retaining wall; assume building, concrete, asphalt, is suitable for cap.
- 6) Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- 7) Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 1) 6-in. thick top soil
 - 2) 18-in thick soil
 - 3) 80 mil geo textile filter
 - 4) 1-ft thick sand drainage layer
 - 5) Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- 8) Dimensions of cap is 256 ft long by 206 ft wide = 52736 ft² total area
- 9) A 200 ft retaining wall will be necessary on the east side due to adjacent buildings.
- 10) A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- 11) Gas venting of the cap will not be required (based on soil-gas char. results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
Soil-gas sampling for methane						\$3,850
Labor, probes, and installation	24	HR	150	PNL	\$3,600	
Equipment rental (LELO2and/or OVA)	1	wk	250	Resp. Rentals	\$250	
Tech memo prep. (incl. soil char. cost)						\$960
Geologist time	16	HR	60	D&M	\$960	
CHARACTERIZATION COSTS SUBTOTAL						\$4,810
Mobilization and General Requirements			15%			\$722
CHARACTERIZATION COSTS SUBTOTAL						\$5,532
Contingencies			20%			\$1,106
Administrative			5%			\$277
CHARACTERIZATION COSTS TOTAL						\$6,914
REMEDIALATION CAPITAL						
Capping(Line item details are included on a separate spreadsheet)	52736	sq ft	\$6.56			\$422,130
Cap installation including materials, labor, and equipment (52736)	1	EA	265027	ENVEST	\$265,027	
Toe Drain	1	EA	46639	ENVEST	\$46,639	
Retaining Wall	1	EA	34342	ENVEST	\$34,342	
Contractor Overhead Adjustment			22%	ENVEST	\$76,122	
CONSTRUCTION COST SUBTOTAL						\$422,130
Mobilization and & Gen'l Req'm'ts @15%						\$63,319
CONSTRUCTION COST SUBTOTAL						\$485,449

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Contingencies						
Bid Contingency @ 10%			10%			\$48,545
Scope Contingency @ 20%			20%			\$97,090
Other Costs						
Administrative @ 5%			5%			\$24,272
Services During Construction @ 10%			10%			\$48,545
Legal @ 5%			5%			\$24,272
IMPLEMENTATION COST TOTAL						\$728,174
Engineering/Design @15%			15%			\$109,226
CAPITAL COST TOTAL						\$837,400
ANNUAL CAP OPERATIONS & MAINTENANCE COST						
Maintenance of Cap						\$1,354
Maintenance of Cap	1	EA	\$694	ENVEST	\$694	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$244	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$1,110
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$21,756
Assuming annual O&M cost for	30	YR	5%			\$17,063
Assuming annual O&M cost for	30	YR	10%			\$10,464
ESTIMATED CHARACTERIZATION						\$6,914
ESTIMATED CAPITAL COST (from above)						\$837,400
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$861,378
Assuming	30	YR	5%			\$861,378
Assuming	30	YR	10%			\$854,778

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #1 (LF01)
Hotspot Onsite Removal and Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume 8 boreholes total (based on geophys. anomalies)
Two of the 8 boreholes will be drilled between the goat buildings to characterize this area.
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 40 samples total)
- 2) Assume 4 hrs geologist labor per boring
- 3) Assume drill and sample 2.5 boreholes/day
- 4) Chloroform and chromium are the main hotspot constituents
- 5) Soil-gas sampling will be performed for VOCs using PID for analysis (up to 25 pts).
- 6) Analyses for soil samples includes the complete list from work plan Table 5.15

Remediation Assumptions:

- A volume of 10% will be removed (estimate based on geophysical anomalies) - total volume = 1848 yd³
- 4 separate hotspots will be removed
- Hotspots are excavated with nearly vertical walls (stabilized with sheeting)
- Excavated material is removed and treated with soil washing
- 50% of excavated material is hazardous waste, 50% of excavated material is returned to the site as backfill.
- Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- Overall surface-water management is not included here, this will be handled on a site-wide basis
- Vadose-zone monitoring will not be required as part of landfill operation
- Cap will meet California seismic design standards
- Buildings - cap would extend to retaining wall; assume building, concrete, asphalt, is suitable for cap.
- Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 6-in. thick top soil
 - 18-in thick soil
 - 80 mil geo textile filter
 - 1-ft thick sand drainage layer
 - Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- Dimensions of cap is 256 ft long by 206 ft wide = 52736 ft² total area
- A 200 ft retaining wall will be necessary on the east side due to adjacent buildings.
- A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- Gas venting of the cap will not be required (based on soil-gas characterization results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for methane/VOC labor, probes, and installation	24	HR	150	Past Experience	\$3,600	\$3,850
equipment rental (LELO2and/or OVA)	1	wk	250	Resp. Rentals	\$250	
Surface Radiation Survey						\$7,920
Germanium detector (10 grid pts)	12	HR	200	PNL	\$2,400	
Beta scintillation detector (20 grid pts)	12	HR	200	PNL	\$2,400	
Mobilization			15%	D&M	\$720	
Analysis and Report Prep.			50%	D&M	\$2,400	
Geophysical survey over area between goat buildings for definition of sampling locations.	16	HR	60	D&M	\$960	\$1,584

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Mobilization			15%	D&M	\$144	
Analysis and Report Prep.			50%	D&M	\$480	
Soil Sampling						\$100,775
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	96	FT	36	D&M	\$3,456	
Geologist Labor	32	HR	60	D&M	\$1,920	
PPE	3	DY	100	D&M	\$300	
Investigative Waste Management	7	DR	35	ENVEST	\$245	
Contractor Overhead Adjustment			22%	ENVEST	\$54	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	40	EA	2145	D&M	\$85,800	
Survey Locations						\$2,560
Field survey	16	HR	145	D&M	\$2,320	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$119,089
Mobilization and General Requirements			15%			\$17,863
CHARACTERIZATION COSTS SUBTOTAL						\$136,952
Contingencies			20%			\$27,390
Administrative			5%			\$6,848
CHARACTERIZATION COSTS TOTAL						\$171,190
REMEDIALTION CAPITAL						
Excavation (With Segregation)	1850	cu yd	\$25.08	ENVEST	\$46,407	\$56,617
(Cost includes: labor and excavation equipment, sheeting, backfill, dust suppressant, equipment decon, and OVA rental). Detailed costs for these items are shown in a separate spreadsheet.						
Contractor Overhead Adjustment			22%	ENVEST	\$10,210	
Treatment						\$244,200
Soil washing	1850	cu yd	\$132		\$244,200	
Waste Manifest Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Disposal (on site)	925	cu yd	\$27		\$24,975	\$24,975
Capping (Line item details are included on a separate spreadsheet)	52736	sq ft	\$6.56			\$422,130
Cap installation including materials, labor, and equipment	1	EA	265027	ENVEST	\$265,027	
Toe Drain	1	EA	46639	ENVEST	\$46,639	
Retaining Wall	1	EA	34342	ENVEST	\$34,342	
Contractor Overhead Adjustment			22%	ENVEST	\$76,122	
CONSTRUCTION COST SUBTOTAL						\$776,721
Mobilization and General Requirements			15%			\$116,508
CONSTRUCTION COST SUBTOTAL						\$893,229
Contingencies						
Bid Contingency			10%			\$89,323
Scope Contingency			20%			\$178,646
Other Costs						
Administrative			5%			\$44,661
Services During Construction			10%			\$89,323
Legal			5%			\$44,661
IMPLEMENTATION COST TOTAL						\$1,339,844
Engineering/Design			15%			\$200,977

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CAPITAL COST TOTAL						\$1,540,821
ANNUAL OPERATIONS & MAINTENANCE						
Maintenance of On site Landfill	925	cu yd	\$2.40	ENVEST	\$2,220	\$2,708
Contractor Overhead Adjustment			22%	ENVEST	\$488	
Maintenance of Cap						\$1,354
Maintenance of Cap	1	EA	\$694	ENVEST	\$694	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$244	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$4,063
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$79,629
Assuming annual O&M cost for	30	YR	5%			\$62,452
Assuming annual O&M cost for	30	YR	10%			\$38,298
ESTIMATED CHARACTERIZATION						\$171,190
ESTIMATED CAPITAL COST (from above)						\$1,540,821
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$1,774,463
Assuming	30	YR	5%			\$1,774,463
Assuming	30	YR	10%			\$1,750,309

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #1 (LF01)
Hotspot Offsite Removal and Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume 8 boreholes total (based on geophys. anomalies)
Two of the 8 boreholes will be drilled between the goat buildings to characterize this area.
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 40 samples total)
 - 2) Assume 4 hrs geologist labor per boring
 - 3) Assume drill and sample 2.5 boreholes/day
 - 4) Chloroform and chromium are the main hotspot constituents
 - 5) Soil-gas sampling will be performed for VOCs using PID for analysis (up to 25 pts).
 - 6) Analyses for soil samples includes the complete list from work plan Table 5.15
- Remediation Assumptions:
- A volume of 10% will be removed (estimate based on geophysical anomalies) - total volume = 1848 yd³
 - 4 separate hotspots will be removed.
 - Hotspots are excavated with nearly vertical walls (stabilized with sheeting)
 - Excavated material is removed and treated with soil washing
 - 50% of excavated material is hazardous waste, 50% of excavated material is returned to the site as backfill.
 - Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
 - Overall surface-water management is not included here, this will be handled on a site-wide basis
 - Vadose-zone monitoring will not be required as part of landfill operation
 - Cap will meet California seismic design standards
 - Buildings - cap would extend to retaining wall; assume building, concrete, asphalt, is suitable for cap.
 - Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
 - Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 6-in. thick top soil
 - 18-in thick soil
 - 80 mil geo textile filter
 - 1-ft thick sand drainage layer
 - Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
 - Dimensions of cap is 256 ft long by 206 ft wide = 52736 ft² total area
 - A 200 ft retaining wall will be necessary on the east side due to adjacent buildings.
 - A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
 - Gas venting of the cap will not be required (based on soil-gas characterization results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for methane/VOC labor, probes, and installation	24	HR	150	PNL	\$3,600	\$3,850
equipment rental (LELO2and/or OVA)	1	wk	250	Resp. Rentals	\$250	
Surface Radiation Survey						\$7,920
Germanium detector (10 grid pts)	12	HR	200	PNL	\$2,400	
Beta scintillation detector (20 grid pts)	12	HR	200	PNL	\$2,400	
Mobilization			15%	D&M	\$720	
Analysis and Report Prep.			50%	D&M	\$2,400	
Geophysical survey over area between goat buildings for definition of sampling locations.	16	HR	60	D&M	\$960	\$1,584

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Mobilization			15%	D&M	\$144	
Analysis and Report Prep.			50%	D&M	\$480	
Soil Sampling						\$100,775
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	96	FT	36	D&M	\$3,456	
Geologist Labor	32	HR	60	D&M	\$1,920	
PPE	3	DY	100	D&M	\$300	
Investigative Waste Management	7	DR	35	ENVEST	\$245	
Contractor Overhead Adjustment			22%	ENVEST	\$54	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	40	EA	2145	D&M	\$85,800	
Survey Locations						\$2,560
Field survey	16	HR	145	D&M	\$2,320	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$119,089
Mobilization and General Requirements			15%			\$17,863
CHARACTERIZATION COSTS SUBTOTAL						\$136,952
Contingencies			20%			\$27,390
Administrative			5%			\$6,848
CHARACTERIZATION COSTS TOTAL						\$171,190
REMEDIATION CAPITAL						
Excavation (With Segregation)	1850	cu yd	\$25.08	ENVEST	\$46,407	\$56,617
(Cost includes: labor and excavation equipment, sheeting, backfill, dust suppressant, equipment decon, and OVA rental). Detailed costs for these items are shown in a separate spreadsheet.						
Contractor Overhead Adjustment			22%	ENVEST	\$10,210	
Treatment				Appendix B		\$244,200
Soil washing	1850	cu yd	\$132		\$244,200	
Waste Manifest Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Disposal (haz. waste)						\$143,375
Transportation (220 miles to Kettleman City, CA)	925	CY	54	Tri-State	\$49,950	
Offsite Disposal (as Hazardous Waste)	925	CY	101	Chem. Waste	\$93,425	
Capping (Line item details are included on a separate spreadsheet)	52736	sq ft	\$6.56			\$422,130
Cap installation including materials, labor, and equipment	1	EA	265027	ENVEST	\$265,027	
Toe Drain	1	EA	46639	ENVEST	\$46,639	
Retaining Wall	1	EA	34342	ENVEST	\$34,342	
Contractor Overhead Adjustment			22%	ENVEST	\$76,122	
CONSTRUCTION COST SUBTOTAL						\$895,121
Mobilization and General Requirements			15%			\$134,268
CONSTRUCTION COST SUBTOTAL						\$1,029,389
Contingencies						
Bid Contingency			10%			\$102,939
Scope Contingency			20%			\$205,878
Other Costs						
Administrative			5%			\$51,469
Services During Construction			10%			\$102,939
Legal			5%			\$51,469

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
IMPLEMENTATION COST TOTAL						\$1,544,084
Engineering/Design			15%			\$231,613
CAPITAL COST TOTAL						\$1,775,697
ANNUAL OPERATIONS & MAINTENANCE						
Maintenance of Cap						\$1,354
Maintenance of Cap	1	EA	\$694	ENVEST	\$694	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$244	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$1,354
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$26,543
Assuming annual O&M cost for	30	YR	5%			\$20,817
Assuming annual O&M cost for	30	YR	10%			\$12,766
ESTIMATED CHARACTERIZATION						\$171,190
ESTIMATED CAPITAL COST (from above)						\$1,775,697
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$1,967,705
Assuming	30	YR	5%			\$1,967,705
Assuming	30	YR	10%			\$1,959,653

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #1 (LF01)

Remove and Onsite Disposal

Description:

Order of Magnitude Level Construction Cost Estimates

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
None Required						\$0
CHARACTERIZATION COSTS TOTAL						\$0
REMEDIATION CAPITAL						
Excavation						\$281,712
Cost includes labor, equipment, backfill, dust suppressant, etc.	18182	CY	\$12.70	ENVEST	\$230,911	
Contractor Overhead Adjustment			22%	ENVEST	\$50,801	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Disposal						\$598,915
Onsite RCRA Landfill	18182	CY	\$27	ENVEST	\$490,914	
Contractor Overhead Adjustment			22%	ENVEST	\$108,001	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$895,027
Mobilization and & Gen'l Reqm'ts @15%						\$134,254
CONSTRUCTION COST SUBTOTAL						\$1,029,281
Contingencies						
Bid Contingency @ 10%			10%			\$102,928
Scope Contingency @ 20%			20%			\$205,856
Other Costs						
Administrative @ 5%			5%			\$51,464
Services During Construction @ 10%			10%			\$102,928
Legal @ 5%			5%			\$51,464
IMPLEMENTATION COST TOTAL						\$1,543,922
Engineering/Design @15%			15%			\$231,588
CAPITAL COST TOTAL						\$1,775,510
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$53,237
Maintenance of On site Landfill	18182	CY	\$2.4	ENVEST	\$43,637	
Contractor Overhead Adjustment			22%	ENVEST	\$9,600	
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$1,043,467
Assuming annual O&M cost for	30	YR	5%			\$818,382
Assuming annual O&M cost for	30	YR	10%			\$501,860
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$1,775,510
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$2,593,891
Assuming	30	YR	5%			\$2,593,891
Assuming	30	YR	10%			\$2,277,369

