DOE/RL-2010-98
Revision 0

Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units

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Appendix K

Cost Estimate

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Contents

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ENVIRONMENTAL COST ESTIMATE

ECE-100FR111-00010

Environmental Cost Estimate for 100 F/IU Vadose Zone and Groundwater RI/FS

Revision 4

Date: December 11, 2013

Project: CH2M HILL Plateau Remediation Company

Topic: Cost Analysis

Lead Estimator: K. Klink

Senior Review: S. Ferries

Administrative Use

CHPRC ENVIRONMENTAL COST ESTIMATE COVER PAGE

Part 1: To be completed by the ER&QA Lead Cost Estimator

Project: 100-F/IU Area RI/FS | **Date:** 12/11/2013

Calculation Title & Description: Environmental Cost Estimate for 100 F/IU Vadose Zone and Groundwater RI/FS

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B. Ostapkowicz **Cost Estimate Checker**	**Basis of Qualification:** Civil Engineer with 9 years experience in hazardous waste site characterization/remediation and process design.
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Part 2: To be completed by Project Cost Estimator

Calculation No.: ECE-100FR111-00010 **Revision No.:** 4

Revision History:

Revision No.	Description	Date	Affected Pages
0&1	Environmental Cost Estimate for 100-F/IU (08/23/11, and 09/26/12)	09/26/12	All
2	Entire Document	12/10/2012	All
3	Entire Document	07/08/2013	All
4	Minor updates to Alternative GW-3 cost	12/11/2013	All

Part 3: Document Review & Approval

Project Cost Estimator:	K. Klink/Chemical Engineer NAME/POSITION [signature] SIGNATURE	Mar 27,2014 DATE
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One Team. One Culture.

Terms

AACE	Association for the Advancement of Cost Engineering International
CHPRC	CH2M HILL Plateau Remediation Company
COC	Contaminant of Concern
DOE	U.S. Department of Energy
ECE	Environmental Cost Estimate
ECF	Environmental Calculation File
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FICA	*Federal Insurance Contributions Act*
FP	Fixed-price
G&A	General and administrative
HSSA	Hanford Site Stabilization Agreement
IAROD	Interim Action Record of Decision
MS Excel™	Microsoft Excel
O&M	Operation and Maintenance
OMB	Office of Management and Budget
PRC	Plateau Remediation Company
PW	Present Worth
RACER™	Remedial Action Cost Engineering and Requirements System (Cost Estimating Software)
RCTs	Radiological Control Technicians
RTD	Remove, Treat, Dispose
TRACE	Tool for Response Action Cost Estimating, version 3.0, 2012

Table of Contents

Figures

Tables

Appendix

Introduction

CHPRC has prepared this Environmental Cost Estimate (ECE) to support the evaluation of remedial action alternatives to be documented in the Remedial Investigation/ Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units, DOE/RL-2010-98.

The cost estimates for each waste site and groundwater area summarized in this ECE have been prepared for comparative response action evaluation(s) from the information available at the time of preparation. The cost estimates reflect specific response action approaches, and scope assumptions and exclusions as well as cost estimating methodologies. The response action cost estimates have expected ranges of accuracy described in the "Estimate Classification" section (Section 12). The final costs of the selected response action will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other factors.

1 Purpose of Estimate

This ECE and backup material supports the response action alternatives analysis for the 100-F/IU Feasibility Study project (Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units). It provides an overview of response action-specific cost inputs, methodology, and results.

The purpose of this ECE is to:

- Describe the methodology applied in performing the cost estimates.
- Describe the general and response action-specific assumptions and cost inputs applied to the subject cost estimates.
- Summarize the response action alternative cost estimates.

This ECE also documents the references that provide additional scope and cost estimate information used to prepare these estimates.

2 General Project Description

In 1989, representatives from Washington State Department of Ecology (Ecology), U.S. Environmental Protection Agency (EPA), and U.S. Department of Energy (DOE) signed the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement [Ecology et al., 1989a]). The agreement created a cohesive regulatory framework, schedule, and adjudication process to administer environmental remediation activities at the Hanford Site for both *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) response action and *Resource Conservation and Recovery Act of 1976* (RCRA) corrective action activities.

For the purpose of remediation, the River Corridor was divided into different geographic areas: 100-BC, 100-K, 100-D, 100-H (managed as 100-D/H), 100-N, 100-F, 100-IU-2, 100-IU-6 (managed as 100-F/IU-2/IU-6), and the 300 Area (see Figure below). These geographic areas include groundwater OUs, source OUs, and facilities that encompass the 100 Area National Priorities List sites.

The 100 Area sites and the groundwater (shown in Figure 1) are contaminated from releases and spills of radiological and/or chemical constituents, and historical solid waste disposal practices, and encompass the

100 Area sites that are on the National Priorities List (NPL) (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan (NCP)."

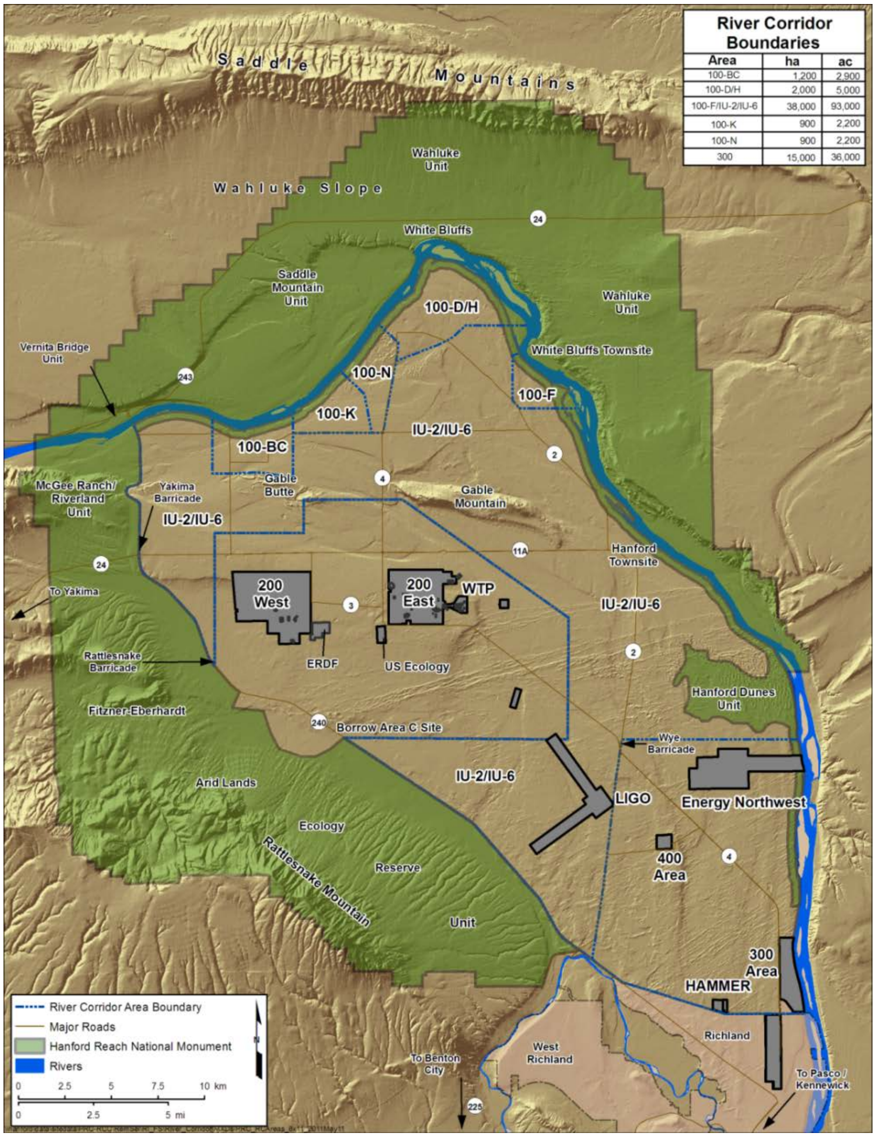

Figure 1-River Corridor Area at Hanford

The 100-F Area (100-FR-1 and 100-FR-2) is located downstream of the 100-H Area and upstream of the 300 Area and contains the F Reactor and associated infrastructure. The 100-IU-2 and 100-IU-6 OUs were not part of reactor operations, including the Hanford and White Bluffs Town sites, and consist of large expanses of open land between and outside the various production areas. 100-FR-3 is the groundwater OU associated with 100-FR-1 and 100-FR-2 OUs. Groundwater contamination in the areas underlying the 100-IU-2 and 100-IU-6 OUs is from past disposal practices in the 100 and 200 Areas. For cleanup purposes, groundwater OUs are linked to the source of the contaminant plume, not to the plume's physical location. There is no groundwater contaminant source from within the 100-IU-2 and 100-IU-6 OUs. Groundwater contamination underlying the 100-IU-2 and 100-IU-6 OUs will be addressed by river corridor and central plateau groundwater OUs.

This cost estimate encompasses the cost of one alternative for waste sites and four groundwater alternatives evaluated in the 100-F/IU Feasibility Study. The FS alternatives focus on the waste sites and groundwater contaminant plumes shown in Table 1.