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #1 (LF01)
Remove and Offsite Disposal

Description:

Order of Magnitude Level Construction Cost Estimates

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
None Required						\$0
CHARACTERIZATION COSTS TOTAL						\$0
REMEDIATION CAPITAL						
Excavation						\$281,712
Cost includes labor, equipment, backfill, dust suppressant, etc.	18182	CY	\$12.70	ENVEST	\$230,911	
Contractor Overhead Adjustment			22%	ENVEST	\$50,801	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Disposal						\$2,818,210
Transportation (220 miles to Kettleman City, CA)	18182	CY	54	Chem. Waste	\$981,828	
Offsite Disposal (to Kettleman City as haz. waste)	18182	CY	101	Chem. Waste	\$1,836,382	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$3,114,322
Mobilization and & Gen'l Reqm'ts @15%						\$467,148
CONSTRUCTION COST SUBTOTAL						\$3,581,470
Contingencies						
Bid Contingency @ 10%			10%			\$358,147
Scope Contingency @ 20%			20%			\$716,294
Other Costs						
Administrative @ 5%			5%			\$179,074
Services During Construction @ 10%			10%			\$358,147
Legal @ 5%			5%			\$179,074
IMPLEMENTATION COST TOTAL						\$5,372,205
Engineering/Design @15%			15%			\$805,831
CAPITAL COST TOTAL						\$6,178,036
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
None Required						
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$6,178,036
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$6,178,036
Assuming	30	YR	5%			\$6,178,036
Assuming	30	YR	10%			\$6,178,036

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #2 (LF02)

No Action

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume dog pens will be removed by D&D workers
- 2) Assume 7 trenches total (based on geophys. anomalies)
- 3) Each trench will need confirmatory soil samples
(assume 2 boreholes per trench, 12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole;
70 samples total)
- 4) Assume 4 hrs geo labor per boring
- 5) 14 boreholes total
- 6) Assume drill and sample 2.5 boreholes/day

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for VOC						\$8,350
Labor, probes, and installation	24	HR	300	PNL past	\$7,200	
Per Diem	3	DY	150	D&M	\$450	
Standby	3	DY	150	D&M	\$450	
Equipment rental (LELO2and/or OVA)	1	wk	250	PNL past	\$250	
Surface Radiation Survey						\$15,840
Germanium detector (10 grid pts)	24	HR	200	PNL	\$4,800	
Beta scintillation detector (20 grid pts)	24	HR	200	PNL	\$4,800	
Mobilization			15%	D&M	\$1,440	
Analysis and Report Prep.			50%	D&M	\$4,800	
Geophysical survey over area between goat buildings for definition of sampling locations.	24	HR	60	D&M	\$1,440	\$2,376
Mobilization			15%	D&M	\$216	
Analysis and Report Prep.			50%	D&M	\$720	
Soil Sampling						\$169,372
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	168	FT	36	D&M	\$6,048	
Geologist Labor	56	HR	60	D&M	\$3,360	
PPE	6	DY	100	D&M	\$600	
Investigative Waste Management	5	DR	35	ENVEST	\$175	
Contractor Overhead Adjustment			22%	ENVEST	\$39	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	70	EA	2145	D&M	\$150,150	
Survey Locations						\$2,560
Field survey	16	HR	145	D&M	\$2,320	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$200,898
Mobilization and General Requirements			15%			\$30,135
CHARACTERIZATION COSTS SUBTOTAL						\$231,032
Contingencies			20%			\$46,206
Administrative			5%			\$11,552
CHARACTERIZATION COSTS TOTAL						\$288,790
REMEDIALTION CAPITAL						

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
None Required						
CONSTRUCTION COST SUBTOTAL						\$0
Mobilization and General Requirements			15%			\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design			15%			\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
None Required						
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$288,790
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$288,790
Assuming	30	YR	5%			\$288,790
Assuming	30	YR	10%			\$288,790

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #2 (LF02)

Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume dog pens will be removed by D&D workers
- 2) Soil-gas sampling will be required for characterization of methane in within the landfill to determine if venting of the cap will be necessary.

Capping Assumptions

- 1) Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- 2) Overall surface-water management is not included here, this will be handled on an site-wide basis
- 3) Vadose-zone monitoring will not be required as part of landfill operation
- 4) Cap will meet California seismic design standards
- 5) Buildings - cap would extend to retaining wall; assume building, concrete, asphalt, is suitable for cap.
- 6) Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- 7) Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 1) 6-in. thick top soil
 - 2) 18-in thick soil
 - 3) 80 mil geo textile filter
 - 4) 1-ft thick sand drainage layer
 - 5) Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- 8) Dimensions of cap is 326 ft long by 306 ft wide = 99756 ft² total area
- 9) A 200 ft retaining wall will be necessary on the east side due to adjacent buildings.
- 10) A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- 11) Gas venting of the cap will not be required (based on soil-gas char. results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
Soil-gas sampling for methane						\$8,350
Labor, probes, and installation	24	HR	300	PNL	\$7,200	
Per Diem	3	DY	150	D&M	\$450	
Standby	3	DY	150	D&M	\$450	
Equipment rental (LELO2and/or OVA)	1	wk	250	Resp. Rentals	\$250	
Tech memo prep. (incl. soil char. cost)						\$960
Geologist time	16	HR	60	D&M	\$960	
CHARACTERIZATION COSTS SUBTOTAL						\$8,350
Mobilization and General Requirements			15%			\$1,253
CHARACTERIZATION COSTS SUBTOTAL						\$9,603
Contingencies			20%			\$1,921
Administrative			5%			\$480
CHARACTERIZATION COSTS TOTAL						\$12,003

REMEDIATION CAPITAL

Capping (Line item details are included on a separate spreadsheet)	99756	sq ft	\$7.21			\$719,123
Cap installation including materials, labor, and equipment	1.00	EA	\$476,704	ENVEST	\$476,704	
Toe Drain	1.00	EA	\$65,609	ENVEST	\$65,609	
Retaining Wall	1.00	EA	\$47,132	ENVEST	\$47,132	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Contractor Overhead Adjustment			22%	ENVEST	\$129,678	
CONSTRUCTION COST SUBTOTAL						\$719,123
Mobilization and & Gen'l Req'm'ts @15%						\$107,868
CONSTRUCTION COST SUBTOTAL						\$826,991
Contingencies						
Bid Contingency @ 10%			10%			\$82,699
Scope Contingency @ 20%			20%			\$165,398
Other Costs						
Administrative @ 5%			5%			\$41,350
Services During Construction @ 10%			10%			\$82,699
Legal @ 5%			5%			\$41,350
IMPLEMENTATION COST TOTAL						\$1,240,487
Engineering/Design @15%			15%			\$186,073
CAPITAL COST TOTAL						\$1,426,560
ANNUAL CAP OPERATIONS & MAINTENANCE COST						
Maintenance of Cap						\$2,036
Maintenance of Cap	1	EA	\$1,253	ENVEST	\$1,253	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$367	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$2,036
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$39,910
Assuming annual O&M cost for	30	YR	5%			\$31,301
Assuming annual O&M cost for	30	YR	10%			\$19,195
ESTIMATED CHARACTERIZATION						\$12,003
ESTIMATED CAPITAL COST (from above)						\$1,426,560
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$1,469,864
Assuming	30	YR	5%			\$1,469,864
Assuming	30	YR	10%			\$1,457,758

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #2 (LF02)
Hotspot Onsite Removal and Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume dog pens will be removed by D&D workers
- 2) Assume 7 trenches (based on geophys. anomalies)
Each trench will need confirmatory soil samples (2 boreholes per trench)
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 70 samples total)
- 3) Assume 4 hrs geo labor per boring
- 4) Assume drill and sample 2.5 boreholes/day
- 5) Chloroform and chromium are the main hotspot constituents
- 6) Soil-gas sampling for methane is required to determine if venting of the cap is needed.
(up to 25 pts)
- 7) Analyses for soil samples includes the complete list from work plan Table 5.15

Remediation Assumptions:

- 1) A volume of 25% will be removed (estimate based on geophysical anomalies)
(total volume = 8890 yd³)
- 2) 2 separate hotspots will be removed
- 3) Hotspots are excavated with nearly vertical walls (stabilized with sheeting)
- 4) Excavated material is removed and treated with soil washing
- 5) 50% of excavated material is hazardous waste,
50% of excavated material is returned to the site as backfill.
- 7) Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- 8) Overall surface-water management is not included here, this will be
handled on an site-wide basis
- 9) Vadose-zone monitoring will not be required as part of landfill operation
- 10) Cap will meet California seismic design standards
- 11) Buildings - cap would extend to retaining wall; assume building,
concrete, asphalt, is suitable for cap.
- 12) Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- 13) Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 1) 6-in. thick top soil
 - 2) 18-in thick soil
 - 3) 80 mil geo textile filter
 - 4) 1-ft thick sand drainage layer
 - 5) Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- 14) Dimensions of cap is 326 ft long by 306 ft wide = 99756 ft² total area
- 15) A 275 ft retaining wall will be necessary on the north side due to adjacent buildings.
- 16) A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- 17) Gas venting of the cap will not be required (based on soil-gas char. results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for methane/VOC						\$8,350
Labor, probes, and installation	24	HR	300	Past Experience	\$7,200	
Per Diem	3	DY	150	D&M	\$450	
Standby	3	DY	150	D&M	\$450	
Equipment rental (LELO2and/or OVA)	1	wk	250	Resp. Rentals	\$250	
Surface Radiation Survey						\$15,840

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Germanium detector (10 grid pts)	24	HR	200	PNL	\$4,800	
Beta scintillation detector (20 grid pts)	24	HR	200	PNL	\$4,800	
Mobilization			15%	D&M	\$1,440	
Analysis and Report Prep.			50%	D&M	\$4,800	
Geophysical survey over area between goat buildings for definition of sampling locations.	24	HR	60	D&M	\$1,440	\$2,376
Mobilization			15%	D&M	\$216	
Analysis and Report Prep.			50%	D&M	\$720	
Soil Sampling						\$169,372
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	168	FT	36	D&M	\$6,048	
Geologist Labor	56	HR	60	D&M	\$3,360	
PPE	6	DY	100	D&M	\$600	
Investigative Waste Management	5	DR	35	ENVEST	\$175	
Contractor Overhead Adjustment			22%	ENVEST	\$39	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	70	EA	2145	D&M	\$150,150	
Survey Locations						\$2,560
Field survey	16	HR	145	D&M	\$2,320	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$200,898
Mobilization and General Requirements			15%			\$30,135
CHARACTERIZATION COSTS SUBTOTAL						\$231,032
Contingencies			20%			\$46,206
Administrative			5%			\$11,552
CHARACTERIZATION COSTS TOTAL						\$288,790
REMEDIALTION CAPITAL						
Excavation (With Segregation)	8890	cu yd	\$23.90	ENVEST	\$212,493	\$259,241
(Cost includes: labor and excavation equipment, sheeting, backfill, dust supressant, equipment decon, and OVA rental). Detailed costs for these items are shown in a separate spreadsheet.						
Contractor Overhead Adjustment			22%	ENVEST	\$46,748	
Treatment						\$1,173,480
Soil washing	8890	cu yd	\$132	Appendix B	\$1,173,480	
Waste Manifest Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Disposal (onsite)	4445	cu yd	\$27	ENVEST	\$120,015	\$146,418
Contractor Overhead Adjustment			22%	ENVEST	\$26,403	
Capping (Line item details are included on a separate spreadsheet)	99756	sq ft	\$6.56			\$719,123
Cap installation including materials, labor, and equipment	1	EA	476704	ENVEST	\$476,704	
Toe Drain	1	EA	65609	ENVEST	\$65,609	
Retaining Wall	1	EA	47132	ENVEST	\$47,132	
Contractor Overhead Adjustment			22%	ENVEST	\$129,678	
CONSTRUCTION COST SUBTOTAL						\$2,327,063
Mobilization and General Requirements			15%			\$349,059

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CONSTRUCTION COST SUBTOTAL						\$2,676,122
Contingencies						
Bid Contingency			10%			\$267,612
Scope Contingency			20%			\$535,224
Other Costs						
Administrative			5%			\$133,806
Services During Construction			10%			\$267,612
Legal			5%			\$133,806
IMPLEMENTATION COST TOTAL						\$4,014,183
Engineering/Design			15%			\$602,127
CAPITAL COST TOTAL						\$4,616,311
ANNUAL OPERATIONS & MAINTENANCE						
Maintenance of On site Landfill	4445	cu yd	\$2.40	ENVEST	\$10,668	\$13,015
Contractor Overhead Adjustment			22%	ENVEST	\$2,347	
Maintenance of Cap						\$2,036
Maintenance of Cap	1	EA	\$1,253	ENVEST	\$1,253	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$367	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$15,051
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$295,009
Assuming annual O&M cost for	30	YR	5%			\$231,373
Assuming annual O&M cost for	30	YR	10%			\$141,886
ESTIMATED CHARACTERIZATION						\$288,790
ESTIMATED CAPITAL COST (from above)						\$4,616,311
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$5,136,474
Assuming	30	YR	5%			\$5,136,474
Assuming	30	YR	10%			\$5,046,987

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #2 (LF02)

Hotspot Removal, Treatment, Offsite Disposal and Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume dog pens will be removed by D&D workers
- 2) Assume 7 trenches (based on geophys. anomalies)
Each trench will need confirmatory soil samples (2 boreholes per trench)
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 70 samples total)
- 3) Assume 4 hrs geo labor per boring
- 4) Assume drill and sample 2.5 boreholes/day
- 5) Chloroform and chromium are the main hotspot constituents
- 6) Soil-gas sampling for methane is required to determine if venting of the cap is needed.
(up to 25 pts)
- 7) Analyses for soil samples includes the complete list from work plan Table 5.15

Remediation Assumptions:

- 1) A volume of 25% will be removed (estimate based on geophysical anomalies)
(total volume = 8890 yd³)
- 2) 2 separate hotspots will be removed
- 3) Hotspots are excavated with nearly vertical walls (stabilized with sheeting)
- 4) Excavated material is removed and treated with soil washing
- 5) 50% of excavated material is hazardous waste,
50% of excavated material is returned to the site as backfill.
- 7) Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- 8) Overall surface-water management is not included here; this will be
handled on an site-wide basis
- 9) Vadose-zone monitoring will not be required as part of landfill operation
- 10) Cap will meet California seismic design standards
- 11) Buildings - cap would extend to retaining wall; assume building,
concrete, asphalt, is suitable for cap.
- 12) Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- 13) Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 1) 6-in. thick top soil
 - 2) 18-in thick soil
 - 3) 80 mil geo textile filter
 - 4) 1-ft thick sand drainage layer
 - 5) Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- 14) Dimensions of cap is 326 ft long by 306 ft wide = 99756 ft² total area
- 15) A 275 ft retaining wall will be necessary on the north side due to adjacent buildings.
- 16) A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- 17) Gas venting of the cap will not be required (based on soil-gas char. results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for VOC						\$8,350
Labor, probes, and installation	24	HR	300	PNL past	\$7,200	
Per Diem	3	DY	150	D&M	\$450	
Standby	3	DY	150	D&M	\$450	
Equipment rental (LELO2and/or OVA)	1	wk	250	PNL past	\$250	
Surface Radiation Survey						\$15,840

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Germanium detector (10 grid pts)	24	HR	200	PNL	\$4,800	
Beta scintillation detector (20 grid pts)	24	HR	200	PNL	\$4,800	
Mobilization			15%	D&M	\$1,440	
Analysis and Report Prep.			50%	D&M	\$4,800	
Geophysical survey over area between goat buildings for definition of sampling locations.	24	HR	60	D&M	\$1,440	\$2,376
Mobilization			15%	D&M	\$216	
Analysis and Report Prep.			50%	D&M	\$720	
Soil Sampling						\$169,372
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Geologist Labor	56	HR	60	D&M	\$3,360	
Investigative Waste Management	5	DR	35	ENVEST	\$175	
Contractor Overhead Adjustment			22%	ENVEST	\$39	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	70	EA	2145	D&M	\$150,150	
Drilling (borehole installation)	168	FT	36	D&M	\$6,048	
PPE	6	DY	100	D&M	\$600	
Survey Locations						\$2,560
Field survey	16	HR	145	D&M	\$2,320	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$200,898
Mobilization and General Requirements			15%			\$30,135
CHARACTERIZATION COSTS SUBTOTAL						\$231,032
Contingencies			20%			\$46,206
Administrative			5%			\$11,552
CHARACTERIZATION COSTS TOTAL						\$288,790
REMEDIALTION CAPITAL						
Excavation (With Segregation)	8890	cu yd	\$23.90	ENVEST	\$212,493	\$259,241
(Cost includes: labor and excavation equipment, sheeting, backfill, dust supressant, equipment decon, and OVA rental). Detailed costs for these items are shown in a separate spreadsheet.						
Contractor Overhead Adjustment			22%	ENVEST	\$46,748	
Treatment						\$1,173,480
Soil washing	8890	CY	\$132	Appendix B	\$1,173,480	
Waste Manifest Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Disposal (off site)						\$688,975
Transportation (220 miles to Kettleman City, CA)	4445	CY	54	Tri-State	\$240,030	
Offsite Disposal (as haz. waste)	4445	CY	101	Chem. Waste	\$448,945	
Capping (Line item details are included on a separate spreadsheet)	99756	sq ft	\$6.56			\$719,123
Cap installation including materials, labor, and equipment	1	EA	476704	ENVEST	\$476,704	
Toe Drain	1	EA	65609	ENVEST	\$65,609	
Retaining Wall	1	EA	47132	ENVEST	\$47,132	
Contractor Overhead Adjustment			22%	ENVEST	\$129,678	
CONSTRUCTION COST SUBTOTAL						\$2,869,619
Mobilization and General Requirements			15%			\$430,443
CONSTRUCTION COST SUBTOTAL						\$3,300,062
Contingencies						
Bid Contingency			10%			\$330,006

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Scope Contingency			20%			\$660,012
Other Costs						
Administrative			5%			\$165,003
Services During Construction			10%			\$330,006
Legal			5%			\$165,003
IMPLEMENTATION COST TOTAL						\$4,950,093
Engineering/Design			15%			\$742,514
CAPITAL COST TOTAL						\$5,692,607
ANNUAL OPERATIONS & MAINTENANCE						
Maintenance of Cap						\$2,036
Maintenance of Cap	1	EA	\$1,253	ENVEST	\$1,253	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$367	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$2,036
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$39,910
Assuming annual O&M cost for	30	YR	5%			\$31,301
Assuming annual O&M cost for	30	YR	10%			\$19,195
ESTIMATED CHARACTERIZATION						\$288,790
ESTIMATED CAPITAL COST (from above)						\$5,692,607
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$6,012,699
Assuming	30	YR	5%			\$6,012,699
Assuming	30	YR	10%			\$6,000,592

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #2 (LF02)

Remove and Onsite Disposal

Description:

Order of Magnitude Level Construction Cost Estimates

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
None Required						\$0
CHARACTERIZATION COSTS TOTAL						\$0
REMEDIATION CAPITAL						
Excavation						\$568,703
Cost includes labor, equipment, backfill, dust suppressant, etc.	38401	CY	\$12.14	ENVEST	\$466,150	
Contractor Overhead Adjustment			22%	ENVEST	\$102,553	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Disposal						\$1,264,929
Onsite RCRA Landfill	38401	CY	\$27	ENVEST	\$1,036,827	
Contractor Overhead Adjustment			22%	ENVEST	\$228,102	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$1,848,032
Mobilization and & Gen'l Req'm'ts @15%						\$277,205
CONSTRUCTION COST SUBTOTAL						\$2,125,237
Contingencies						
Bid Contingency @ 10%			10%			\$212,524
Scope Contingency @ 20%			20%			\$425,047
Other Costs						
Administrative @ 5%			5%			\$106,262
Services During Construction @ 10%			10%			\$212,524
Legal @ 5%			5%			\$106,262
IMPLEMENTATION COST TOTAL						\$3,187,855
Engineering/Design @15%			15%			\$478,178
CAPITAL COST TOTAL						\$3,666,033
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$112,438
Maintenance of Onsite Landfill	38401	CY	\$2.4	ENVEST	\$92,162	
Contractor Overhead Adjustment			22%	ENVEST	\$20,276	
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$2,203,837
Assuming annual O&M cost for	30	YR	5%			\$1,728,450
Assuming annual O&M cost for	30	YR	10%			\$1,059,945
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$3,666,033
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$5,394,483
Assuming	30	YR	5%			\$5,394,483
Assuming	30	YR	10%			\$4,725,978

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #2 (LF02)
Remove and Offsite Disposal

Description:

Order of Magnitude Level Construction Cost Estimates

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
None Required						\$0
CHARACTERIZATION COSTS TOTAL						\$0
REMEDIATION CAPITAL						
Excavation						\$568,703
Cost includes labor, equipment, backfill, dust suppressant, etc.	38401	CY	\$12.14	ENVEST	\$466,150	
Contractor Overhead Adjustment			22%	ENVEST	\$102,553	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Disposal						\$5,952,155
Transportation (220 miles to Kettleman City, CA)	38401	CY	54	Chem. Waste	\$2,073,654	
Offsite Disposal (to Kettleman City as haz. waste)	38401	CY	101	Chem. Waste	\$3,878,501	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$6,535,258
Mobilization and & Gen'l Req'm'ts @15%						\$980,289
CONSTRUCTION COST SUBTOTAL						\$7,515,547
Contingencies						
Bid Contingency @ 10%			10%			\$751,555
Scope Contingency @ 20%			20%			\$1,503,109
Other Costs						
Administrative @ 5%			5%			\$375,777
Services During Construction @ 10%			10%			\$751,555
Legal @ 5%			5%			\$375,777
IMPLEMENTATION COST TOTAL						\$11,273,320
Engineering/Design @15%			15%			\$1,690,998
CAPITAL COST TOTAL						\$12,964,318
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
None Required						
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$12,964,318
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$12,964,318
Assuming	30	YR	5%			\$12,964,318
Assuming	30	YR	10%			\$12,964,318

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #3 (LF03)

No Action

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume 3 boreholes total (based on geophys. anomalies)
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 15 samples total)
- 2) Assume 4 hrs geo labor per boring.
- 3) Assume drill and sample 2.5 boreholes/day
- 4) Soil-gas sampling for VOCs will be performed using PID for analysis.
- 5) Analyses for soil samples includes the complete list from work plan Table 5.15

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for VOCs (up to 18 pts)						\$2,950
Labor, probes, and installation	8	HR	300	D&M	\$2,400	
Per Diem	1	DY	150	D&M	\$150	
Standby	1	DY	150	D&M	\$150	
Equipment rental (LELO2and/or OVA)	1	wk	250	PNL past	\$250	
Surface Radiation Survey						\$7,920
Germanium detector (10 grid pts)	12	HR	200	PNL	\$2,400	
Beta scintillation detector (20 grid pts)	12	HR	200	PNL	\$2,400	
Mobilization			15%	D&M	\$720	
Analysis and Report Prep.			50%	D&M	\$2,400	
Soil Sampling						\$43,434
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	36	FT	36	D&M	\$1,296	
Geologist Labor	12	HR	60	D&M	\$720	
PPE	2	DY	100	D&M	\$200	
Investigative Waste Management	1	DR	35	ENVEST	\$35	
Contractor Overhead Adjustment			22%	ENVEST	\$8	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	15	EA	2145	D&M	\$32,175	
Survey Locations						\$820
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$57,524
Mobilization and General Requirements			15%			\$8,629
CHARACTERIZATION COSTS SUBTOTAL						\$66,152
Contingencies			20%			\$13,230
Administrative			5%			\$3,308
CHARACTERIZATION COSTS TOTAL						\$82,690
REMEDIATION CAPITAL						
None Required						
CONSTRUCTION COST SUBTOTAL						\$0
Mobilization and General Requirements			15%			\$0
CONSTRUCTION COST SUBTOTAL						\$0
Contingencies						\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Bid Contingency			10%			\$0
Scope Contingency			20%			\$0
Other Costs						
Administrative			5%			\$0
Services During Construction			10%			\$0
Legal			5%			\$0
IMPLEMENTATION COST TOTAL						\$0
Engineering/Design			15%			\$0
CAPITAL COST TOTAL						\$0
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
None Required						
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$82,690
ESTIMATED CAPITAL COST (from above)						\$0
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$82,690
Assuming	30	YR	5%			\$82,690
Assuming	30	YR	10%			\$82,690

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #3 (LF03)

Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Soil-gas sampling will be required for characterization of methane within the landfill to determine if venting of the cap will be necessary.

Capping Assumptions

- 1) Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- 2) Overall surface-water management is not included here, this will be handled on an site-wide basis
- 3) Vadose-zone monitoring will not be required as part of landfill operation
- 4) Cap will meet California seismic design standards
- 5) Buildings - cap would extend to retaining wall; assume building, concrete, asphalt, is suitable for cap.
- 6) Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- 7) Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 1) 6-in. thick top soil
 - 2) 18-in thick soil
 - 3) 80 mil geo textile filter
 - 4) 1-ft thick sand drainage layer
 - 5) Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- 8) Dimensions of cap are 181 ft long by 106 ft wide = 19186 ft² total area
- 9) A retaining wall will not be necessary.
- 10) A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- 11) Gas venting of the cap will not be required (based on soil-gas char. results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
Soil-gas sampling for VOCs (up to 18 pts)						\$5,650
Labor, probes, and installation	16	HR	300	D&M	\$4,800	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Equipment rental (LELO2and/or OVA)	1	wk	250	PNL past	\$250	
Tech memo prep. (incl. soil char. cost)						\$960
Geologist time	16	HR	60	D&M	\$960	
CHARACTERIZATION COSTS SUBTOTAL						\$5,650
Mobilization and General Requirements			15%			\$848
CHARACTERIZATION COSTS SUBTOTAL						\$6,498
Contingencies			20%			\$1,300
Administrative			5%			\$325
CHARACTERIZATION COSTS TOTAL						\$8,122
REMEDIATION CAPITAL						
Capping (Line item details are included on a separate spreadsheet)	19186	sq ft	\$8.67			\$166,387
Cap installation including materials, labor, and equipment (52736)	1.00	EA	\$103,258	ENVEST	\$103,258	
Toe Drain	1.00	EA	\$33,125	ENVEST	\$33,125	
Contractor Overhead Adjustment			22%	ENVEST	\$30,004	
CONSTRUCTION COST SUBTOTAL						\$166,387
Mobilization and & Gen'l Reqm'ts @15%						\$24,958

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CONSTRUCTION COST SUBTOTAL						\$191,345
Contingencies						
Bid Contingency @ 10%			10%			\$19,135
Scope Contingency @ 20%			20%			\$38,269
Other Costs						
Administrative @ 5%			5%			\$9,567
Services During Construction @ 10%			10%			\$19,135
Legal @ 5%			5%			\$9,567
IMPLEMENTATION COST TOTAL						\$287,018
Engineering/Design @ 15%			15%			\$43,053
CAPITAL COST TOTAL						\$330,071
ANNUAL CAP OPERATIONS & MAINTENANCE COST						
Maintenance of Cap						\$864
Maintenance of Cap	1	EA	\$292	ENVEST	\$292	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$156	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$864
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$16,930
Assuming annual O&M cost for	30	YR	5%			\$13,278
Assuming annual O&M cost for	30	YR	10%			\$8,143
ESTIMATED CHARACTERIZATION						\$8,122
ESTIMATED CAPITAL COST (from above)						\$330,071
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$351,471
Assuming	30	YR	5%			\$351,471
Assuming	30	YR	10%			\$346,335

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #3 (LF03)

Hotspot Removal, Treatment, Onsite Disposal and Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume 3 boreholes total (based on geophys. anomalies)
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 15 samples total)
- 2) Assume 4 hrs geo labor per boring
- 3) Assume drill and sample 2.5 boreholes/day
- 4) Chloroform and chromium are the main hotspot constituents
- 5) Soil-gas sampling for methane is required to determine if venting of the cap is needed.

Removal and Treat Assumptions:

- 1) A volume of 10% will be removed (estimate based on geophysical anomalies)
(total volume = 650 yd³)
- 2) 2 separate hotspots will be removed
- 3) Hotspots are excavated with nearly vertical walls (stabilized with sheeting)
- 4) Excavated material is removed and treated with soil washing
- 5) 50% of excavated material is hazardous waste,
50% of excavated material is returned to the site as backfill.

Capping Assumptions

- 1) Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- 2) Overall surface-water management is not included here, this will be handled on an site-wide basis
- 3) Vadose-zone monitoring will not be required as part of landfill operation
- 4) Cap will meet California seismic design standards
- 5) Buildings - cap would extend to retaining wall; assume building, concrete, asphalt, is suitable for cap.
- 6) Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- 7) Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 1) 6-in. thick top soil
 - 2) 18-in thick soil
 - 3) 80 mil geo textile filter
 - 4) 1-ft thick sand drainage layer
 - 5) Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- 8) Dimensions of cap is 181 ft long by 106 ft wide = 19186 ft² total area
- 9) A retaining wall will not be necessary.
- 10) A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- 11) Gas venting of the cap will not be required (based on soil-gas char. results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for VOCs (up to 18 pts)						\$5,650
labor, probes, and installation	16	HR	300	D&M	\$4,800	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
equipment rental (LELO2and/or OVA)	1	wk	250	PNL past	\$250	
Soil Sampling						\$44,154
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	36	FT	36	D&M	\$1,296	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Geologist Labor	24	HR	60	D&M	\$1,440	
PPE	2	DY	100	D&M	\$200	
Investigative Waste Management	1	DR	35	ENVEST	\$35	
Contractor Overhead Adjustment			22%	ENVEST	\$8	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	15	EA	2145	D&M	\$32,175	
Survey Locations						\$1,400
Field survey	8	HR	145	D&M	\$1,160	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$53,604
Mobilization and General Requirements			15%			\$8,041
CHARACTERIZATION COSTS SUBTOTAL						\$61,644
Contingencies			20%			\$12,329
Administrative			5%			\$3,082
CHARACTERIZATION COSTS TOTAL						\$77,055
REMEDIALTION CAPITAL						
Excavation (With Segregation)	650	cu yd	\$25.32	ENVEST	\$16,458	\$20,079
(Cost includes: labor and excavation equipment, sheeting, backfill, dust supressant, equipment decon, and OVA rental). Detailed costs for these items are shown in a separate spreadsheet.						
Contractor Overhead Adjustment			22%	ENVEST	\$3,621	
Treatment						\$85,800
Soil washing	650	cu yd	\$132	Appendix B	\$85,800	
Waste Manifest Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Disposal (onsite)	325	cu yd	\$27		\$8,775	\$8,775
Capping (Line item details are included on a separate spreadsheet)	19186	sq ft	\$8.67			\$166,387
Cap installation including materials, labor, and equipment	1.00	EA	\$103,258	ENVEST	\$103,258	
Toe Drain	1.00	EA	\$33,125	ENVEST	\$33,125	
Contractor Overhead Adjustment			22%	ENVEST	\$30,004	
CONSTRUCTION COST SUBTOTAL						\$309,841
Mobilization and General Requirements			15%			\$46,476
CONSTRUCTION COST SUBTOTAL						\$356,317
Contingencies						
Bid Contingency			10%			\$35,632
Scope Contingency			20%			\$71,263
Other Costs						
Administrative			5%			\$17,816
Services During Construction			10%			\$35,632
Legal			5%			\$17,816
IMPLEMENTATION COST TOTAL						\$534,476
Engineering/Design			15%			\$80,171
CAPITAL COST TOTAL						\$614,647
ANNUAL OPERATIONS & MAINTENANCE						
Maintenance of Onsite Landfill	325	cu yd	\$2.40	ENVEST	\$780	\$780
Contractor Overhead Adjustment			22%	ENVEST	\$172	
Maintenance of Cap						\$864

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Maintenance of Cap	1	EA	\$292	ENVEST	\$292	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$156	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$1,644
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$32,218
Assuming annual O&M cost for	30	YR	5%			\$25,269
Assuming annual O&M cost for	30	YR	10%			\$15,496
ESTIMATED CHARACTERIZATION						\$77,055
ESTIMATED CAPITAL COST (from above)						\$614,647
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$716,971
Assuming	30	YR	5%			\$716,971
Assuming	30	YR	10%			\$707,198

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #3 (LF03)

Hotspot Removal, Treatment, Offsite Disposal and Capping

Description:

Order of Magnitude Level Construction Cost Estimates

Basis/Assumptions:

- 1) Assume 3 boreholes total (based on geophys. anomalies)
(12 ft depth borehole, 1 sample every 2.5 ft depth = 5 samples per borehole = 15 samples total)
- 2) Assume 4 hrs geo labor per boring
- 3) Assume drill and sample 2.5 boreholes/day
- 4) Chloroform and chromium are the main hotspot constituents
- 5) Soil-gas sampling for methane is required to determine if venting of the cap is needed.

Removal and Treat Assumptions:

- 1) A volume of 10% will be removed (estimate based on geophysical anomalies)
(total volume = 650 yd³)
- 2) 2 separate hotspots will be removed
- 3) Hotspots are excavated with nearly vertical walls (stabilized with sheeting)
- 4) Excavated material is removed and treated with soil washing
- 5) 50% of excavated material is hazardous waste,
50% of excavated material is returned to the site as backfill.

Capping Assumptions

- 1) Cut-off walls will not be required; HSU-1 K is low enough already (2.7e-4cm/s)
- 2) Overall surface-water management is not included here, this will be
handled on an site-wide basis
- 3) Vadose-zone monitoring will not be required as part of landfill operation
- 4) Cap will meet California seismic design standards
- 5) Buildings - cap would extend to retaining wall; assume building,
concrete, asphalt, is suitable for cap.
- 6) Compact and grade site (site prep.) - sheep's foot roller, is included as part of cap installation.
- 7) Cap is a RCRA-type and includes the following layers (from top to bottom):
 - 1) 6-in. thick top soil
 - 2) 18-in thick soil
 - 3) 80 mil geo textile filter
 - 4) 1-ft thick sand drainage layer
 - 5) Impervious layer
 - 80 mil liner
 - 20 mil VLDPE liner
 - 2-ft thick clay layer
 - 1-ft thick final cover
- 8) Dimensions of cap is 181 ft long by 106 ft wide = 19186 ft² total area
- 9) A retaining wall will not be necessary.
- 10) A 3 ft deep, 456 ft long toe drain will be installed as part of the cap
- 11) Gas venting of the cap will not be required (based on soil-gas char. results).

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Soil-gas sampling for VOCs (up to 18 pts)						\$5,650
labor, probes, and installation	16	HR	300	D&M	\$4,800	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
equipment rental (LELO2and/or OVA)	1	wk	250	PNL past	\$250	
Soil Sampling						\$44,154
Mobilization (incl. decon. between holes).	1	EA	9000	D&M	\$9,000	
Drilling (borehole installation)	36	FT	36	D&M	\$1,296	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Geologist Labor	24	HR	60	D&M	\$1,440	
PPE	2	DY	100	D&M	\$200	
Investigative Waste Management	1	DR	35	ENVEST	\$35	
Contractor Overhead Adjustment			22%	ENVEST	\$8	
Chemical Sample Analysis (metals, Cr, VOC analysis w/bottle prep.)	15	EA	2145	D&M	\$32,175	
Survey Locations						\$1,400
Field survey	8	HR	145	D&M	\$1,160	
Data Reduction/Reporting	4	HR	60	D&M	\$240	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$53,604
Mobilization and General Requirements			15%			\$8,041
CHARACTERIZATION COSTS SUBTOTAL						\$61,644
Contingencies			20%			\$12,329
Administrative			5%			\$3,082
CHARACTERIZATION COSTS TOTAL						\$77,055
REMEDIAL CAPITAL						
Excavation (With Segregation)	650	cu yd	\$25.32	ENVEST	\$16,458	\$20,079
(Cost includes: labor and excavation equipment, sheeting, backfill, dust suppressant, equipment decon, and OVA rental). Detailed costs for these items are shown in a separate spreadsheet.						
Contractor Overhead Adjustment			22%	ENVEST	\$3,621	
Treatment						\$85,800
Soil washing	650	cu yd	\$132	Appendix B	\$85,800	
Waste Manifest Sampling						\$28,800
Sample Analyses (Composite)	8	EA	3600	OHM	\$28,800	
Disposal						\$50,375
Transportation (220 miles to Kettleman City, CA)	325	CY	54	Chem. Waste	\$17,550	
Offsite Disposal (to Kettleman City as haz. waste)	325	CY	101	Chem. Waste	\$32,825	
Capping (Line item details are included on a separate spreadsheet)	19186	sq ft	\$8.67			\$166,387
Cap installation including materials, labor, and equipment	1.00	EA	\$103,258	ENVEST	\$103,258	
Toe Drain	1.00	EA	\$33,125	ENVEST	\$33,125	
Contractor Overhead Adjustment			22%	ENVEST	\$30,004	
CONSTRUCTION COST SUBTOTAL						\$351,441
Mobilization and General Requirements			15%			\$52,716
CONSTRUCTION COST SUBTOTAL						\$404,157
Contingencies						
Bid Contingency			10%			\$40,416
Scope Contingency			20%			\$80,831
Other Costs						
Administrative			5%			\$20,208
Services During Construction			10%			\$40,416
Legal			5%			\$20,208
IMPLEMENTATION COST TOTAL						\$606,236
Engineering/Design			15%			\$90,935
CAPITAL COST TOTAL						\$697,171
ANNUAL OPERATIONS & MAINTENANCE						
Maintenance of Cap						\$864

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Maintenance of Cap	1	EA	\$292	ENVEST	\$292	
Maintenance of Toe Drain	1	EA	\$416	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$156	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$864
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$16,930
Assuming annual O&M cost for	30	YR	5%			\$13,278
Assuming annual O&M cost for	30	YR	10%			\$8,143
ESTIMATED CHARACTERIZATION						\$77,055
ESTIMATED CAPITAL COST (from above)						\$697,171
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$787,505
Assuming	30	YR	5%			\$787,505
Assuming	30	YR	10%			\$782,369

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #3 (LF03)

Remove and Onsite Disposal

Description:

Order of Magnitude Level Construction Cost Estimates

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
None Required						\$0
CHARACTERIZATION COSTS TOTAL						\$0
REMEDIATION CAPITAL						
Excavation						\$568,703
Cost includes labor, equipment, backfill, dust suppressant, etc.	7794	CY	\$59.81	ENVEST	\$466,150	
Contractor Overhead Adjustment			22%	ENVEST	\$102,553	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Disposal						\$256,734
Onsite RCRA Landfill	7794	CY	\$27	ENVEST	\$210,438	
Contractor Overhead Adjustment			22%	ENVEST	\$46,296	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$839,837
Mobilization and & Gen'l Reqm'ts @ 15%						\$125,976
CONSTRUCTION COST SUBTOTAL						\$965,813
Contingencies						
Bid Contingency @ 10%			10%			\$96,581
Scope Contingency @ 20%			20%			\$193,163
Other Costs						
Administrative @ 5%			5%			\$48,291
Services During Construction @ 10%			10%			\$96,581
Legal @ 5%			5%			\$48,291
IMPLEMENTATION COST TOTAL						\$1,448,719
Engineering/Design @ 15%			15%			\$217,308
CAPITAL COST TOTAL						\$1,666,027
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$22,821
Maintenance of Onsite Landfill	7794	CY	\$2.4	ENVEST	\$18,706	
Contractor Overhead Adjustment			22%	ENVEST	\$4,115	
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$447,298
Assuming annual O&M cost for	30	YR	5%			\$350,812
Assuming annual O&M cost for	30	YR	10%			\$215,130
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$1,666,027
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$2,016,839
Assuming	30	YR	5%			\$2,016,839
Assuming	30	YR	10%			\$1,881,157

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU5 - Landfill Unit #3 (LF03)
Remove and Offsite Disposal

Description:

Order of Magnitude Level Construction Cost Estimates

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS						
None Required						\$0
CHARACTERIZATION COSTS TOTAL						\$0
REMEDIATION CAPITAL						
Excavation						\$568,703
Cost includes labor, equipment, backfill, dust suppressant, etc.	7794	CY	\$59.81	ENVEST	\$466,150	
Contractor Overhead Adjustment			22%	ENVEST	\$102,553	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Disposal						\$1,208,070
Transportation (220 miles to Kettleman City, CA)	7794	CY-M	54	Chem. Waste	\$420,876	
Offsite Disposal (to Kettleman City as haz. waste)	7794	CY	101	Chem. Waste	\$787,194	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
CONSTRUCTION COST SUBTOTAL						\$1,791,173
Mobilization and & Gen'l Req'm'ts @15%						\$268,676
CONSTRUCTION COST SUBTOTAL						\$2,059,849
Contingencies						
Bid Contingency @ 10%			10%			\$205,985
Scope Contingency @ 20%			20%			\$411,970
Other Costs						
Administrative @ 5%			5%			\$102,992
Services During Construction @ 10%			10%			\$205,985
Legal @ 5%			5%			\$102,992
IMPLEMENTATION COST TOTAL						\$3,089,773
Engineering/Design @15%			15%			\$463,466
CAPITAL COST TOTAL						\$3,553,239
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
None Required						
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$0
ESTIMATED CAPITAL COST (from above)						\$3,553,239
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming	30	YR	3%			\$3,553,239
Assuming	30	YR	5%			\$3,553,239
Assuming	30	YR	10%			\$3,553,239

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Southwest Trenches

Hotspot Removal with Offsite Disposal and Capping

Description:

Hotspot removal and capping involves the excavation and removal of hotspots. The hotspot excavations would be backfilled with clean soils before capping the entire source area. The cap would consist of eight layers, combine natural and synthetic materials, and meet RCRA standards. Contaminated debris and soils would be disposed of offsite, without segregation or treatment.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwest Trenches is estimated to be 470 yd³. Approximately 50 percent of this volume is assumed to be excavated during hotspot removal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; soil borings; and chemical sampling and analysis. The surveys would be used to delineate the hotspots, with borings and sampling and analysis as confirmation. Stockpiled wastes will be characterized for disposal. Backhoe exploration and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
SW Trenches (*2)	125	5	10	12500	470	359