Table 1-List of Waste Sites and Groundwater Plumes in CHPRC 100-F/IU Estimate

Waste Sites for Institutional Controls	
100-F-19:1 (includes sub sites: 100-F-19:3, 100-F-34, and 116-F-12)	118-F-6
100-F-19:2 (includes sub sites: 100-F-29, 100-F-10, and UPR-100-F-1)	118-F-8:3
116-F-2	118-F-8:4
116-F-6	116-F-14
116-F-9	
Groundwater Plumes	
Hexavalent chromium (Cr(VI))	Strontium-90 (Sr-90)
Trichloroethene (TCE)	Nitrate

3 Scope of Work

The cost estimate for the 100-F/IU Feasibility Study project was developed in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA/540/R-00/002, OSWER 9355.0-75 [EPA, 2000]), and contractor cost estimating procedures.

Quantities used in this estimate were based on the information provided by the technical project manager in the Environmental Calculation File (ECF) document, ECF-100FR3-11-0148, Rev 1, July 2013.

Remedial action alternatives were developed for fifteen waste sites and four groundwater contaminant plumes. The waste sites listed in Table 1 have site specific institutional controls as an alternative. Washington Closure Hanford (WCH) provided costs for the “Sites Remaining for Remedial Action” of which there are 36 sites. The alternative for these interim action sites is Remove, Treatment, and Disposal (RTD), as identified in the interim actionROD. RTD cost estimates were provided by WCH and shown in appendix Table A-1. The waste site alternatives are described further in Section 3.1.

The four groundwater contaminant plumes include a 41 acre plume of hexavalent chromium, 18 acre plume of Sr-90, two TCE plumes of 3.6 acres and 242 acres, and a nitrate plume of 2,617 acres and are described further in the RI/FS and Sections 3.2, 4, and 5 of this document.

3.1 Waste Site Alternatives

3.1.1 Alternative S-1: No Action.

The National Contingency Plan (NCP) (40 CFR 300.430(e)(6)) requires consideration of a No Action Alternative. The No Action Alternative, which serves as a baseline for evaluating other remediation action alternatives, is retained throughout the FS process. No action means that no remediation would be implemented to alter the existing conditions. For this alternative, it was assumed that all site remedial activities and interim actions (with the possible exception of backfilling any open excavations for safety purposes) would be discontinued. No conceptual designs or cost estimates are prepared for Alternative S-1 because no actions are proposed.

3.1.2 Alternative S-2: RTD.

Alternative S-2 uses RTD at 36 waste sites with costs provided from WCH (Table A-1), and site-specific institutional controls (ICs) and programmatic ICs at 15 waste sites (Tables A-2 to A-4).

As of March, 2013, 36 waste sites remained for remedial action under an Interim Action Record of Decision (IAROD) and are included in the cost estimate.

The RTD includes:

- Collection of confirmatory samples where warranted, based on the expected and actual risk drivers (media and contaminants of potential concern [COPCs]). Confirmatory evaluation will determine the need for remediation at selected sites and confirmation of contamination.
- Demolition of any surface and/or subsurface structures, as required.
- Excavation of waste site structures and vadose zone soil where contaminant concentrations are above cleanup levels. RTD to depth of contamination or 4.6 m (15 ft), whichever is greater, for contaminants exceeding cleanup levels for direct contact or ecological PRGs. RTD to depth of contamination or groundwater for contaminants exceeding groundwater and surface water PRGs. RTD will be performed using standard and deep excavation technologies.
- Determination of the extent of excavation required uses an observational approach. Removal actions use in situ and ex situ sampling, process knowledge, and field measurements to guide day-to-day excavation.
- Excavation using best practices, which includes appropriately sloped sidewalls based on the type of material being removed, benching, shoring, and proper placement of the stockpiled material according to Occupational Safety and Health Administration (OSHA) standards.
- Sampling and field screening during excavation to ensure that the overall remediation meets the cleanup levels.
- Suppression of dust during excavation to ensure that contaminants are not spread by wind.
- Disposal of excavated material to Environmental Restoration Disposal Facility (ERDF) as long as the material meets disposal criteria. Waste is treated as needed to meet land disposal restrictions before disposal at ERDF or an EPA-approved offsite location.
- Verification sampling following remediation to demonstrate that soil remaining in the remediation area does not exceed the cleanup levels.
- Site restoration through backfilling and contouring the excavation to match the surrounding ground surface, followed by re-vegetation. Sources for backfill material include local borrow pits

and the excavated material determined to be clean (verified as clean by meeting cleanup levels). Sites are re-vegetated with native plant species after backfilling.

Site specific institutional controls will be implemented for 15 waste sites within 100-F/IU with deep contamination. The ICs will include the following:

- Excavation restrictions on the waste sites to prevent unplanned disturbance or an irrigation restriction as identified by CERCLA decision documents.
- Land use and real property controls (for example, easements and covenants) to ensure that the use of land is in accordance with Hanford Site plans and CERCLA decision documents.
- Notices providing visual identification and warning of hazardous or sensitive areas.
- Procedural requirements for access, warning signs, or fencing implemented to prevent or limit the access of humans to hazardous or sensitive areas.
- Administrative mechanism, such as the waste information data system (WIDS), to maintain and provide access to information on the location and nature of contamination.
- Residual Cr(VI) concentrations present at waste site 116-F-14 exceeded the groundwater and surface water protection PRG under an irrigation land use scenario. Under Alternative S-2, an IC that prohibits irrigation will be implemented at this waste site.
- Institutional controls will be maintained for these 15 sites until unrestricted use is allowable.

Programmatic ICs: The estimated costs for providing the sitewide programmatic ICs are also included in the costs developed for this alternative . These ICs include site access restrictions, personnel badging, real estate and deed controls, warning signs along the Columbia River bank and other access points, maintaining a current site wide institutional controls plan, controls for excavating soil, restriction on accessing and using groundwater, and irrigation restrictions.

For comparison purposes for the Feasibility Study, a rough order of magnitude cost estimate was prepared to determine the cost for RTD of the 15 waste sites proposed for ICs (Table 1). The estimated cost assumed the sites were excavated using deep excavation technology; material was treated as necessary to meet disposal criteria, and transported and disposed of at ERDF. The estimated cost included backfilling and re-contouring, followed by re-vegetation. There is no O&M post remediation. The costs and key quantities are presented in Tables A-5 to A-7.

3.2 Groundwater

Each of the four groundwater alternatives are described below. The groundwater total costs are shown in Table A-8, costs for the individual plumes in Table A-9 and important input quantities in Table A-10. The estimated time frames to achieve PRGs are based on the 90th percentile (C90) concentration meeting the PRGs for the contaminants of concern (COCs) Table 2 provides the basis for the PRGs.

Table 2. Basis for Preliminary Remediation Goals

Contaminant of Concern	Units	Preliminary Remediation Goal	Basis
Strontium-90	pCi/L	8	DWS
Cr(VI)	µg/L	10/48	WAC 173-201A/ WAC 173-340-720
Trichloroethene	µg/L	4	WAC 173-340-720
Nitrate[a]	µg/L	45,000	DWS

Sources:

DWS from 40 CFR 141, "National Primary Drinking Water Regulations."

WAC 173-201A, "Water Quality Standards for Surface Waters of the State of Washington."

WAC 173-340-720, "Model Toxics Control Act—Cleanup," "Groundwater Cleanup Standards."

Notes:

Nitrate may be expressed as nitrate-nitrogen (NO_3-N) or as nitrate (NO_3). The DWSs for NO_3-N and NO_3 are 10,000 and 45,000 µg/L, respectively.

Cr(VI)= hexavalent chromium

DWS = drinking water standard

3.2.1 Alternative GW-1: No Action.

This alternative is required by the NCP ("Remedial Investigation/Feasibility Study and Selection of Remedy" [40 CFR 300.430(e)(6)]). The No Action Alternative, which serves as a baseline for evaluating other remediation action alternatives, is retained throughout the FS process. No action means that no remediation would be implemented to address the groundwater contaminant plumes. All existing groundwater monitoring and data evaluation and reporting would be discontinued, and existing institutional controls (ICs) lifted. No conceptual designs or cost estimates are prepared for Alternative GW-1 because no actions are proposed.

3.2.2 Alternative GW-2: Monitored Natural Attenuation (MNA) and ICs.

This alternative uses MNA processes to reduce contaminant of concern (COC) concentrations to preliminary remediation goals (PRGs), while ICs are maintained to prevent exposure to contaminated groundwater. The estimated time frame to achieve PRGs, based on the 90th percentile (C90) concentration, is 25 years for Cr(VI) based on the 10 µg/L State surface water quality standard, 30 years for nitrate, and 90 years for strontium-90. In lieu of the C90 concentration, the maximum projected (Cmax) concentration was used for the trichloroethene plume because the C90 concentration is projected to be below the PRG at time zero. The estimated timeframe for the trichloroethene plume to achieve its PRG based on Cmax is 50 years. Installation of 15 new monitoring wells, groundwater sampling and analysis, and data evaluation and reporting are also important components of this alternative to confirm that natural attenuation processes are reducing COC concentrations in accordance with expectations, and to provide a basis for determining when remedial action is complete and ICs can be removed.

3.2.3 Alternative GW-3: Pump-and-Treat with In situ Treatment and MNA.

This alternative utilizes pump-and-treat for Cr(VI), trichloroethene, strontium-90 and nitrate for cleanup of the remedial action target area. Substrate injection will be performed at up gradient nitrate and Cr(VI) injection wells to promote in-situ reduction of nitrate to nitrogen gas and reduction of Cr(VI) to Cr(III). Incidental reductive dechlorination of trichloroethene to cis 1,2-dichloroethene is also expected to occur, although such was not simulated under this alternative. MNA, following pump-and-treat operations, will also contribute to achieving cleanup levels for strontium-90 and the southern portion of the nitrate plume. The estimated remedial action timeframes based on the C90 concentration are: 5 years for Cr(VI) based on the 10 µg/L State surface water quality standard, 20 years for nitrate, and 85 years for strontium-90. The estimated timeframe to achieve the PRG for trichloroethene is 10 years, based on the Cmax concentration.

3.2.4 Alternative GW-4: Enhanced Pump-and-Treat

This alternative uses pump-and-treat with ex situ treatment technology for Cr(VI), strontium-90, trichloroethene, and nitrate-contaminated groundwater. This alternative uses a more aggressive pump-and-treat technology, similar to that employed for many of the 100 Area groundwater interim actions, to achieve PRGs within a shorter timeframe relative to the other groundwater remedial action alternatives. The estimated remedial action timeframes under this alternative, based on the C90 concentrations, are: 5 years for Cr(VI) based on the 10 µg/L State surface water quality standard, 10 years for nitrate, and 85 years for strontium-90. The estimated timeframe to achieve the PRG for trichloroethene, based on Cmax, is 10 years.

4 Overall Costs

Table 3 presents site specific capital, annual, periodic[1], total non-discounted, and total discounted (present value) costs for the site-specific ICs for the 15 Deep RAD contaminated sites, the 36 Post-ROD RTD sites and overall programmatic ICs. Table 4 presents site specific capital, annual, periodic, total non-discounted, and total discounted (present value) costs for each of the four groundwater alternatives for 100-F/IU.

Table 2-Summary of Alternative S-2 Total Costs[a]

Category	Amount
Total Capital (Non-discounted)	$ 9,630,000
Total Annual (Non-discounted)	$26,640,000
Total Periodic (Non-discounted)	$ 1,118,000
Total Non-discounted Cost	$37,388,000
Total Discounted (Discounted)	$20,579,000

Note: Range of accuracy is expected to be +50%/-30%
a. RTD costs for 36 waste sites under the Interim Action ROD and site specific institutional controls for 15 sites.

[1] Periodic costs are costs which occur on an irregular basis, rather than monthly or annually. Examples would be analytical costs occurring every other year, or every 5 years.

Table 3-Summary of Total Costs (Groundwater)

	Alternative GW-2	Alternative GW-3	Alternative GW-4
Total Capital (Non-discounted)	$4,930,000	$80,243,000	$96,534,000
Total Annual (Non-discounted)	$30,636,000	$91,840,000	$87,883,000
Total Periodic (Non-discounted)	$24,073,000	$31,863,000	$36,508,000
Total Non-discounted Cost	$59,639,000	$203,946,000	$220,925,000
Total Discounted (Discounted)	**$36,261,000**	**$176,780,000**	**$193,814,000**
Note: Range of accuracy is expected to be +50%/-30%			

Additional figures for the wastes sites can be found in Appendix A and are listed below:

Figure A-1 Waste Site: 100-F-19:1 (100-F-19:3, 100-F-34, and 116-F-12)
Figure A-2(a) Waste Site: 100-F-19:2(1) (100-F-29, UPR-100-F-1, and 100-F-10)
Figure A-2(b) Waste Site: 100-F-19:2(2) (100-F-29, UPR-100-F-1, and 100-F-10)
Figure A-2(c) Waste Site: 100-F-19:2(3) (100-F-29, UPR-100-F-1, and 100-F-10)
Figure A-3(a) Waste Site: 116-F-2(1)
Figure A-3(b) Waste Site: 116-F-2(2)
Figure A-3(c) Waste Site: 116-F-2(3)
Figure A-4 Waste Site: 116-F-6
Figure A-5 Waste Site: 116-F-9
Figure A-6 Waste Site: 116-F-14
Figure A-7 Waste Site: 118-F-6
Figure A-8 Waste Site: 118-F-8:3
Figure A-9 Waste Site: 118-F-8:4

5 Major Assumptions

There are two different types of assumptions and inputs for cost estimation; general and response activity specific.

5.1 General Assumptions and Inputs

General assumptions apply to all response action cost estimates. The general assumptions discussed in the sections below include direct and indirect cost assumptions and other general pricing assumptions.

5.1.1 General Direct Cost Assumptions

Direct costs include all costs that can be directly attributed to a particular construction activity or item of work required to accomplish the project. Typical direct cost items include: labor, material, equipment and subcontract items. Direct cost assumptions for this estimate include:

- Scope and Bid Contingencies, see Section 8

- Project management, remedial design, and construction management capital costs, see Section 9.
- Construction labor are discussed in Section 15
- Materials: backfill soil, grout, worker health and safety protective items, anionic ion exchange resin, vapor phase granular activated carbon, HDPE pipe, and bio-substrate are included in the estimates. Material costs were based on operating Hanford systems costs, RACER 2011 unit costs.
- Site preparation costs such as site access enhancements and controls, utility connections, site clearing and leveling, were included as allowances based on estimator judgment.
- Cost impacts for performing work under specific levels of worker health safety protection: work assumed to be performed under worker health and safety level D was assumed to be at the standard TRACE V3 unit cost rates

5.1.2 General Indirect Cost Assumptions

Indirect costs are costs not directly attributable to the completion of an activity. Indirect costs are typically allocated or spread across all activities on a predetermined basis. Indirect costs items can include the following job-related overhead items: taxes; project-specific insurance; bonds; permits and licenses; general supervision; temporary office personnel; schedules; preparatory work and testing services; temporary project facilities; temporary utilities; operations and maintenance of temporary project-site facilities; project vehicles; quality controls; mobilization and demobilization; and site security.

General indirect cost assumptions for this estimate include:

- Markups are included for profit and G&A, see Section 7
- Mobilization/demobilization and bonding/insurance – a standard TRACE V3 percentage allowance was used based on project size and using the high percentage value from the low, medium, and high percentages presented by TRACE V3 for the project size.

5.1.3 Other General Cost Assumptions

Remedial action assumptions and cost inputs used in this cost estimate were provided by the technical team in the *100-F/IU Cost Estimate Inputs for Remedial Investigation/Feasibility Study Alternatives for 100-FR-1, 100-FR-2, 100-IU-2, 100-IU-6 and 100-FR-3 Operable Units* (ECF-100FR3-11-0148, Rev1). Any changes from the original quantities and any additional cost estimate basis assumptions are documented below.

Institutional Controls

The estimated costs for providing the sitewide or programmatic ICs include site access, personnel badging, real estate and deeds, warning signs along the Columbia River bank and other access points, maintaining a current site wide institutional controls plan, controls for excavating soil, restrictions on accessing and using groundwater, and irrigation restrictions. These costs were developed for each alternative as follows:

  - Costs were assembled and where appropriate a 50% adjustment was made to represent CERCLA cleanup as a portion of the current Hanford Site mission. The TPA currently identifies 22 CERCLA Records of Decision, so each ROD would be allocated an equal portion of the CERCLA programmatic ICs costs. The programmatic ICs costs are projected for the next 150 years. In 2068 ICs costs are reduced by 50% to reflect removal of the 100 area reactors, as the more active programmatic controls, like site access, would be likewise reduced.

- The total non-discounted cost for the ICs for 150 years is estimated to be $563,000,000 for the Hanford site (about $26,000,000 per ROD). The total discounted cost for the ICs at Hanford are estimated at $221,000,000 (about $10,000,000 per ROD).
- The total non-discounted cost for the 5-Year Reviews for 150 years is estimated to be $14,000,000 (about $630,000 per ROD). The total discounted cost for the 5-Year Reviews for 150 years is estimated to be $4,000,000 (about $190,000 per ROD).

5.2 Response Activity-Specific Assumptions and Inputs

Assumptions specific to the proposed remedial activities for this cost estimate are described below. Quantity inputs used in the TRACE V3 cost estimating workbook are summarized for the vadose zone and groundwater estimates in Tables A-4 and A-10, respectively.

5.2.1 Groundwater Flow Rates

The groundwater flow rates were provided by the technical team for the following time ranges:

- Alternative GW-2 – not applicable
- Alternative GW-3
  - Cr(VI) plume: 2014 to 2018
  - Sr-90 plume: 2014 to 2023
  - TCE plume: 2014 to 2023
  - Nitrate plume: 2014 to 2023 (bio-injection through 2023)
- Alternative GW-4
  - Cr(VI) plume: 2014 to 2018
  - Sr-90 plume: 2014 to 2023
  - TCE plume: 2014 to 2023
  - Nitrate plume: 2014 to 2023

5.2.2 Summary of Cost by Site

The costs for the 100 F/IU remedial action alternatives were calculated both individually and combined as a total cost, with itemized waste site costs and itemized groundwater remediation costs for each alternative. Costs for each of the 15 waste sites with deep contamination, 36 RTD sites (costs from WCH), and four groundwater plumes were calculated and summarized separately from the alternative total costs by:

- Breaking out and summing each of the site-specific costs for each site

- Allocating a portion of the overall mobilization/demobilization/bonding/insurance, site preparation, and alternative markup costs to each specific site based on the site subtotal cost of the overall alternative cost

5.2.3 Modified Standard TRACE V3 Unit Costs

The following unit costs were used in the cost estimate and were added to the original TRACE V3 default costs. The source of the unit cost is listed beside the item in the list below.