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$767
GPR	3	HR	155	D&M	\$465	
Mobilization			15%	D&M	\$70	
Analysis and Report Prep.			50%	D&M	\$233	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$5,280
Germanium detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Beta scintillation detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Mobilization			15%	D&M	\$480	
Analysis and Report Prep.			50%	D&M	\$1,600	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis						\$33,209
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (5 * 12')	60	FT	36	D&M	\$2,160	
Standby			7%	D&M	\$151	
Geologist Labor	20	HR	60		\$1,200	
PPE	3	DY	100	D&M	\$300	
Investigative Waste Management	2	DR	35	ENVEST	\$70	
Contractor Overhead Adjustment			22%	ENVEST	\$15	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	5	EA	2195	D&M	\$10,973	
Partial Suite	5	EA	1868	D&M	\$9,340	
Physical Testing (Not Required)						\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$48,892
Mobilization and General Requirements			15%			\$7,334
CHARACTERIZATION COSTS SUBTOTAL						\$56,226
Contingencies			20%			\$11,245
Administrative			5%			\$2,811
CHARACTERIZATION COSTS TOTAL						\$70,283
REMEDIALTION CAPITAL						
Hotspot Removal and Offsite Disposal						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	235	CY	18.69	ENVEST		\$4,393
Material					\$983	
Labor					\$1,504	
Equipment					\$1,114	
Contractor Overhead Adjustment			22%		\$792	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Transportation (625 miles to Envirocare in Utah)	235	CY-M	142	Tri-State, 1993	\$33,341	\$33,341
Offsite Disposal (to Envirocare as RMW debris)	235	CY	1620	Envirocare	\$380,700	\$380,700
Capping						\$47,398
Cap	1	EA		ENVEST	\$20,064	
Toe Drain	1	EA		ENVEST	\$18,787	
Contractor Overhead Adjustment			22%	ENVEST	\$8,547	
CONSTRUCTION COST SUBTOTAL						\$480,232
Mobilization and General Requirements			15%			\$72,035
CONSTRUCTION COST SUBTOTAL						\$552,267
Contingencies						
Bid Contingency			10%			\$55,227
Scope Contingency			20%			\$110,453
Other Costs						
Administrative			5%			\$27,613
Services During Construction			10%			\$55,227
Legal			5%			\$27,613
IMPLEMENTATION COST TOTAL						\$828,400
Engineering/Design			15%			\$124,260
CAPITAL COST TOTAL						\$952,660
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Cap						\$599
Maintenance of Cap	1	EA	NA	ENVEST	\$75	
Maintenance of Toe Drain	1	EA	NA	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$108	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$599

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$11,741
Assuming annual O&M cost for	30	YR	5%			\$9,208
Assuming annual O&M cost for	30	YR	10%			\$5,647
ESTIMATED CHARACTERIZATION						\$70,283
ESTIMATED CAPITAL COST (from above)						\$952,660
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$1,034,684
Assuming 30 years @ 5%						\$1,032,151
Assuming 30 years @ 10%						\$1,028,590

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

49 Waste Holes

Hotspot Removal with Onsite Disposal and Capping

Description:

Hotspot removal and capping involves the excavation and removal of hotspots. The hotspot excavations would be backfilled with clean soils before capping the entire source area. The cap would consist of eight layers, combine natural and synthetic materials, and meet RCRA standards. Contaminated debris and soils would be disposed of onsite, without segregation or treatment.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3860 yd³. Approximately 50 percent of this volume is assumed to be excavated during hotspot removal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; soil borings; and chemical sampling and analysis. The surveys would be used to delineate the hotspots, with borings and sampling and analysis as confirmation. Stockpiled wastes will be characterized for disposal. Backhoe exploration and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Width Depth			Volume (ft ³)	Volume (yd ³)	Volume (m ³)
	Length (ft)	(ft)	(ft)			
49 Waste Holes	260	40	10	104000	3860	2951

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
Ground Penetrating Radar	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis						\$58,474
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (10" x 15')	150	FT	36	D&M	\$5,400	
Standby			7%	D&M	\$378	
Geologist Labor	40	HR	60		\$2,400	
PPE	5	DY	100	D&M	\$500	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	10	EA	2195	D&M	\$21,945	
Partial Suite	10	EA	1868	D&M	\$18,680	
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$80,716
Mobilization and General Requirements			15%			\$12,107
CHARACTERIZATION COSTS SUBTOTAL						\$92,823
Contingencies			20%			\$18,565
Administrative			5%			\$4,641
CHARACTERIZATION COSTS TOTAL						\$116,029
REMEDIALTION CAPITAL						
Hotspot Removal and Onsite Disposal						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	1930	CY	16.83	ENVEST		\$32,487
Material					\$9,849	
Labor					\$8,276	
Equipment					\$8,504	
Contractor Overhead Adjustment			22%	ENVEST	\$5,858	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$63,574
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	1930	CY	27	ENVEST	\$52,110	
Contractor Overhead Adjustment			22%	ENVEST	\$11,464	
Capping						\$317,660
Cap (assumes 266 ft * 46 ft)	3.29	EA	35505	ENVEST	\$116,811	
Toe Drain	3.29	EA	43637	ENVEST	\$143,566	
Contractor Overhead Adjustment			22%	ENVEST	\$57,283	
CONSTRUCTION COST SUBTOTAL						\$428,121
Mobilization and General Requirements			15%			\$64,218
CONSTRUCTION COST SUBTOTAL						\$492,339
Contingencies						
Bid Contingency			10%			\$49,234
Scope Contingency			20%			\$98,468
Other Costs						
Administrative			5%			\$24,617
Services During Construction			10%			\$49,234
Legal			5%			\$24,617
IMPLEMENTATION COST TOTAL						\$738,509
Engineering/Design			15%			\$110,776
CAPITAL COST TOTAL						\$849,285
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	1930	CY	2	ENVEST	\$4,632	\$5,651
Contractor Overhead Adjustment			22%	ENVEST	\$1,019	
Maintenance of Cap						\$2,127
Maintenance of Cap	3.29	EA	\$114	ENVEST	\$375	
Maintenance of Toe Drain	3.29	EA	\$416	ENVEST	\$1,369	
Contractor Overhead Adjustment			22%	ENVEST	\$384	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$7,778

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$152,459
Assuming annual O&M cost for	30	YR	5%			\$119,572
Assuming annual O&M cost for	30	YR	10%			\$73,326
ESTIMATED CHARACTERIZATION						\$116,029
ESTIMATED CAPITAL COST (from above)						\$849,285
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$1,117,774
Assuming 30 years @ 5%						\$1,084,887
Assuming 30 years @ 10%						\$1,038,640

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

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49 Waste Holes

Hotspot Removal with Offsite Disposal and Capping

Description:

Hotspot removal and capping involves the excavation and removal of hotspots. The hotspot excavations would be backfilled with clean soils before capping the entire source area. The cap would consist of eight layers, combine natural and synthetic materials, and meet RCRA standards. Contaminated debris and soils would be disposed of offsite, without segregation or treatment.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3860 yd³. Approximately 50 percent of this volume is assumed to be excavated during hotspot removal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; soil borings; and chemical sampling and analysis. The surveys would be used to delineate the hotspots, with borings and sampling and analysis as confirmation. Stockpiled wastes will be characterized for disposal. Backhoe exploration and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
49 Waste Holes	260	40	10	104000	3860	2951

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
Ground Penetrating Radar	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (10 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (10 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis						\$58,474
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (10" x 15')	150	FT	36	D&M	\$5,400	
Standby			7%	D&M	\$378	
Geologist Labor	40	HR	60		\$2,400	
PPE	5	DY	100	D&M	\$500	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	10	EA	2195	D&M	\$21,945	
Partial Suite	10	EA	1868	D&M	\$18,680	
Physical Testing (Not Required)						\$0

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$80,716
Mobilization and General Requirements			15%			\$12,107
CHARACTERIZATION COSTS SUBTOTAL						\$92,823
Contingencies			20%			\$18,565
Administrative			5%			\$4,641
CHARACTERIZATION COSTS TOTAL						\$116,029

REMEDIALTION CAPITAL

Hotspot Removal and Offsite Disposal

Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	1930	CY	16.83	ENVEST		\$32,487
Material					\$9,849	
Labor					\$8,276	
Equipment					\$8,504	
Contractor Overhead Adjustment			22%	ENVEST	\$5,858	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Transportation (625 miles to Envirocare in Utah)	1930	CY	142	Tri-State, 1993	\$273,819	\$273,819
Offsite Disposal (to Envirocare as RMW debris)	1930	CY	1620	Envirocare	\$3,126,600	\$3,126,600
Capping						\$317,660
Cap	3.29	EA	35505	ENVEST	\$116,811	
Toe Drain	3.29	EA	43637	ENVEST	\$143,566	
Contractor Overhead Adjustment			22%	ENVEST	\$57,283	

CONSTRUCTION COST SUBTOTAL

Mobilization and General Requirements	15%		\$3,764,966
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CONSTRUCTION COST SUBTOTAL

Contingencies			\$432,971
Bid Contingency	10%		\$865,942
Scope Contingency	20%		
Other Costs			
Administrative	5%		\$216,486
Services During Construction	10%		\$432,971
Legal	5%		\$216,486

IMPLEMENTATION COST TOTAL

Engineering/Design	15%		\$6,494,566
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CAPITAL COST TOTAL

\$7,468,751

ANNUAL OPERATIONS & MAINTENANCE COST

Maintenance of Cap						\$599
Maintenance of Cap	1	EA	NA	ENVEST	\$75	
Maintenance of Toe Drain	1	EA	NA	ENVEST	\$416	
Contractor Overhead Adjustment			22%	ENVEST	\$108	

ANNUAL OPERATIONS & MAINTENANCE COST TOTAL

\$599

PRESENT WORTH COSTS

PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Assuming annual O&M cost for	30	YR	3%			\$11,741
Assuming annual O&M cost for	30	YR	5%			\$9,208
Assuming annual O&M cost for	30	YR	10%			\$5,647
ESTIMATED CHARACTERIZATION						\$116,029
ESTIMATED CAPITAL COST (from above)						\$7,468,751
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$7,596,521
Assuming 30 years @ 5%						\$7,593,988
Assuming 30 years @ 10%						\$7,590,427

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Solid Waste Trenches

Hotspot Removal with Onsite Disposal and Capping

Description:

Hotspot removal and capping involves the excavation and removal of hotspots. The hotspot excavations would be backfilled with clean soils before capping the entire source area. The cap would consist of eight layers, combine natural and synthetic materials, and meet RCRA standards. Contaminated debris and soils would be disposed of onsite, without segregation or treatment.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2790 yd³. Approximately 50 percent of this volume is assumed to be excavated during hotspot removal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; soil borings; and chemical sampling and analysis. The surveys would be used to delineate the hotspots, with borings and sampling and analysis to confirm hotspot locations. Stockpiled wastes will be characterized for disposal. Backhoe exploration and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Solid Waste Trenches Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
South of dog pens	275	10	10	27500	1020	780
Eastern Trenches	200	14	10	28000	1040	795
NE Trench	185	4	10	7400	280	214
Northern Trenches	85	12	10	10200	380	291
Trench #5	45	4	10	1800	70	54
Total				74900	2790	2133

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
Ground Penetrating Radar	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis						\$53,594
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (9 • 15')	135	FT	36	D&M	\$4,860	
Standby			7%	D&M	\$340	
Geologist Labor	36	HR	60		\$2,160	
PPE	5	DY	100	D&M	\$500	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	9	EA	2195	D&M	\$19,751	
Partial Suite	9	EA	1868	D&M	\$16,812	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$75,836
Mobilization and General Requirements			15%			\$11,375
CHARACTERIZATION COSTS SUBTOTAL						\$87,211
Contingencies			20%			\$17,442
Administrative			5%			\$4,361
CHARACTERIZATION COSTS TOTAL						\$109,014
REMEDIALTION CAPITAL						
Hotspot Removal and Onsite Disposal						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	1395	CY	14.95	ENVEST		\$25,450
Material	0.32	EA	17713	ENVEST	\$5,668	
Labor	0.32	EA	27361	ENVEST	\$8,756	
Equipment	0.32	EA	20115	ENVEST	\$6,437	
Contractor Overhead Adjustment			22%	ENVEST	\$4,589	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$45,951
(incl. capital for RCRA landfill + \$1/yd ³ for transport)	1395	CY	27	ENVEST	\$37,665	
Contractor Overhead Adjustment			22%	ENVEST	\$8,286	
Capping						\$382,734
Cap	2.29	EA	65781	ENVEST	\$150,638	
Toe Drain	2.29	EA	71213	ENVEST	\$163,078	
Contractor Overhead Adjustment			22%	ENVEST	\$69,018	
CONSTRUCTION COST SUBTOTAL						\$468,535
Mobilization and General Requirements			15%			\$70,280
CONSTRUCTION COST SUBTOTAL						\$538,815
Contingencies						
Bid Contingency			10%			\$53,882
Scope Contingency			20%			\$107,763
Other Costs						
Administrative			5%			\$26,941
Services During Construction			10%			\$53,882
Legal			5%			\$26,941
IMPLEMENTATION COST TOTAL						\$808,223
Engineering/Design			15%			\$121,233
CAPITAL COST TOTAL						\$929,456

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	1395	CY	2	ENVEST	\$3,348	\$4,085
Contractor Overhead Adjustment			22%	ENVEST	\$737	
Maintenance of Cap						\$4,140
Maintenance of Cap	2.29	EA	\$234	ENVEST	\$536	
Maintenance of Toe Drain	2.29	EA	\$1,248	ENVEST	\$2,858	
Contractor Overhead Adjustment			22%	ENVEST	\$747	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$8,225
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$161,213
Assuming annual O&M cost for	30	YR	5%			\$126,438
Assuming annual O&M cost for	30	YR	10%			\$77,536
ESTIMATED CHARACTERIZATION						\$109,014
ESTIMATED CAPITAL COST (from above)						\$929,456
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$1,199,683
Assuming 30 years @ 5%						\$1,164,908
Assuming 30 years @ 10%						\$1,116,006

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Solid Waste Trenches

Hotspot Removal with Offsite Disposal and Capping

Description:

Hotspot removal and capping involves the excavation and removal of hotspots. The hotspot excavations would be backfilled with clean soils before capping the entire source area. The cap would consist of eight layers, combine natural and synthetic materials, and meet RCRA standards. Contaminated debris and soils would be disposed of offsite, without segregation or treatment.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2790 yd³. Approximately 50 percent of this volume is assumed to be excavated during hotspot removal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; soil borings; and chemical sampling and analysis. The surveys would be used to delineate the hotspots, with borings and sampling and analysis to confirm hotspot locations. Stockpiled wastes will be characterized for disposal. Backhoe exploration and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Solid Waste Trenches Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
South of dog pens	275	10	10	27500	1020	780
Eastern Trenches	200	14	10	28000	1040	795
NE Trench	185	4	10	7400	280	214
Northern Trenches	85	12	10	10200	380	291
Trench #5	45	4	10	1800	70	54
Total				74900	2790	2133