From the groundwater cost estimate:

- Air stripper system with granular activate carbon (GAC) and complete elec/mech/I&C – Estimator Allowance
- Bionode System – Estimator Allowance
- Sr-90 Treatment Process Development – Estimator Allowance
- Tanks, pumps, miscellaneous process equipment not in system – Alt 3 – Estimator Allowance
- Tanks, pumps, miscellaneous process equipment not in system – Alt 4 – Estimator Allowance
- Maintain GWT systems readiness during 5 year compliance check – Estimator Allowance
- Annual O&M for air stripper– Estimator Allowance
- Annual O&M for Nitrate Anionic Resin IX – Based on Cr(IV) Anionic Resin IX O&M cost
- Final decommissioning/removal of above ground systems-Cr(VI) Alt 3 – 33% of capital cost
- Final decommissioning/removal of treatment systems-Sr-90 Alt 3 – 33% of capital cost
- Final decommissioning/removal of treatment systems-TCE Alt 3 – 33% of capital cost
- Final decommissioning/removal of treatment systems -NO3 Alt 3 – 33% of capital cost
- Final decommissioning/removal of treatment systems-Cr(VI) Alt4 – 33% of capital cost
- Final decommissioning/removal of treatment systems-Sr-90 Alt 4 – 33% of capital cost
- Final decommissioning/removal of treatment systems-TCE Alt 4 – 33% of capital cost
- Final decommissioning/removal of treatment systems -NO3 Alt 4 – 33% of capital cost

For the soil estimate:

- Annual inspection of the waste site - Hanford historical cost

5.2.4 Specific Assumptions

The following specific assumptions were included in the cost estimates:

- Monitoring well replacement – every 30 years
- Monitoring well pump replacement – every 5 years
- Extraction well replacement – every 20 years
- Extraction well rehabilitations – every 10 years
- Extraction well pump replacement – every 5 years
- Injection well replacement – every 10 years
- Injection well rehabilitations – every 2 years

- Site preparation – estimator's judgment at $100,000 to $500,000 for groundwater plume specific, alternative specific estimates.
- A single mobilization/demobilization for the groundwater remediation.

5.3 Alternative Specific Assumptions Used in Estimate

Each of the alternatives included specific assumptions as described below.

5.3.1 Waste Site Remedial Action Alternatives

The following assumptions for the waste site alternatives are based on data for the 100-F/IU operable units, as presented in Chapter 9 of DOE/RL-2010-98

Alternative S-1: No Action

- There are no alternative development cost estimate assumptions associated with this alternative.

Alternative S-2: RTD and ICs

The following 15 sites have site specific excavation restriction or irrigation restriction ICs associated with them. Table 5 provides the site name, along with the site specific duration.

Table 4-Waste Sites with Site Specific ICs

Waste Site	Period	Total IC Duration
100-F-19:1 (includes sub sites: 100-F-19:3, 100-F-34, and 116-F-12)	2012 to 2113	100 years
100-F-19:2 (includes sub sites: 100-F-29, 100-F-10, and UPR-100-F-1)	2012 to 2057	46 years
116-F-2	2012 to 2108	95 years
116-F-6	2012 to 2122	109 years
116-F-9	2012 to 2074	61 years
118-F-6	2012 to 2033	20 years
118-F-8:3	2012 to 2278	75 years
118-F-8:4	2012 to 2059	46 years
116-F-14	2012 to 2110	97 years

RTD costs for waste sites remaining for remedial action, as of March 2013, were provided by WCH for the following 36 sites: 600-20; 600-279; 600-293; 600-294; 600-301; 600-329; 600-331; 600-332; 600-334:2; 600-349; 600-358; 600-368; 600-369:1; 600-369:2; 600-369:3; 600-369:4; 600-369:5; 600-369:6;

600-369:7; 600-369:8; 600-370; 600-371; 600-372:1; 600-372:2; 600-373; 600-374; 600-375:1; 600-375:2; 600-375:3; 600-375:4; 600-375:5; 600-376:1; 600-376:2; 600-377; 600-378; and 600-379

5.3.2 Site: 100-F/ IU (100-FR-3 Groundwater OU)

The following assumptions for the GW alternatives are based on data for the 100-F/IU operable units, as presented in Chapter 9 of DOE/RL-2010-8.

Alternative GW-1- No Action Alternative

- There are no cost estimate development assumptions associated with this alternative

Alternative GW-2- MNA and ICs
The alternative development assumptions are based on Chapter 9 of DOE/RL-2010-98. Cost elements are segregated for all COC plumes and are shown below:

- Monitored Natural Attenuation
- Monitor Wells
- Groundwater Monitoring
- Well Abandonment
- Site Closeout

Alternative GW-3 – Pump-and-Treat with In situ Treatment and MNA

The alternative development assumptions are based on Chapter 9 of DOE/RL-2010-98. Cost elements are segregated for all COC plumes (except as noted in parentheses) and are shown below:

- Monitored Natural Attenuation
- Monitor Wells
- Extraction Wells
- Injection Wells (Cr(VI), TCE and nitrate plumes only)
- Ion Exchange (Cr(VI), nitrate and Sr-90 plumes only)
- Air Stripping (TCE plume only)
- In Situ Biodegredation (Cr(VI), TCE and nitrate plumes only)
- Well Abandonment
- Site Closeout

Alternative GW-4 – Enhanced Pump-and-Treat

The alternative development assumptions are based on Chapter 9 of DOE/RL-2010-98. Cost elements are segregated for all COC plumes (except as noted in parenthesis) and are noted below:

- Monitor Wells

- Extraction Wells
- Injection Wells (Cr(VI), nitrate, and TCE plumes only)
- Ion Exchange (Cr(VI), nitrate and Sr-90 plumes only)
- Air Stripping (TCE plume only)
- Well Abandonment
- Site Closeout

6 Exclusions

This section identifies costs that have not been included in the estimate. The exclusions are:

- Escalation – Separate escalation has not been included in these calculations. The costs are all based on fiscal year 2013 costs distributed into years that the activities and associated costs would occur, and a present value (PV) analysis is performed to convert all costs back to fiscal year 2013 basis using the alternative-specific stated OMB real discount rate.
- Costs for remediating the sites individually under separate contracts. The costs in this estimate assume that the sites are remediated under one contract corresponding to the specific alternative, or at most one waste site and one groundwater contract. If sites are remediated separately, the individual site costs would be expected to be higher than shown for the individual sites in Table A-2, since certain fixed costs would not be spread over a group of sites and certain activity economies of scale would not be present.

7 Markups

The following markups have been included in the Cost Estimate:

- Subcontractor Profit at 8 percent.
- Prime Contractor Profit at 10 percent.
- PRC Direct Distributable/ General and Administrative (DD/G&A) costs have been applied at a rate of 30.24[2] percent to all PRC labor, material, and equipment. DD/G&A is also applied to the fixed price (FP) contractor costs. This markup includes a number of job-related overhead items:
  - Taxes
  - Project-specific insurance
  - Bonds
  - Permits and licenses
  - General supervision
  - Temporary office personnel

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[2] G&A rate is obtained from CH2M Hill Plateau Remediation Company FY 2012 - – (provisional approval granted) http://prc.rl.gov/rapidweb/finance/index.cfm?pagenum=11.
Note: The G&A rate is typically updated each year per CH2M Hill's Financial Department's direction. Since this estimate is for comparison purposes, and this is a minor revision the G&A has been kept at the 2012 For this estimate Direct Distributable was included with the G&A markup. G&A + DD (direct distributable) rate of 30.24%.

- Schedules
- Preparatory work and testing services
- Temporary project facilities and O&M of these facilities
- Temporary utilities (e.g. phone, electrical)
- Project vehicles
- Personal protective equipment and Occupational Health and Safety requirements
- Quality controls
- Mobilization and demobilization
- Site security

8 Contingencies

Contingency is factored into a cost estimate to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the available data at the time the estimate is prepared. It is used to reduce the risk of possible cost overruns.

The two main types of contingency are scope and bid. Scope contingency covers unknown costs due to scope changes that may occur during design. Bid contingency covers unknown costs associated with constructing and implementing a given project scope. The range for bid contingency is typically from 10 to 20 percent.

- Scope Contingency. The scope contingency for this estimate has been set at 0% for the Alternative S-2 (only O&M costs in estimate, capital costs from WCH); 35% for Alternative GW-2 and 25% for Alternatives GW-3 and GW-4.

- Bid Contingency. The range for bid contingency is typically from 10 to 20 percent. The bid contingency for this estimate has been set at 0% for Alternative S-2, and 20% for Alternatives GW-2, GW-3, and GW-4.

- O&M Contingency. The O&M contingency has been estimated to be 20% for Alternative S-2, 30% for Alternative GW-2, and 20% for Alternatives GW-3 and GW-4.

9 Project Management, Remedial Design, and Construction Management Costs

Project management, remedial design, and construction management capital costs are estimated using factors based on EPA/540/R-00/002, Exhibit 5-8.

- For projects with construction costs less than $100,000 – remedial design is planned at 20 percent, project management is planned at 10 percent, and construction management is planned at 15 percent of the construction cost.

- For projects with construction costs from $100,000 to $500,000 – remedial design is planned at 15 percent, project management is planned at 8 percent, and construction management is planned at 10 percent of the construction cost.

- For projects with construction costs from $500,000 to $2 million – remedial design is planned at 12 percent, project management is planned at 6 percent, and construction management is planned at 8 percent of the construction cost.

- For projects with construction costs from $2 million to $10 million – remedial design is planned at 8 percent, project management is planned at 5 percent, and construction management is planned at 6 percent of the construction cost. This range was used for Alternative GW-2.
- For projects with construction costs greater than $10 million – remedial design is planned at 6 percent, project management is planned at 5 percent, and construction management is planned at 6 percent of the construction cost. This range was used for Alternatives GW-3 and GW-4.

10 Present Worth

The estimate includes present worth calculations for work performed in out years based on *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* **(**EPA/540/R-00/002, OSWER 9355.0-75 [EPA, 2000]).

The costs are presented as present worth values. The present worth value method establishes a common baseline for evaluating costs that occur during different time periods, thus allowing for direct cost comparisons between different alternatives. The present worth value represents the dollars that would need to be set aside today, at the defined real discount rate, to ensure that funds would be available in the future as they are needed to perform the response action alternative.

Present worth costs were estimated using the real discount rate published in Appendix C of the Office of Management and Budget (OMB) Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, effective October 2012*[3] (OMB, 2012). Based on this guidance and durations of 109 years for alternative 2 for waste sites, 97 yrs for groundwater alternative 2 and 92 years for groundwater alternatives 3 and 4, a real discount rate of 2.0 percent was used in the cost estimate present value calculations for these alternatives.

11 Estimate Classification

This estimate was prepared in accordance with the guidelines of "*A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, EPA 540-R-00-002, OSWER 9355.0-75, (EPA, 2000). As identified in guidance, at the FS stage the design for the response action project is still conceptual, not detailed, and the cost estimate is considered to be "order-of-magnitude." The expected accuracy range of the cost estimate at this stage is approximately plus 50 percent to minus 30 percent.

The expected accuracy range is an indication of the degree to which the final cost outcome for a given project could vary from the estimated cost. Accuracy is traditionally expressed as a +/- percentage range around the point estimate after application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range (+/- measures are a useful simplification, given that actual cost outcomes have different frequency distributions for different types of projects). Typically, this results in a 90% confidence that the actual cost will fall within the bounds of the low and high ranges.

The accuracy range of an estimate is dependent upon a number of characteristics of the estimate input information and the estimating process. The extent and the maturity of the input information as measured by percentage completion (and related to level of project definition) is an important determinant of

[3] This estimate originated in 2012. Since this estimate is a minor revision and has the possibility of changing again the decision was made to continue to use the 2012 discount rates.

accuracy. However, there are factors besides the available input information that also greatly affect estimate accuracy measures. Primary among these are the state of technology in the project and the quality of reference cost estimating data.

The accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as technology, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by estimate basis, usually in conjunction with some form of risk analysis process.

12 Cost Resources

The following is a list of the cost resources used in the development of the cost estimate.

- TRACE V3 (ECF-Hanford-11-0098 through 0107)
- RACER™ 2011
- RS Means
- Hanford historical actual costs
- Estimator Judgment

13 Estimate Methodology

The cost estimate for the 100-F/IU project was developed in accordance with *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* **(**EPA/540/R-00/002, OSWER 9355.0-75 [EPA, 2000]), and contractor cost estimating procedures. The TRACE V3 cost estimating workbook in conjunction with the RACER™ Cost Estimator software were used to develop the cost estimate for each of the removal action alternatives.

This cost estimate has been prepared for guidance in project evaluation from the information available at the time of the estimate. The final cost of the project will depend on final design, selected scope of work, actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimate presented here. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

14 Sensitivity Analysis

Sensitivity analysis for this cost estimate was not performed. The following factors might cause the estimate to significantly change.

- Levels of contamination
- Depth and extent of contamination encountered during RTD of waste sites
- Rate(s) of groundwater extraction and injection

- Duration of extraction and injection systems
- Duration and actual operations and maintenance requirements for groundwater treatment systems
- Less favorable working conditions and/or increased monitoring requirements that would significantly increase the impact of working in health and safety protection and/or increase the health and safety protection requirements.

Because of these factors:

1. The remedy selection process must consider differences in response action cost uncertainties/cost risks in addition to response action-specific cost estimates and ranges.
2. Funding needs must be carefully reviewed before making specific financial decisions or establishing final budgets.

15 Labor Costs

Construction craft FP labor rates are those listed in Appendix A of the Site Stabilization Agreement for All Construction Work for the U.S. Department of Energy at the Hanford Site (commonly known as the Hanford Site Stabilization Agreement [HSSA]). The HSSA rates include base wage, fringe benefits, and other compensation as negotiated between CH2M HILL Plateau Remediation Company (CHPRC) and the National Building and Construction Trades Department American Federation of Labor-Congress of Industrial Organizations (AFL-CIO). Other factors that account for additional costs (Workman's Compensation, Federal Insurance Contributions Act (FICA), and state and Federal unemployment insurance) to develop a fully burdened rate by craft, have been incorporated. The labor rates used are for 2012[4].

Plateau Remediation Contractor (PRC) labor rates for management, engineering, safety oversight, and technical support are based on the PRC-approved planning rates for fiscal year 2012.

16 Sales Tax

Washington State sales tax has been applied to all materials and equipment purchases at 8.3 percent and is included in the PRC general and administrative (G&A) percentage discussed in section 7.

17 References

EPA 540-R-00-002, 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, OSWER 9355.0-75, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

PRC-PRO-EP-40282, 2010, *Cost Estimating Procedure for Response Action Decision-Making*, Rev. 0, Chg. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Means, R. S., 2001, ECHOS *Environmental Remediation Cost Date Unit Price*, Robert S. Means Company, Kingston, Massachusetts.

[4]This estimate originated in 2012. Since this estimate is a minor revision and has the possibility of changing again the decision was made to continue to use the 2012 labor rates.

Means, R. S., 2010a, *Building Construction Cost Book*, 68th annual ed., Robert S. Means Company, Kingston, Massachusetts.

Means, R. S., 2010b, *Heavy Construction Cost Data,* 24th annual ed., Robert S. Means Company, Kingston, Massachusetts.

OMB Circular No. A-94, 2011, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs" (memorandum for Heads of Executive Departments and Establishments), Appendix C, "Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses," as revised, Office of Management and Budget, Washington, D.C.

Site Stabilization Agreement for All Construction Work for the U.S. Department of Energy at the Hanford Site, 1984, as amended, commonly known as the Hanford Site Stabilization Agreement (HSSA)(original title, *Site Stabilization Agreement, Hanford Site, between J.A. Jones Construction Services Company and Morrison-Knudsen Company, Inc., and the Building and Construction Trades Department of the AFL-CIO and its affiliated international unions, and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America.*

ECF-Hanford-11-0164, Environmental Calculation File TRACEV3 – Site Cost Distribution

ECF-Hanford-11-0098, Environmental Calculation File for TRACE_V3-Overview, (Rev1)

ECF-Hanford-11-0099, Environmental Calculation File for TRACE_V3-Actual Costs, (Rev1)

ECF-Hanford-11-0100, Environmental Calculation File for TRACE_V3- RACER Costs, (Rev1)

ECF-Hanford-11-0101, Environmental Calculation File for TRACE_V3-Calculations, (Rev1)

ECF-Hanford-11-0102 Environmental Calculation File for TRACE_V3-Unit Costs, (Rev1)

ECF-Hanford-11-0103, Environmental Calculation File for TRACE_V3-Capital Cost, (Rev1)

ECF-Hanford-11-0104, Environmental Calculation File for TRACE_V3-O&M Cost, (Rev1)

ECF-Hanford-11-0105, Environmental Calculation File for TRACE_V3-O&M Distribution, (Rev1)

ECF-Hanford-11-0106, Environmental Calculation File for TRACE_V3-Present Value, (Rev1)

ECF-Hanford-11-0107, Environmental Calculation File for TRACE_V3-Totals, (Rev1)

ECF-Hanford-11-0037, Environmental Calculation File for Excavation Template_V1

DOE/RL-2001-41, Revision 5, Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions, June 2012

The Hanford Sitewide Institutional Control Plan, DOE/RL-2001-41, Rev. 5

EPA/ROD/R10-00/121, Record of Decision for the USDOE Hanford 100-Area, Benton County, Washington

EPA, 2001, USDOE Hanford Site, First Five-Year Review Report

EPA/ROD/R10-01/119, Record of Decision for the USDOE Hanford 300 Area, Benton County, Washington

DOE/EIS-0222-F, Final Hanford Comprehensive Land-Use Plan Environmental Impact Statements

DOE/EIS-0019F, NEPA Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, December 1992.

Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs,* Appendix C of the Office of Management and Budget (OMB), Washington D.C., *20*

ECF-Hanford-12-0067, Institutional Controls Costs Apportioned by ROD Groups

Appendix

Table A-1: Waste Sites (RTD of 36 Post-ROD Sites) – Costs from WCH

100-IU Sites Remaining for Remedial Action		
Site	**RTD Estimate**	**Estimate Basis**
600-20	$230,000	Analogy to the RTD cost estimated for the similar 600-280 site in the 2009 Explanation of Significant Difference to the Remaining Sites ROD.
600-279	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-293	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-294	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-301	$2,000,000	Analogy to the RTD cost for the 1607-D2 septic system in the 2009 Explanation of Significant Difference to the Remaining Sites ROD.
600-329	$400,000	Analogy to the RTD cost for the 100-F-43 spillway in the 2009 Explanation of Significant Difference to the Remaining Sites ROD.
600-331	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-332	$520,000	Analogy to the RTD cost for the 100-D-14 septic system in the 2009 Explanation of Significant Difference to the Remaining Sites ROD.
600-334:2	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-349	$2,400,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD. Estimated cost scaled up by a factor of 20 based on large site footprint area and 600-149 remediation experience.
600-358	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-368	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:1	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:2	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:3	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:4	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:5	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:6	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:7	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-369:8	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
300-370	$1,200,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD. Estimated cost scaled up by a factor of 10 based on large site footprint area.
600-371	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-372:1	$120,000	Estiamted total cost for both small subsites based on analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-372:2		
600-373	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-374	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.