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
Ground Penetrating Radar	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis						\$53,594
Mobilization	1	EA	9000	D&M	\$9,000	
Borehole installation (9 * 15')	135	FT	36	D&M	\$4,860	
Standby			7%	D&M	\$340	
Geologist Labor	36	HR	60		\$2,160	
PPE	5	DY	100	D&M	\$500	
Investigative Waste Management	4	DR	35	ENVEST	\$140	
Contractor Overhead Adjustment			22%	ENVEST	\$31	
Chemical Sample Analysis (incl. bottle prep.)						
Full Suite	9	EA	2195	D&M	\$19,751	
Partial Suite	9	EA	1868	D&M	\$16,812	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$75,836
Mobilization and General Requirements			15%			\$11,375
CHARACTERIZATION COSTS SUBTOTAL						\$87,211
Contingencies			20%			\$17,442
Administrative			5%			\$4,361
CHARACTERIZATION COSTS TOTAL						\$109,014
REMEDIALTION CAPITAL						
Hotspot Removal and Offsite Disposal						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	1395	CY	14.95	ENVEST		\$25,450
Material	0.32	EA	17713	ENVEST	\$5,668	
Labor	0.32	EA	27361	ENVEST	\$8,756	
Equipment	0.32	EA	20115	ENVEST	\$6,437	
Contractor Overhead Adjustment			22%	ENVEST	\$4,589	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Transportation (625 miles to Envirocare in Utah)	1395	CY	142	Tri-State	\$197,916	\$197,916
Offsite Disposal (to Envirocare as RMW debris)	1395	CY	1620	Envirocare	\$2,259,900	\$2,259,900
Capping						\$382,734
Cap	2.29	EA	65781	ENVEST	\$150,638	
Toe Drain	2.29	EA	71213	ENVEST	\$163,078	
Contractor Overhead Adjustment			22%	ENVEST	\$69,018	
CONSTRUCTION COST SUBTOTAL						\$2,880,399
Mobilization and General Requirements			15%			\$432,060
CONSTRUCTION COST SUBTOTAL						\$3,312,459
Contingencies						
Bid Contingency			10%			\$331,246
Scope Contingency			20%			\$662,492
Other Costs						
Administrative			5%			\$165,623
Services During Construction			10%			\$331,246
Legal			5%			\$165,623
IMPLEMENTATION COST TOTAL						\$4,968,689
Engineering/Design			15%			\$745,303
CAPITAL COST TOTAL						\$5,713,992
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Cap						\$4,140
Maintenance of Cap	2.29	EA	\$234	ENVEST	\$536	
Maintenance of Toe Drain	2.29	EA	\$1,248	ENVEST	\$2,858	
Contractor Overhead Adjustment			22%	ENVEST	\$747	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$4,140

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$81,154
Assuming annual O&M cost for	30	YR	5%			\$63,648
Assuming annual O&M cost for	30	YR	10%			\$39,031
ESTIMATED CHARACTERIZATION						\$109,014
ESTIMATED CAPITAL COST (from above)						\$5,713,992
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$5,904,159
Assuming 30 years @ 5%						\$5,886,654
Assuming 30 years @ 10%						\$5,862,037

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

DOE Disposal Box

Removal and Onsite Disposal

Description:

Removal and disposal involves the excavation, removal, and disposal of buried waste materials and contaminated soils, without segregation or treatment. The excavations would be backfilled with clean soils. Contaminated debris and soils would be disposed of onsite.

Basis/Assumptions:

The total volume of the box and adjacent soils is estimated to be 320 yd³. This response action assumes 100 percent of this volume is to be excavated.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
DOE Disposal Box	42.5	20	10	8500	320	245

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Geophysical Survey						\$446
Electromagnetics	2	HR	135	D&M	\$270	
Mobilization			15%	D&M	\$41	
Analysis and Report Prep.			50%	D&M	\$135	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$2,640
Germanium detector (15 grid pts)	4	HR	200	PNL	\$800	
Beta scintillation detector (15 grid pts)	4	HR	200	PNL	\$800	
Mobilization			15%	D&M	\$240	
Analysis and Report Prep.			50%	D&M	\$800	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$11,282
Mobilization and General Requirements			15%			\$1,692
CHARACTERIZATION COSTS SUBTOTAL						\$12,974
Contingencies			20%			\$2,595
Administrative			5%			\$649
CHARACTERIZATION COSTS TOTAL						\$16,217

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
REMEDIATION CAPITAL						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	320	CY	18.24	ENVEST		\$5,836
Material	1.08	EA	854	ENVEST	\$923	
Labor	1.08	EA	2305	ENVEST	\$2,492	
Equipment	1.08	EA	1266	ENVEST	\$1,369	
Contractor Overhead Adjustment			22%	ENVEST	\$1,052	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$10,541
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	320	CY	27	ENVEST	\$8,640	
Contractor Overhead Adjustment			22%	ENVEST	\$1,901	
CONSTRUCTION COST SUBTOTAL						\$39,557
Mobilization and General Requirements			15%			\$5,934
CONSTRUCTION COST SUBTOTAL						\$45,491
Contingencies						
Bid Contingency			10%			\$4,549
Scope Contingency			20%			\$9,098
Other Costs						
Administrative			5%			\$2,275
Services During Construction			10%			\$4,549
Legal			5%			\$2,275
IMPLEMENTATION COST TOTAL						\$68,236
Engineering/Design			15%			\$10,235
CAPITAL COST TOTAL						\$78,471
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	320	CY	2	ENVEST	\$768	\$768
Contractor Overhead Adjustment			22%	ENVEST	\$169	\$169
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$937
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$18,365
Assuming annual O&M cost for	30	YR	5%			\$14,403
Assuming annual O&M cost for	30	YR	10%			\$8,833
ESTIMATED CHARACTERIZATION						\$16,217
ESTIMATED CAPITAL COST (from above)						\$78,471
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$113,053
Assuming 30 years @ 5%						\$109,092
Assuming 30 years @ 10%						\$103,521

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

DOE Disposal Box

Removal and Offsite Disposal

Description:

Removal and disposal involves the excavation, removal, and disposal of buried waste materials and contaminated soils, without segregation or treatment. The excavations would be backfilled with clean soils. Contaminated debris and soils would be disposed of offsite.

Basis/Assumptions:

The total volume of the box and adjacent soils is estimated to be 320 yd³. This response action assumes 100 percent of this volume is to be excavated.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
DOE Disposal Box	42.5	20	10	8500	320	245

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Geophysical Survey						\$446
Electromagnetics	2	HR	135	D&M	\$270	
Mobilization			15%	D&M	\$41	
Analysis and Report Prep.			50%	D&M	\$135	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$2,640
Germanium detector (15 grid pts)	4	HR	200	PNL	\$800	
Beta scintillation detector (15 grid pts)	4	HR	200	PNL	\$800	
Mobilization			15%	D&M	\$240	
Analysis and Report Prep.			50%	D&M	\$800	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$11,282
Mobilization and General Requirements			15%			\$1,692
CHARACTERIZATION COSTS SUBTOTAL						\$12,974
Contingencies			20%			\$2,595
Administrative			5%			\$649
CHARACTERIZATION COSTS TOTAL						\$16,217

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
REMEDATION CAPITAL						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	320	CY	18.24	ENVEST		\$5,836
Material	1.08	EA	854	ENVEST	\$923	
Labor	1.08	EA	2305	ENVEST	\$2,492	
Equipment	1.08	EA	1266	ENVEST	\$1,369	
Contractor Overhead Adjustment			22%	ENVEST	\$1,052	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Offsite Disposal						
Transportation (625 miles to Envirocare in Utah)	320	CY	142	Tri-State, 1993	\$45,400	\$45,400
Offsite Disposal (to Envirocare as RMW debris)	320	CY	1620	Envirocare	\$518,400	\$518,400
CONSTRUCTION COST SUBTOTAL						\$592,816
Mobilization and General Requirements			15%			\$88,922
CONSTRUCTION COST SUBTOTAL						\$681,739
Contingencies						
Bid Contingency			10%			\$68,174
Scope Contingency			20%			\$136,348
Other Costs						
Administrative			5%			\$34,087
Services During Construction			10%			\$68,174
Legal			5%			\$34,087
IMPLEMENTATION COST TOTAL						\$1,022,608
Engineering/Design			15%			\$153,391
CAPITAL COST TOTAL						\$1,175,999
ANNUAL OPERATIONS & MAINTENANCE COST						
Not Required						
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$16,217
ESTIMATED CAPITAL COST (from above)						\$1,175,999
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$1,192,216
Assuming 30 years @ 5%						\$1,192,216
Assuming 30 years @ 10%						\$1,192,216

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

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49 Waste Holes

Removal and Onsite Disposal

Description:

Removal and disposal involves the excavation, removal, and disposal of buried waste materials and contaminated soils, without segregation or treatment. The excavations would be backfilled with clean soils. Contaminated debris and soils would be disposed of onsite.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3860 yd³. This response action assumes 100 percent of this volume is to be excavated.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
49 Waste Holes	260	40	10	104000	3860	2951

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
Ground Penetrating Radar	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
REMEDATION CAPITAL						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	3860	CY	18.26	ENVEST		\$70,482
Material	1.88	EA	10466	ENVEST	\$19,697	
Labor	1.88	EA	11194	ENVEST	\$21,067	
Equipment	1.88	EA	9037	ENVEST	\$17,008	
Contractor Overhead Adjustment			22%	ENVEST	\$12,710	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Onsite Disposal						\$127,148
(incl. capital for RCRA landfill + \$1/yd ³ for transport))	3860	CY	27	ENVEST	\$104,220	
Contractor Overhead Adjustment			22%	ENVEST	\$22,928	
CONSTRUCTION COST SUBTOTAL						\$220,810
Mobilization and General Requirements			15%			\$33,122
CONSTRUCTION COST SUBTOTAL						\$253,932
Contingencies						
Bid Contingency			10%			\$25,393
Scope Contingency			20%			\$50,786
Other Costs						
Administrative			5%			\$12,697
Services During Construction			10%			\$25,393
Legal			5%			\$12,697
IMPLEMENTATION COST TOTAL						\$380,898
Engineering/Design			15%			\$57,135
CAPITAL COST TOTAL						\$438,032
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	3860	CY	2	ENVEST	\$9,264	\$11,302
Contractor Overhead Adjustment			22%	ENVEST	\$2,038	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$11,302
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$221,526
Assuming annual O&M cost for	30	YR	5%			\$173,741
Assuming annual O&M cost for	30	YR	10%			\$106,544
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$438,032
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$691,531
Assuming 30 years @ 5%						\$643,746
Assuming 30 years @ 10%						\$576,549

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

49 Waste Holes

Removal and Offsite Disposal

Description:

Removal and disposal involves the excavation, removal, and disposal of buried waste materials and contaminated soils, without segregation or treatment. The excavations would be backfilled with clean soils. Contaminated debris and soils would be disposed of offsite.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3860 yd³. This response action assumes 100 percent of this volume is to be excavated.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
49 Waste Holes	260	40	10	104000	3860	2951

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
Ground Penetrating Radar	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
REMEDIATION CAPITAL						
Excavation (incl. shoring, concrete demolition, transport, backfill, etc)	3860	CY	18.26	ENVEST		\$70,482
Material	1.88	EA	10466	ENVEST	\$19,697	
Labor	1.88	EA	11194	ENVEST	\$21,067	
Equipment	1.88	EA	9037	ENVEST	\$17,008	
Contractor Overhead Adjustment			22%	ENVEST	\$12,710	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Offsite Disposal						\$6,800,838
Transportation (625 miles to Envirocare in Utah)	3860	CY	142	Tri-State	\$547,638	
Offsite Disposal (to Envirocare as RMW debris)	3860	CY	1620	Envirocare	\$6,253,200	
CONSTRUCTION COST SUBTOTAL						\$6,894,499
Mobilization and General Requirements			15%			\$1,034,175
CONSTRUCTION COST SUBTOTAL						\$7,928,674
Contingencies						
Bid Contingency			10%			\$792,867
Scope Contingency			20%			\$1,585,735
Other Costs						
Administrative			5%			\$396,434
Services During Construction			10%			\$792,867
Legal			5%			\$396,434
IMPLEMENTATION COST TOTAL						\$11,893,011
Engineering/Design			15%			\$1,783,952
CAPITAL COST TOTAL						\$13,676,963
ANNUAL OPERATIONS & MAINTENANCE COST						
Not Required						
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$13,676,963
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$13,708,936
Assuming 30 years @ 5%						\$13,708,936
Assuming 30 years @ 10%						\$13,708,936

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Southwest Trenches

Remove, Segregate, and Dispose On Site

Description:

This response action is similar to the removal and disposal response action except that the contaminated soils would be segregated from the waste materials before disposal onsite. No treatment would be performed on the segregated soils. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwestern Trenches is estimated to be 470 yd³. This response action assumes 100 percent of this volume is to be excavated.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
SW Trenches (*2)	125	5	10	12500	470	359

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey (GPR)						\$767
GPR	3	HR	155	D&M	\$465	
Mobilization			15%	D&M	\$70	
Analysis and Report Prep.			50%	D&M	\$233	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$5,280
Germanium detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Beta scintillation detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Mobilization			15%	D&M	\$480	
Analysis and Report Prep.			50%	D&M	\$1,600	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$15,683
Mobilization and General Requirements			15%			\$2,352
CHARACTERIZATION COSTS SUBTOTAL						\$18,036
Contingencies			20%			\$3,607
Administrative			5%			\$902
CHARACTERIZATION COSTS TOTAL						\$22,545

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
REMEDICATION CAPITAL						
Excavation w/Segregation (incl. shoring, concrete dem., backfill, etc)	470	CY	27.38			\$12,867
Material	0.35	EA	5674	ENVEST	\$1,965	
Labor	0.35	EA	14388	ENVEST	\$4,983	
Equipment	0.35	EA	10388	ENVEST	\$3,598	
Contractor Overhead Adjustment			22%	ENVEST	\$2,320	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Onsite Disposal						\$15,482
(incl. capital for RCRA landfill + \$1/cy for transport))	470	CY	27	ENVEST	\$12,690	
Contractor Overhead Adjustment			22%	ENVEST	\$2,792	
CONSTRUCTION COST SUBTOTAL						\$51,528
Mobilization and General Requirements			15%			\$7,729
CONSTRUCTION COST SUBTOTAL						\$59,258
Contingencies						
Bid Contingency			10%			\$5,926
Scope Contingency			20%			\$11,852
Other Costs						
Administrative			5%			\$2,963
Services During Construction			10%			\$5,926
Legal			5%			\$2,963
IMPLEMENTATION COST TOTAL						\$88,887
Engineering/Design			15%			\$13,333
CAPITAL COST TOTAL						\$102,220
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	470	CY	2	ENVEST	\$1,128	\$1,376
Contractor Overhead Adjustment			22%	ENVEST	\$248	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$1,376
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$26,973
Assuming annual O&M cost for	30	YR	5%			\$21,155
Assuming annual O&M cost for	30	YR	10%			\$12,973
ESTIMATED CHARACTERIZATION						\$22,545
ESTIMATED CAPITAL COST (from above)						\$102,220
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$151,738
Assuming 30 years @ 5%						\$145,919
Assuming 30 years @ 10%						\$137,737