100-IU Sites Remaining for Remedial Action		
Site	**RTD Estimate**	**Estimate Basis**
600-375:1 600-375:2 600-375:3 600-375:4 600-375:5	$120,000	Estiamted total cost for all subsites based on analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-376:1 600-376:2	$120,000	Estiamted total cost for both small subsites based on analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-377	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-378	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
600-379	$120,000	Analogy to the RTD cost estimated for many small 100-IU-2&6 sites in the 2009 Explanation of Significant Difference and 2010 Fact Sheet for the Remaining Sites ROD.
Total	**$9,630,000**	

Table A-2: Waste Sites (Site-Specific and Programmatic ICs) – Total Cost

Waste sites - Total Cost

COMPARISON OF TOTAL COST OF RESPONSE ACTION ALTERNATIVES*			
Site:	100-F/IU	**Base Year:**	2013
Location:	Hanford, WA	**Date:**	July-13
Phase:	FS	**Rev:**	0

	Alternative S-2		
	No-dig ICs		
Total Duration (years)	***		
Cost Summary			
Capital Cost	$9,630,000		
Total Annual Cost	$26,640,000		
Total Periodic Cost	$1,118,000		
Non-Discounted **	**$37,388,000**		
Real Discount Rate	**2.0%**		
Total Present Value of Alternative (Discounted)	**$20,579,000**		

Expected Accuracy Range for total present value is +50%/-30%

-30%	**$14,406,000**		
50%	**$30,869,000**		

*Notes:
Range of accuracy is expected to be +50%/-30%
** RTD costs for sites remaining for remedial action are included in the total

Table A-3: Waste Sites (Site-specific and Programmatic ICs) – Individual Site Costs

Estimated Cost of Alternative S-2 RTD and ICs

Duration of the ICs = 100 Years	No-dig ICs			
Site name	**100-F-19:1**	**Includes subsites: 100-F-19:3, 100-F-34, and 116-F-12**		
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 160,000	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 55,000	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 215,000	$ -	$ -	$ -
Discounted (PV)	$ 77,000	$ -	$ -	$ -

Duration of the ICs = 46 Years				
Site name	**100-F-19:2**	**Includes subsites: 100-F-29, UPR-100-F-1, and 116-F-11**		
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 74,000	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 55,000	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 129,000	$ -	$ -	$ -
Discounted (PV)	$ 70,000	$ -	$ -	$ -

Duration of the ICs = 95 Years				
Site name	**116-F-2**			
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 152,000	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 55,000	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 207,000	$ -	$ -	$ -
Discounted (PV)	$ 77,000	$ -	$ -	$ -

Duration of the ICs = 109 Years				
Site name	**116-F-6**			
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 175,000	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 55,000	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 230,000	$ -	$ -	$ -
Discounted (PV)	$ 78,000	$ -	$ -	$ -

Duration of the ICs = 61 Years				
Site name	**116-F-9**			
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 98,000	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 55,000	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 153,000	$ -	$ -	$ -
Discounted (PV)	$ 74,000	$ -	$ -	$ -

Duration of the ICs = 20 Years				
Site name	**118-F-6**			
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 32,000	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 54,400	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 86,400	$ -	$ -	$ -
Discounted (PV)	$ 62,772	$ -	$ -	$ -

Estimated Cost of Alternative S-2 RTD and ICs

Duration of the ICs = 75 Years				
Site name	118-F-8:3			
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 120,000	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 54,400	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 174,400	$ -	$ -	$ -
Discounted (PV)	$ 74,203	$ -	$ -	$ -

Duration of the ICs = 46 Years				
Site name	118-F-8:4			
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 73,600	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 54,400	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 128,000	$ -	$ -	$ -
Discounted (PV)	$ 69,705	$ -	$ -	$ -

Duration of the ICs = 97 Years				
Site name	116-F-14			
Capital Cost	$ -	$ -	$ -	$ -
Annual (site inspection)	$ 155,200	$ -	$ -	$ -
Periodic (Site Closeout Rpt)	$ 54,400	$ -	$ -	$ -
Individual Site (Non Discounted)	$ 209,600	$ -	$ -	$ -
Discounted (PV)	$ 76,250	$ -	$ -	$ -
Subtotal Discounted Waste Sites	*$ 658,930*			

Duration of the ICs = 150 Years				
Site name	Programmatic Institutional Controls			
Capital Cost				
Annual (Programmatic ICs (100-F/IU) 150 Yrs)	$ 25,600,000		$ -	$ -
Periodic (5-Year Review (100-F/IU) 150 Yrs)	$ 625,000		$ -	$ -
Individual Site (Non Discounted)	$ 26,225,000		$ -	$ -
Discounted (PV)	$ 10,290,000		$ -	$ -

Site name	Sites Remaining for Remedial Action			
*Capital Cost	$ 9,630,000		$ -	$ -
Annual	$ -		$ -	$ -
Periodic	$ -		$ -	$ -
Individual Site (Non Discounted)	$ 9,630,000		$ -	$ -
Discounted (PV)	$ 9,630,000		$ -	$ -
Total Capital (Non-discounted)	**$ 9,630,000**	**$ -**	**$ -**	**$ -**
Total Annual (Non-discounted)	**$ 26,640,000**	**$ -**	**$ -**	**$ -**
Total Periodic (Non-discounted)	**$ 1,118,000**	**$ -**	**$ -**	**$ -**
Total Non Discounted	**$ 37,388,000**	**$ -**	**$ -**	**$ -**
Total Discounted (Discounted)	**$ 20,579,000**	**$ -**	**$ -**	**$ -**

Institutional Controls Costs

from the ECF for the Institutional Controls, 2012 (ECF-HANFORD-12-0067, Rev 0)

*The total non-discounted cost for the ICs for 150 years is estimated to be $562,781,000 for the Hanford site (about **$25,600,000 per ROD**). The total discounted cost for the ICs at Hanford are estimated at $221,299,000 (about **$10,100,000 per ROD**).*

*The total non-discounted cost for the 5-Year Reviews for 150 years is estimated to be $13,740,000 (about **$625,000 per ROD**). The total discounted cost for the 5-Year Reviews for 150 years is estimated to be $4,175,000 (about **$190,000 per ROD**).*

** Capital Cost is only provided due to expected completion timeframe of remediation, approximately 2013 to 2014.*

Table A-4: Waste Sites (Site-specific and Programmatic ICs) – Important Input Quantities to Cost Estimate

TABLE A-4

TRACE V3 Setup SCOPE PARAMETER	ALTERNATIVE S-2
Site specific ICs	
100-F-19:1	**x**
Start Date	2012
End Date	2112
Site Visit per year	1
100-F-19:2	**x**
Start Date	2012
End Date	2058
Site Visit per year	1
116-F-2	**x**
Start Date	2012
End Date	2107
Site Visit per year	1
116-F-6	**x**
Start Date	2012
End Date	2121
Site Visit per year	1
116-F-9	**x**
Start Date	2012
End Date	2073
Site Visit per year	1
118-F-6	**x**
Start Date	2012
End Date	2032
Site Visit per year	1
118-F-8:3	**x**
Start Date	2012
End Date	2087
Site Visit per year	1
118-F-8:4	**x**
Start Date	2012
End Date	2058
Site Visit per year	1
116-F-14	**x**
Start Date	2012
End Date	2109
Site Visit per year	1

Table A-5: Waste Sites (RTD of Deep Radiological Contamination Sites) – Total Costs

ROM of DEEP Rad Sites

COMPARISON OF TOTAL COST OF RESPONSE ACTION ALTERNATIVES*

Site:	100 F/IU	Base Yr: 2013
Location:	Hanford, WA	Date: October 2013
Phase:	FS	Rev. 0

	Alternative 2	
Total Duration (years)	**3**	
Cost Summary		
Capital Cost	$162,312,000	
% of Total Non-discounted cost	100.00%	
Total Annual Cost	$0	
% of Total Non-discounted cost	0.00%	
Total Periodic Cost	$0	
% of Total Non-discounted cost	0%	
Non-Discounted	**$162,312,000**	
Real Discount Rate	**0.0%**	
Total Present Value of Alternative (Discounted)	**$162,312,000**	

Expected Accuracy Range for total present value is +50%/-30%

-30%	**$113,619,000**	
50%	**$243,468,000**	

*Notes:

Range of accuracy is expected to be +50%/0%

Table A-6: Waste Sites (RTD of Deep Radiological Contamination Sites) – Individual Site Costs

Estimated RTD Costs for Waste Sites with Deep Radiological Contamination

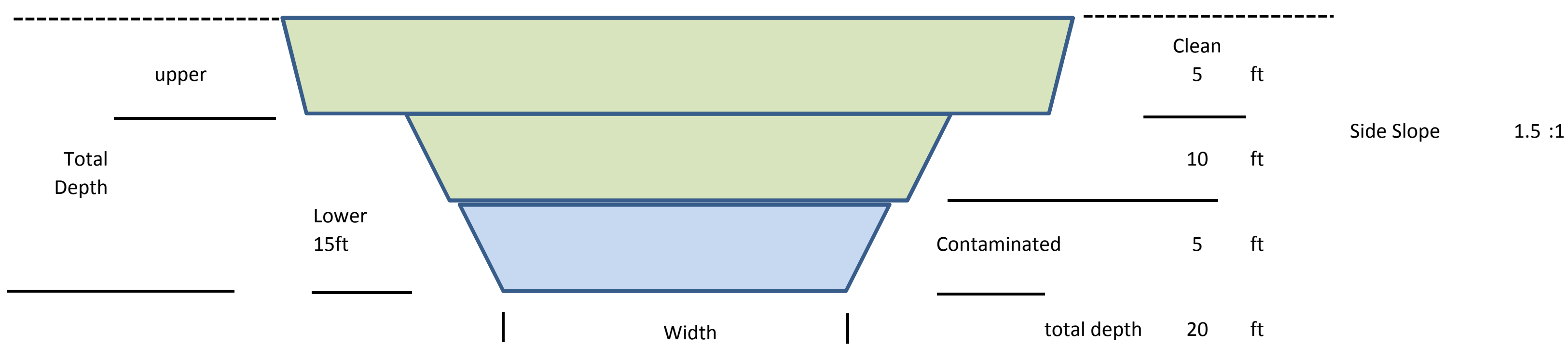
	RTD	
Site name	**100-F-19:1**	**includes sites: 100-F-19:3, 100-F-34, and 116-F-12**
Capital Cost	$ 10,739,000	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 10,739,000	
Discounted (PV)	$ 10,739,000	
Site name	**100-F-19:2 (1)**	**includes sites: 100-F-29, UPR-100-F-1, and 116-F-11**
Capital Cost	$ 7,804,000	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 7,804,000	
Discounted (PV)	$ 7,804,000	
Site name	**116-F-2**	
Capital Cost	$ 15,755,649	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 15,755,649	
Discounted (PV)	$ 15,755,649	
Site name	**116-F-6**	
Capital Cost	$ 4,546,810	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 4,546,810	
Discounted (PV)	$ 4,546,810	
Site name	**116-F-9**	
Capital Cost	$ 7,706,737	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 7,706,737	
Discounted (PV)	$ 7,706,737	
Site name	**116-F-14**	
Capital Cost	$ 107,489,092	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 107,489,092	
Discounted (PV)	$ 107,489,092	
Site name	**118-F-6**	
Capital Cost	$ 2,805,755	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 2,805,755	
Discounted (PV)	$ 2,805,755	
Site name	**118-F-8:3**	
Capital Cost	$ 2,731,781	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 2,731,781	
Discounted (PV)	$ 2,731,781	
Site name	**118-F-8:4**	
Capital Cost	$ 2,732,908	
Annual	$ -	
Periodic	$ -	
Individual Site (Non Discounted)	$ 2,732,908	
Discounted (PV)	$ 2,732,908	
Total Capital (Non-discounted)	**$ 162,312,000**	
Total Annual (Non-discounted)	**$ -**	
Total Periodic (Non-discounted)	**$ -**	
Total Non Discounted	**$ 162,312,000**	
Total Discounted (Discounted)	**$ 162,312,000**	

NOTE: The above plume/area totals are rounded up to nearest thousand dollars individually - if added together they will give slightly different totals (approximately 0.003% more) for each Response Action Alternative than the corresponding totals in the TRACE V3 "Totals" spreadsheet (the latter totals cost for all line items for all plumes and then rounds to the nearest thousand dollars).

Table A-7: Waste Sites (RTD of Deep Radiological Contamination Sites) – Important Input Quantities to Cost Estimate

Figure A-1

Waste Site : **100-F-19:1**



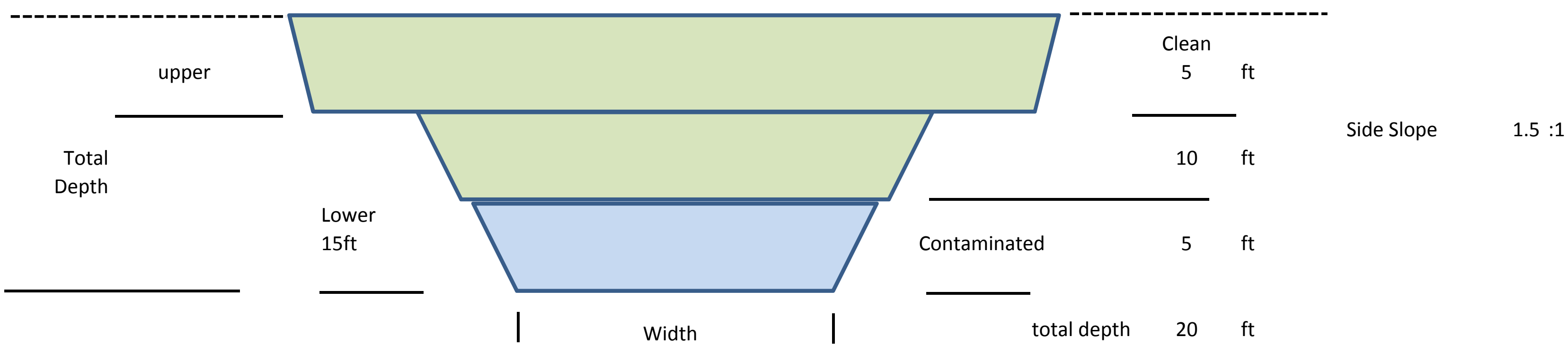
Length (L)	430 ft
Width (W)	148 ft
total depth(Dt)	20 ft
Overburden depth	15 ft
Eq Bench width(Eb)	34 ft
Lower Height(h)	15 ft

Total Volume=	21,221	CY
Contaminated Volume =	925	CY
Clean Volume =	20,296	CY

100-F-19:1 includes Sites: 100-F-19:3, 100-F-34, and 116-F-12

Figure A-2(a)

Waste Site : **100-F-19:2(1)**



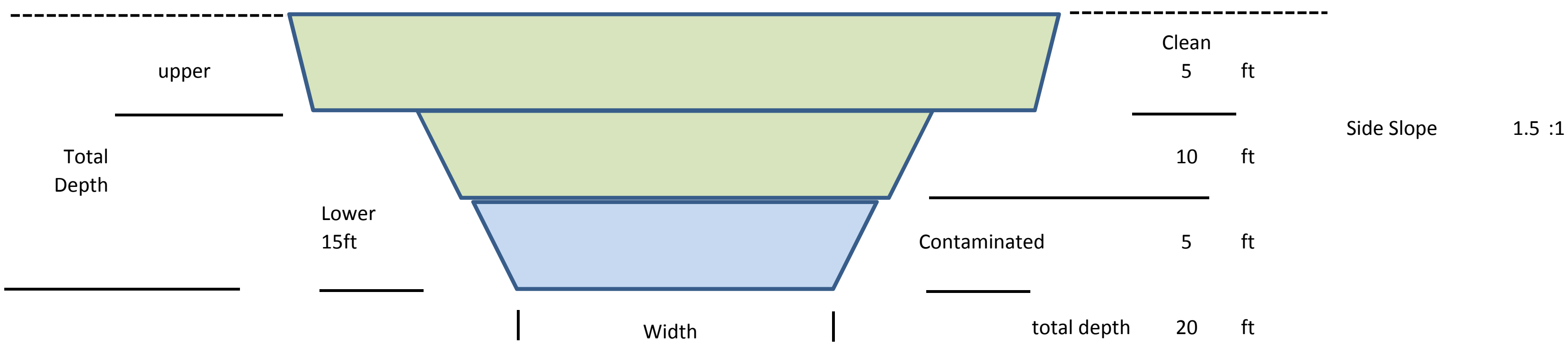
Length (L)	115	ft
Width (W)	23	ft
total depth(Dt)	20	ft
Overburden depth	15	ft
Eq Bench width(Eb)	34	ft
Lower Height(h)	15	ft

Total Volume=	21,221	CY
Contaminated Volume =	925	CY
Clean Volume =	20,296	CY

100-F-19:2(1),(2),(3) Includes Sites: 100-F-29, UPR-100-F-1, and 116-F-11

Figure A-2(b)

Waste Site : **100-F-19:2(2)**



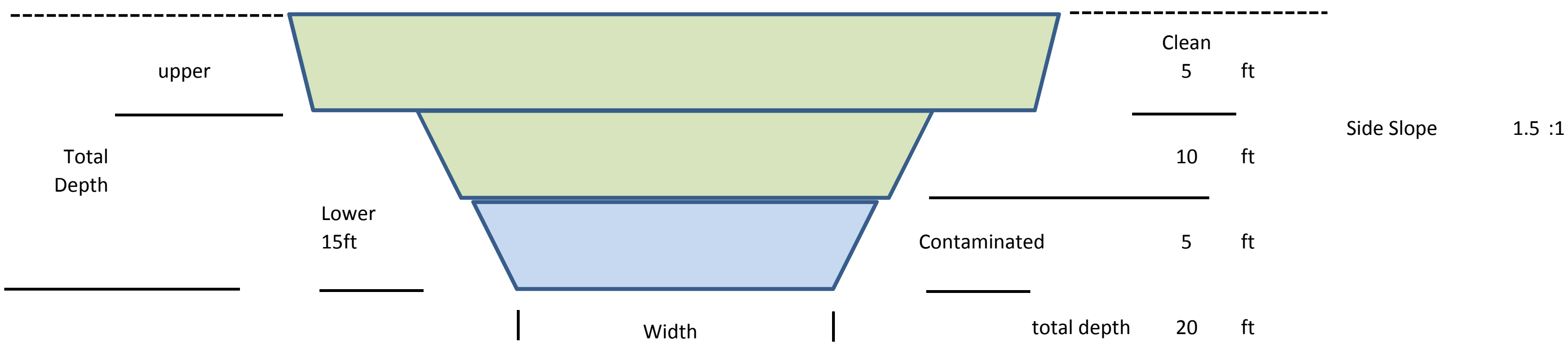
Length (L)	131 ft
Width (W)	23 ft
total depth(Dt)	20 ft
Overburden depth	15 ft
Eq Bench width(Eb)	34 ft
Lower Height(h)	15 ft