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Southwest Trenches

Remove, Segregate, and Dispose Offsite

Description:

This response action is similar to the removal and disposal response action except that the contaminated soils would be segregated from the waste materials before disposal off site. No treatment would be performed on the segregated soils. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwestern Trenches is estimated to be 470 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation would result in 50% RMW debris and 50% RMW soil to be disposed.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
SW Trenches (*2)	125	5	10	12500	470	359

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$767
GPR	3	HR	155	D&M	\$465	
Mobilization			15%	D&M	\$70	
Analysis and Report Prep.			50%	D&M	\$233	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$5,280
Germanium detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Beta scintillation detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Mobilization			15%	D&M	\$480	
Analysis and Report Prep.			50%	D&M	\$1,600	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$15,683
Mobilization and General Requirements			15%			\$2,352
CHARACTERIZATION COSTS SUBTOTAL						\$18,036
Contingencies			20%			\$3,607
Administrative			5%			\$902
CHARACTERIZATION COSTS TOTAL						\$22,545

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
REMEDIATION CAPITAL						
Excavation w/Segregation (incl. shoring, concrete dem., backfill, etc)	470	CY	27.38			\$12,867
Material	0.35	EA	5674	ENVEST	\$1,965	
Labor	0.35	EA	14388	ENVEST	\$4,983	
Equipment	0.35	EA	10388	ENVEST	\$3,598	
Contractor Overhead Adjustment			22%	ENVEST	\$2,320	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Offsite Disposal						\$701,181
Transportation (625 miles to Envirocare in Utah)	470	CY	142	Tri-State	\$66,681	
Offsite Disposal (to Envirocare)						
RMW debris	235	CY	1620	Envirocare	\$380,700	
RMW soil	235	CY	1080	Envirocare	\$253,800	
CONSTRUCTION COST SUBTOTAL						\$737,228
Mobilization and General Requirements			15%			\$110,584
CONSTRUCTION COST SUBTOTAL						\$847,812
Contingencies						
Bid Contingency			10%			\$84,781
Scope Contingency			20%			\$169,562
Other Costs						
Administrative			5%			\$42,391
Services During Construction			10%			\$84,781
Legal			5%			\$42,391
IMPLEMENTATION COST TOTAL						\$1,271,718
Engineering/Design			15%			\$190,758
CAPITAL COST TOTAL						\$1,462,476
ANNUAL OPERATIONS & MAINTENANCE COST						
Not Required						
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$22,545
ESTIMATED CAPITAL COST (from above)						\$1,462,476
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$1,485,020
Assuming 30 years @ 5%						\$1,485,020
Assuming 30 years @ 10%						\$1,485,020

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Solid Waste Trenches

Remove, Segregate, and Dispose Onsite

Description:

This response action is similar to the removal and disposal response action except that the contaminated soils would be segregated from the waste materials before disposal onsite. No treatment would be performed on the segregated soils. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2790 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation results in 50% RMW debris and 50% RMW soil requiring disposal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Solid Waste Trenches	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
South of dog pens	275	10	10	27500	1020	780
Eastern Trenches	200	14	10	28000	1040	795
NE Trench	185	4	10	7400	280	214
Northern Trenches	85	12	10	10200	380	291
Trench #5	45	4	10	1800	70	54
Total				74900	2790	2133

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
GPR	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973
REMEDATION CAPITAL						
Excavation W/ Segregation (incl. shoring, concrete dem., backfill, etc)	2790	CY	27.6	ENVEST		\$77,017
Material	0.65	EA	17712	ENVEST	\$11,450	
Labor	0.65	EA	45598	ENVEST	\$29,476	
Equipment	0.65	EA	34347	ENVEST	\$22,203	
Contractor Overhead Adjustment			22%	ENVEST	\$13,888	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Onsite Disposal						\$91,903
(incl. capital for RCRA landfill + \$1/cy for transport))	2790	CY	27	ENVEST	\$75,330	
Contractor Overhead Adjustment			22%	ENVEST	\$16,573	
CONSTRUCTION COST SUBTOTAL						\$192,099
Mobilization and General Requirements			15%			\$28,815
CONSTRUCTION COST SUBTOTAL						\$220,914
Contingencies						
Bid Contingency			10%			\$22,091
Scope Contingency			20%			\$44,183
Other Costs						
Administrative			5%			\$11,046
Services During Construction			10%			\$22,091
Legal			5%			\$11,046
IMPLEMENTATION COST TOTAL						\$331,372
Engineering/Design			15%			\$49,706
CAPITAL COST TOTAL						\$381,077
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	2790	CY	2	ENVEST	\$6,696	\$8,169
Contractor Overhead Adjustment			22%	ENVEST	\$1,473	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$8,169
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$160,118
Assuming annual O&M cost for	30	YR	5%			\$125,579
Assuming annual O&M cost for	30	YR	10%			\$77,010
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$381,077

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$573,169
Assuming 30 years @ 5%						\$538,630
Assuming 30 years @ 10%						\$490,060

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Solid Waste Trenches

Remove, Segregate, and Dispose Offsite

Description:

This response action is similar to the removal and disposal response action except that the contaminated soils would be segregated from the waste materials before disposal offsite. No treatment would be performed on the segregated soils. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2790 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation results in 50% RMW debris and 50% RMW soil requiring disposal.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Solid Waste Trenches	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
South of dog pens	275	10	10	27500	1020	780
Eastern Trenches	200	14	10	28000	1040	795
NE Trench	185	4	10	7400	280	214
Northern Trenches	85	12	10	10200	380	291
Trench #5	45	4	10	1800	70	54
Total				74900	2790	2133

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
GPR	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973
REMEDIALTION CAPITAL						
Excavation W/ Segregation (incl. shoring, concrete dem., backfill, etc)	2790	CY	27.6	ENVEST		\$77,017
Material	0.65	EA	17712	ENVEST	\$11,450	
Labor	0.65	EA	45598	ENVEST	\$29,476	
Equipment	0.65	EA	34347	ENVEST	\$22,203	
Contractor Overhead Adjustment			22%	ENVEST	\$13,888	
Waste Manifest Sampling						\$14,400
Sample Analyses (Composite)	4	EA	3600	OHM	\$14,400	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Offsite Disposal						\$4,162,331
Transportation (625 miles to Envirocare in Utah)	2790	CY	142	Tri-State	\$395,831	
Offsite Disposal						
RMW debris	1395	CY	1620	Envirocare	\$2,259,900	
RMW soil	1395	CY	1080	Envirocare	\$1,506,600	
CONSTRUCTION COST SUBTOTAL						\$4,262,528
Mobilization and General Requirements			15%			\$639,379
CONSTRUCTION COST SUBTOTAL						\$4,901,907
Contingencies						
Bid Contingency			10%			\$490,191
Scope Contingency			20%			\$980,381
Other Costs						
Administrative			5%			\$245,095
Services During Construction			10%			\$490,191
Legal			5%			\$245,095
IMPLEMENTATION COST TOTAL						\$7,352,861
Engineering/Design			15%			\$1,102,929
CAPITAL COST TOTAL						\$8,455,790
ANNUAL OPERATIONS & MAINTENANCE COST						
Not Required						
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$8,455,790

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$8,487,763
Assuming 30 years @ 5%						\$8,487,763
Assuming 30 years @ 10%						\$8,487,763

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Southwest Trenches

Remove, Segregate, Treat, and Dispose Onsite

Description:

Removal, segregation, treatment, and disposal involves the excavation, removal, segregation, treatment, and disposal of buried waste materials and contaminated soils. The contaminated soils would be segregated from the waste materials for treatment. Treatment would involve soil washing to concentrate contaminants into smaller volumes through classification techniques and/or dissolution/desorption. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwestern Trenches is estimated to be 470 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation would separate the waste into 50% debris and 50% soil. Classification and soil washing would reduce the contaminated soil volume a 75%, allowing that fraction to be returned to the site.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Width Depth			Volume (ft ³)	Volume (yd ³)	Volume (m ³)
	Length (ft)	(ft)	(ft)			
SW Trenches (*2)	125	5	10	12500	470	359

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$767
GPR	3	HR	155	D&M	\$465	
Mobilization			15%	D&M	\$70	
Analysis and Report Prep.			50%	D&M	\$233	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$5,280
Germanium detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Beta scintillation detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Mobilization			15%	D&M	\$480	
Analysis and Report Prep.			50%	D&M	\$1,600	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$15,683
Mobilization and General Requirements			15%			\$2,352

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$18,036
Contingencies			20%			\$3,607
Administrative			5%			\$902
CHARACTERIZATION COSTS TOTAL						\$22,545
REMEDIATION CAPITAL						
Excavation w/Segregation (incl. shoring, concrete dem., backfill, etc)	470	CY	27.38			\$12,867
Material	0.35	EA	5674	ENVEST	\$1,965	
Labor	0.35	EA	14388	ENVEST	\$4,983	
Equipment	0.35	EA	10388	ENVEST	\$3,598	
Contractor Overhead Adjustment			22%	ENVEST	\$2,320	
Treatment						\$31,490
Classification	470	CY	1	Appendix B	\$470	
Soil Washing	235	CY	132	Appendix B	\$31,020	
Waste Manifest Sampling						\$43,200
Sample Analyses (Composite- 4 per waste type)	12	EA	3600	OHM	\$43,200	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Onsite Disposal						\$9,676
(incl. capital for RCRA landfill + \$1/cy for transport))	294	CY	27	ENVEST	\$7,931	
Contractor Overhead Adjustment			22%	ENVEST	\$1,745	
CONSTRUCTION COST SUBTOTAL						\$106,013
Mobilization and General Requirements			15%			\$15,902
CONSTRUCTION COST SUBTOTAL						\$121,915
Contingencies						
Bid Contingency			10%			\$12,191
Scope Contingency			20%			\$24,383
Other Costs						
Administrative			5%			\$6,096
Services During Construction			10%			\$12,191
Legal			5%			\$6,096
IMPLEMENTATION COST TOTAL						\$182,872
Engineering/Design			15%			\$27,431
CAPITAL COST TOTAL						\$210,303
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	294	CY	2	ENVEST	\$705	\$860
Contractor Overhead Adjustment			22%	ENVEST	\$155	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$860
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$16,858
Assuming annual O&M cost for	30	YR	5%			\$13,222
Assuming annual O&M cost for	30	YR	10%			\$8,108
ESTIMATED CHARACTERIZATION						\$22,545
ESTIMATED CAPITAL COST (from above)						\$210,303

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
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TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST

Assuming 30 years @ 3%						\$249,706
Assuming 30 years @ 5%						\$246,069
Assuming 30 years @ 10%						\$240,956

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Southwest Trenches

Remove, Segregate, Treat, and Dispose Offsite

Description:

Removal, segregation, treatment, and disposal involves the excavation, removal, segregation, treatment, and disposal of buried waste materials and contaminated soils. The contaminated soils would be segregated from the waste materials for treatment. Treatment would involve soil washing to concentrate contaminants into smaller volumes through classification techniques and/or dissolution/desorption. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Southwestern Trenches is estimated to be 470 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation would separate the waste into 50% debris and 50% soil. Classification and soil washing would reduce the contaminated soil volume a 75%, allowing that fraction to be returned to the site.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
SW Trenches (*2)	125	5	10	12500	470	359

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$767
GPR	3	HR	155	D&M	\$465	
Mobilization			15%	D&M	\$70	
Analysis and Report Prep.			50%	D&M	\$233	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$5,280
Germanium detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Beta scintillation detector (10 grid pts)	8	HR	200	PNL	\$1,600	
Mobilization			15%	D&M	\$480	
Analysis and Report Prep.			50%	D&M	\$1,600	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$15,683
Mobilization and General Requirements			15%			\$2,352
CHARACTERIZATION COSTS SUBTOTAL						\$18,036
Contingencies			20%			\$3,607
Administrative			5%			\$902

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS TOTAL						\$22,545
REMEDIALTION CAPITAL						
Excavation w/Segregation (incl. shoring, concrete dem., backfill, etc)	470	CY	27.38			\$12,867
Material	0.35	EA	5674	ENVEST	\$1,965	
Labor	0.35	EA	14388	ENVEST	\$4,983	
Equipment	0.35	EA	10388	ENVEST	\$3,598	
Contractor Overhead Adjustment			22%	ENVEST	\$2,320	
Treatment						\$31,490
Classification	470	CY	1	Appendix B	\$470	
Soil Washing	235	CY	132	Appendix B	\$31,020	
Waste Manifest Sampling						\$43,200
Sample Analyses (Composite- 4 per waste type)	12	EA	3600	OHM	\$43,200	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Offsite Disposal						\$435,066
Transportation (625 miles to Envirocare in Utah)	294	CY	142	Tri-State	\$41,676	
Off-Site Disposal (to Envirocare as RMW debris)	235	CY	1620	Envirocare	\$380,700	
Off-Site Disposal (to Envirocare as LLW soil)	59	CY	216	Envirocare	\$12,690	
CONSTRUCTION COST SUBTOTAL						\$531,402
Mobilization and General Requirements			15%			\$79,710
CONSTRUCTION COST SUBTOTAL						\$611,113
Contingencies						
Bid Contingency			10%			\$61,111
Scope Contingency			20%			\$122,223
Other Costs						
Administrative			5%			\$30,556
Services During Construction			10%			\$61,111
Legal			5%			\$30,556
IMPLEMENTATION COST TOTAL						\$916,669
Engineering/Design			15%			\$137,500
CAPITAL COST TOTAL						\$1,054,170
ANNUAL OPERATIONS & MAINTENANCE COST						
None Required						
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$22,545
ESTIMATED CAPITAL COST (from above)						\$1,054,170

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$1,076,714
Assuming 30 years @ 5%						\$1,076,714
Assuming 30 years @ 10%						\$1,076,714

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Solid Waste Trenches

Remove, Segregate, Treat, and Dispose Onsite

Description:

Removal, segregation, treatment, and disposal involves the excavation, removal, segregation, treatment, and disposal of buried waste materials and contaminated soils. The contaminated soils would be segregated from the waste materials for treatment. Treatment would involve soil washing to concentrate contaminants into smaller volumes through classification techniques and/or dissolution/desorption. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2790 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation would separate the waste into 50% debris and 50% soil. Classification and soil washing would reduce the contaminated soil volume 75%, allowing that fraction to be returned to the site.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Solid Waste Trenches	Width Depth			Volume (ft ³)	Volume (yd ³)	Volume (m ³)
	Length (ft)	(ft)	(ft)			
South of dog pens	275	10	10	27500	1020	780
Eastern Trenches	200	14	10	28000	1040	795
NE Trench	185	4	10	7400	280	214
Northern Trenches	85	12	10	10200	380	291
Trench #5	45	4	10	1800	70	54
Total				74900	2790	2133

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
GPR	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973
REMEDIAL CAPITAL						
Excavation W/Segregation (incl. shoring, concrete dem., backfill, etc)	2790	CY	27.6	ENVEST		\$77,017
Material	0.65	EA	17712	ENVEST	\$11,450	
Labor	0.65	EA	45598	ENVEST	\$29,476	
Equipment	0.65	EA	34347	ENVEST	\$22,203	
Contractor Overhead Adjustment			22%	ENVEST	\$13,888	
Treatment						\$186,930
Classification	2790	CY	1	Appendix B	\$2,790	
Soil Washing	1395	CY	132	Appendix B	\$184,140	
Waste Manifest Sampling						\$43,200
Sample Analyses (Composite - 4 per waste type)	12	EA	3600	OHM	\$43,200	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Onsite Disposal						\$57,439
(incl. capital for RCRA landfill + \$1/cy for transport))	1744	CY	27	ENVEST	\$47,081	
Contractor Overhead Adjustment			22%	ENVEST	\$10,358	
CONSTRUCTION COST SUBTOTAL						\$373,366
Mobilization and General Requirements			15%			\$56,005
CONSTRUCTION COST SUBTOTAL						\$429,371
Contingencies						
Bid Contingency			10%			\$42,937
Scope Contingency			20%			\$85,874
Other Costs						
Administrative			5%			\$21,469
Services During Construction			10%			\$42,937
Legal			5%			\$21,469
IMPLEMENTATION COST TOTAL						\$644,056
Engineering/Design			15%			\$96,608
CAPITAL COST TOTAL						\$740,665
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	1744	CY	2	ENVEST	\$4,185	\$4,185
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$4,185
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$82,028
Assuming annual O&M cost for	30	YR	5%			\$64,334
Assuming annual O&M cost for	30	YR	10%			\$39,452
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$740,665

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$854,666
Assuming 30 years @ 5%						\$836,971
Assuming 30 years @ 10%						\$812,089

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

Solid Waste Trenches

Remove, Segregate, Treat, and Dispose Offsite

Description:

Removal, segregation, treatment, and disposal involves the excavation, removal, segregation, treatment, and disposal of buried waste materials and contaminated soils. The contaminated soils would be segregated from the waste materials for treatment. Treatment would involve soil washing to concentrate contaminants into smaller volumes through classification techniques and/or dissolution/desorption. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the Solid Waste Trenches is estimated to be 2790 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation would separate the waste into 50% debris and 50% soil. Classification and soil washing would reduce the contaminated soil volume 75%, allowing that fraction to be returned to the site.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Solid Waste Trenches	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
South of dog pens	275	10	10	27500	1020	780
Eastern Trenches	200	14	10	28000	1040	795
NE Trench	185	4	10	7400	280	214
Northern Trenches	85	12	10	10200	380	291
Trench #5	45	4	10	1800	70	54
Total				74900	2790	2133

Cost Component Description	Quantity	Unit	Unit Price	Basis for Unit Price	Component Cost	Category Subtotal
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
GPR	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973
REMEDIALTION CAPITAL						
Excavation W/ Segregation (incl. shoring, concrete dem., backfill, etc)	2790	CY	27.6	ENVEST		\$77,017
Material	0.65	EA	17712	ENVEST	\$11,450	
Labor	0.65	EA	45598	ENVEST	\$29,476	
Equipment	0.65	EA	34347	ENVEST	\$22,203	
Contractor Overhead Adjustment			22%	ENVEST	\$13,888	
Treatment						\$186,930
Classification	2790	CY	1	Appendix B	\$2,790	
Soil Washing	1395	CY	132	Appendix B	\$184,140	
Waste Manifest Sampling						\$43,200
Sample Analyses (Composite - 4 per waste type)	12	EA	3600	OHM	\$43,200	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Offsite Disposal						\$2,883,945
Transportation (625 miles to Envirocare in Utah)	1744	CY	142	Tri-State	\$247,395	
Offsite Disposal						
RMW debris	1395	CY	1620	Envirocare	\$2,259,900	
RMW soil	349	CY	1080	Envirocare	\$376,650	
CONSTRUCTION COST SUBTOTAL						\$3,199,871
Mobilization and General Requirements			15%			\$479,981
CONSTRUCTION COST SUBTOTAL						\$3,679,852
Contingencies						
Bid Contingency			10%			\$367,985
Scope Contingency			20%			\$735,970
Other Costs						
Administrative			5%			\$183,993
Services During Construction			10%			\$367,985
Legal			5%			\$183,993
IMPLEMENTATION COST TOTAL						\$5,519,778
Engineering/Design			15%			\$827,967
CAPITAL COST TOTAL						\$6,347,745
ANNUAL OPERATIONS & MAINTENANCE COST						
Not Required						
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$6,347,745

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$6,379,718
Assuming 30 years @ 5%						\$6,379,718
Assuming 30 years @ 10%						\$6,379,718

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

49 Waste Holes

Remove, Segregate, Treat, and Dispose Onsite

Description:

Removal, segregation, treatment, and disposal involves the excavation, removal, segregation, treatment, and disposal of buried waste materials and contaminated soils. The contaminated soils would be segregated from the waste materials for treatment. Treatment would involve soil washing to concentrate contaminants into smaller volumes through classification techniques and/or dissolution/desorption. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3860 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation would separate the waste into 25% debris and 75% soil. Screening and classification would further segregate the debris waste into RMW debris (40%), Category 3 waste (10%) and RMW soil (50%). Soil washing of the segregated soil waste would reduce the volume of contaminated soil (LLW) by 75%.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
49 Waste Holes	260	40	10	104000	3860	2951

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
GPR	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973
REMEDIATION CAPITAL						
Excavation w/ Segregation (incl. shoring, concrete dem., backfill, etc)	3860	CY	27.41	ENVEST		\$105,818
Material	1.88	EA	10466	ENVEST	\$19,697	
Labor	1.88	EA	19837	ENVEST	\$37,333	
Equipment	1.88	EA	15784	ENVEST	\$29,706	
Contractor Overhead Adjustment			22%	ENVEST	\$19,082	
Treatment						\$383,105
Classification	965	CY	1	Appendix B	\$965	
Soil Washing	2895	CY	132	Appendix B	\$382,140	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Waste Manifest Sampling						\$43,200
Sample Analyses (Composite)	12	EA	3600	OHM	\$43,200	
Onsite Disposal						\$52,440
(incl. capital for RCRA landfill + \$1/cy for transport))	1592	CY	27	ENVEST	\$42,984	
Contractor Overhead Adjustment			22%	ENVEST	\$9,456	
CONSTRUCTION COST SUBTOTAL						\$593,344
Mobilization and General Requirements			15%			\$89,002
CONSTRUCTION COST SUBTOTAL						\$682,345
Contingencies						
Bid Contingency			10%			\$68,235
Scope Contingency			20%			\$136,469
Other Costs						
Administrative			5%			\$34,117
Services During Construction			10%			\$68,235
Legal			5%			\$34,117
IMPLEMENTATION COST TOTAL						\$1,023,518
Engineering/Design			15%			\$153,528
CAPITAL COST TOTAL						\$1,177,045
ANNUAL OPERATIONS & MAINTENANCE COST						
Maintenance of Onsite Landfill	1592	CY	2	ENVEST	\$3,821	\$4,661
Contractor Overhead Adjustment			22%	ENVEST	\$841	
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$4,661
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$91,365
Assuming annual O&M cost for	30	YR	5%			\$71,657
Assuming annual O&M cost for	30	YR	10%			\$43,942
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$1,177,045

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$1,300,383
Assuming 30 years @ 5%						\$1,280,675
Assuming 30 years @ 10%						\$1,252,961

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

OU-1

49 Waste Holes

Remove, Segregate, Treat, and Dispose Offsite

Description:

Removal, segregation, treatment, and disposal involves the excavation, removal, segregation, treatment, and disposal of buried waste materials and contaminated soils. The contaminated soils would be segregated from the waste materials for treatment. Treatment would involve soil washing to concentrate contaminants into smaller volumes through classification techniques and/or dissolution/desorption. The excavations would be backfilled with clean soils.

Basis/Assumptions:

The total volume of buried waste materials, contaminated soils, and overburden associated with the 49 Waste Holes is estimated to be 3860 yd³. This response action assumes 100 percent of this volume is to be excavated. Segregation would separate the waste into 25% debris and 75% soil. Screening and classification would further segregate the debris waste into RMW debris (40%), Category 3 waste (10%) and RMW soil (50%). Soil washing of the segregated soil waste would reduce the volume of contaminated soil (LLW) by 75%.

Characterization activities associated with this response action include geophysical, soil gas, and radiological surveys; and chemical sampling and analysis. The surveys would be used to delineate the source area boundaries, with sampling and analysis to confirm that all contaminated materials were excavated. Stockpiled wastes will be characterized for disposal. Backhoe exploration, soil borings, and physical testing proposed in the Final Draft RI/FS Work Plan (DOE 1994) are considered unnecessary. Details of remedial technology assumptions are included in Appendix B.

Component	Length (ft)	Width (ft)	Depth (ft)	Volume (ft ³)	Volume (yd ³)	Volume (m ³)
49 Waste Holes	260	40	10	104000	3860	2951

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION						
Literature Review	24	HR	60	D&M	\$1,440	\$1,440
Geophysical Survey						\$2,046
GPR	8	HR	155	D&M	\$1,240	
Mobilization			15%	D&M	\$186	
Analysis and Report Prep.			50%	D&M	\$620	
Backhoe Exploration & Sampling (Not Required)						\$0
Surface Radiation Survey						\$10,560
Germanium detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Beta scintillation detector (20 grid pts)	16	HR	200	PNL	\$3,200	
Mobilization			15%	D&M	\$960	
Analysis and Report Prep.			50%	D&M	\$3,200	
Soil Gas						\$5,100
Labor & Materials	15	HR	300	D&M	\$4,500	
Per Diem	2	DY	150	D&M	\$300	
Standby	2	DY	150	D&M	\$300	
Soil Borings, Sampling, and Analysis (Not Required)						\$0
Physical Testing (Not Required)						\$0
Survey Locations						\$696
Field survey	4	HR	145	D&M	\$580	
Data Reduction/Reporting			20%	D&M	\$116	
Tech memo prep.						\$2,400
Geologist time	40	HR	60	D&M	\$2,400	
CHARACTERIZATION COSTS SUBTOTAL						\$22,242
Mobilization and General Requirements			15%			\$3,336

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
CHARACTERIZATION COSTS SUBTOTAL						\$25,578
Contingencies			20%			\$5,116
Administrative			5%			\$1,279
CHARACTERIZATION COSTS TOTAL						\$31,973
REMEDIALTION CAPITAL						
Excavation w/ Segregation (incl. shoring, concrete dem., backfill, etc)	3860	CY	27.41	ENVEST		\$105,818
Material	1.88	EA	10466	ENVEST	\$19,697	
Labor	1.88	EA	19837	ENVEST	\$37,333	
Equipment	1.88	EA	15784	ENVEST	\$29,706	
Contractor Overhead Adjustment			22%	ENVEST	\$19,082	
Treatment						\$383,105
Classification	965	CY	1	Appendix B	\$965	
Soil Washing	2895	CY	132	Appendix B	\$382,140	
Confirmatory Sampling						\$8,780
Sample Analyses	4	EA	2195	D&M	\$8,780	
Waste Manifest Sampling						\$43,200
Sample Analyses (Composite)	12	EA	3600	OHM	\$43,200	
Offsite Disposal						\$1,760,347
Transportation (625 miles to Envirocare in Utah)	1592	CY	142	Tri-State	\$225,900	
Off-Site Disposal to Envirocare as RMW debris	386	CY	1620	Envirocare	\$625,320	
Off-Site Disposal to Envirocare as RMW soil	483	CY	1080	Envirocare	\$521,100	
Off-Site Disposal to Envirocare as LLW soil	724	CY	216	Envirocare	\$156,330	
Transportation (miles to Hanford, WA)	97	CY	187	Tri-State	\$18,046	
Offsite Disposal to Hanford as Category 3 waste	97	CY	2214	WHC	\$213,651	
CONSTRUCTION COST SUBTOTAL						\$2,301,250
Mobilization and General Requirements			15%			\$345,188
CONSTRUCTION COST SUBTOTAL						\$2,646,438
Contingencies						
Bid Contingency			10%			\$264,644
Scope Contingency			20%			\$529,288
Other Costs						
Administrative			5%			\$132,322
Services During Construction			10%			\$264,644
Legal			5%			\$132,322
IMPLEMENTATION COST TOTAL						\$3,969,656
Engineering/Design			15%			\$595,448
CAPITAL COST TOTAL						\$4,565,105
ANNUAL OPERATIONS & MAINTENANCE COST						
Not Required						
ANNUAL OPERATIONS & MAINTENANCE COST TOTAL						\$0
PRESENT WORTH COSTS						
PRESENT WORTH OF OPERATIONS & MAINTENANCE COSTS						
Assuming annual O&M cost for	30	YR	3%			\$0
Assuming annual O&M cost for	30	YR	5%			\$0
Assuming annual O&M cost for	30	YR	10%			\$0
ESTIMATED CHARACTERIZATION						\$31,973
ESTIMATED CAPITAL COST (from above)						\$4,565,105

<u>Cost Component Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Basis for Unit Price</u>	<u>Component Cost</u>	<u>Category Subtotal</u>
TOTAL PRESENT WORTH OF CAPITAL COST & OPERATIONS & MAINTENANCE COST						
Assuming 30 years @ 3%						\$4,597,078
Assuming 30 years @ 5%						\$4,597,078
Assuming 30 years @ 10%						\$4,597,078

The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. Final project costs will depend on actual labor and material costs, actual site conditions at the time of remediation, productivity, competitive market conditions, final project scope, final project schedule, the firm selected to perform the engineering, and many other variables. As a result, the final project costs will differ from the estimates presented here. Because of the inherent variability, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

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