Total Volume=	7,801 CY
Contaminated Volume =	780 CY
Clean Volume =	7,021 CY

100-F-19:2(1),(2),(3) Includes Sites: 100-F-29, UPR-100-F-1, and 116-F-11

Figure A-2(c)

Waste Site : 100-F-19:2(3)



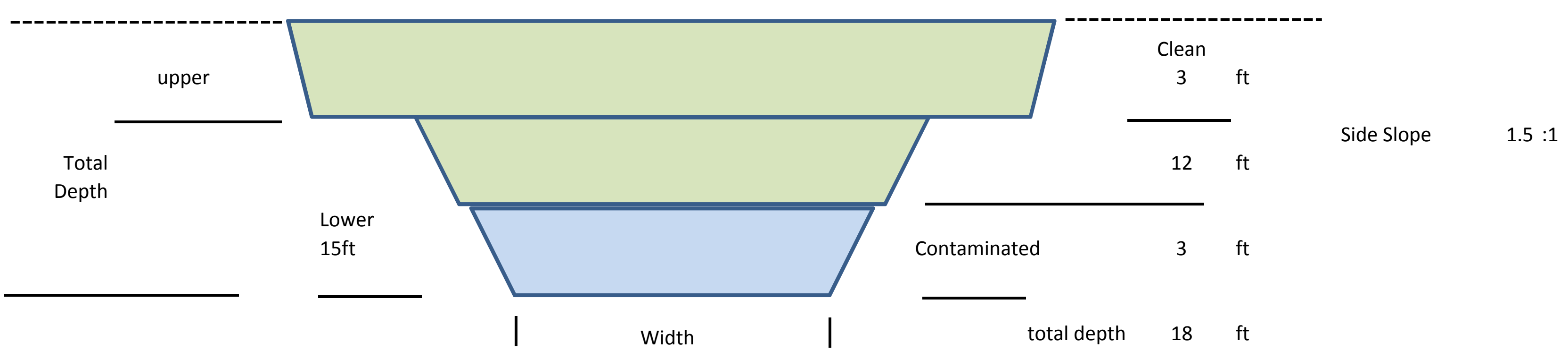
Length (L)	197 ft
Width (W)	49 ft
total depth(Dt)	20 ft
Overburden depth	15 ft
Eq Bench width(Eb)	34 ft
Lower Height(h)	15 ft

Total Volume=	15,664 CY
Contaminated Volume =	1,894 CY
Clean Volume =	13,770 CY

100-F-19:2(1),(2),(3) Includes Sites: 100-F-29, UPR-100-F-1, and 116-F-11

Figure A-3(a)

Waste Site : 116-F-2 (1)

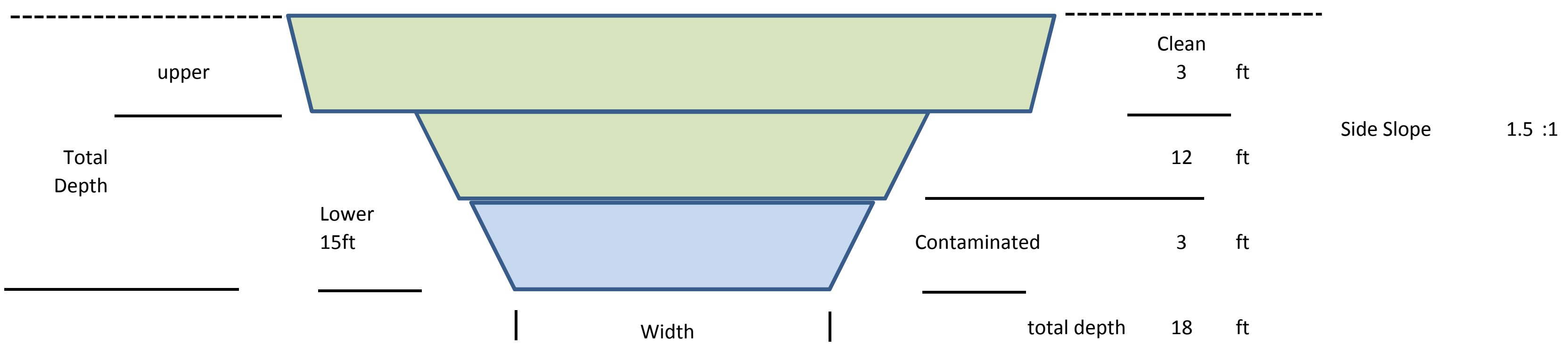


Length (L)	138 ft
Width (W)	79 ft
total depth(Dt)	18 ft
Overburden depth	15 ft
Eq Bench width(Eb)	34 ft
Lower Height(h)	15 ft

Total Volume=	14,338 CY
Contaminated Volume =	1,515 CY
Clean Volume =	12,823 CY

Figure A-3(b)

Waste Site : **116-F-2 (2)**

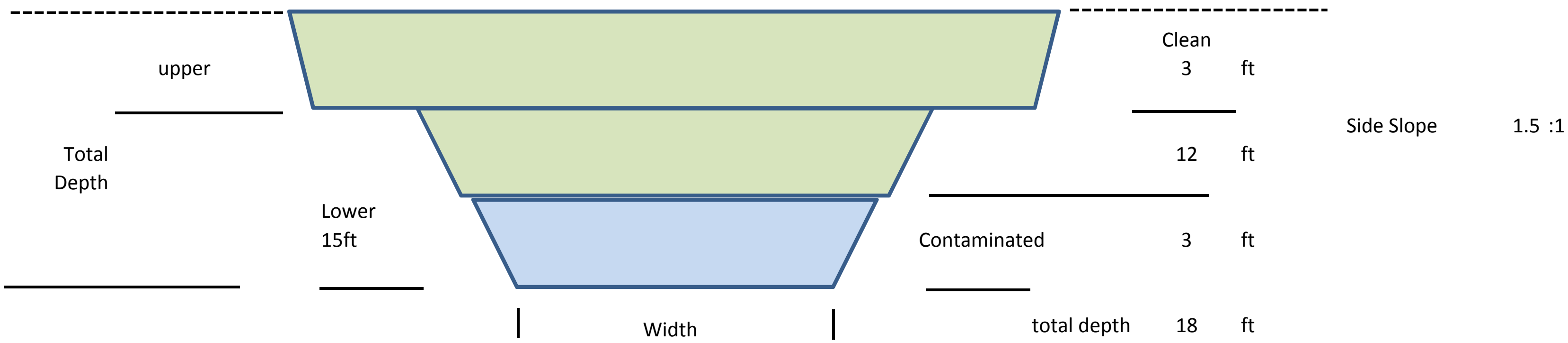


Length (L)	308 ft
Width (W)	30 ft
total depth(Dt)	18 ft
Overburden depth	15 ft
Eq Bench width(Eb)	34 ft
Lower Height(h)	15 ft

Total Volume=	15,590 CY
Contaminated Volume =	1,559 CY
Clean Volume =	14,031 CY

Figure A-3(c)

Waste Site : **116-F-2 (3)**

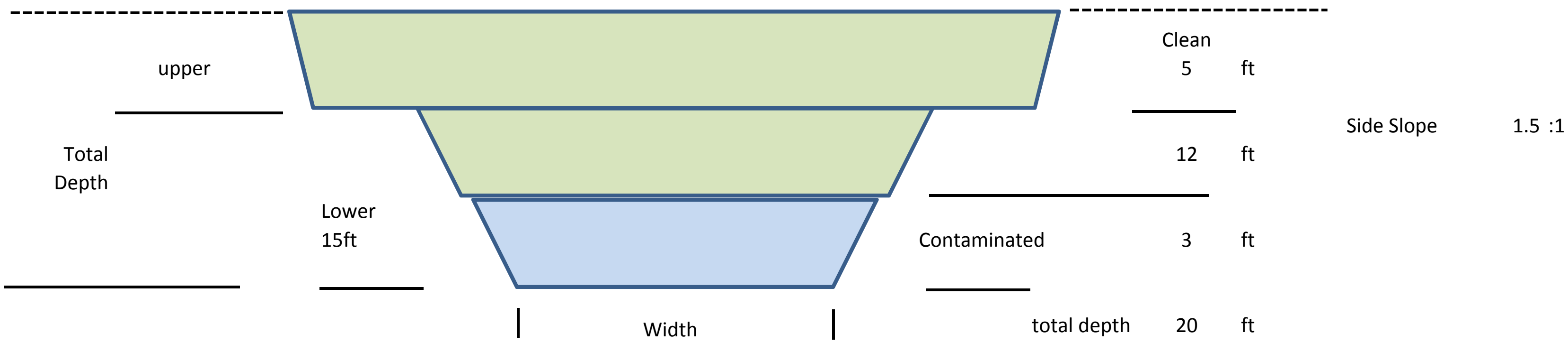


Length (L)	315	ft
Width (W)	174	ft
total depth(Dt)	18	ft
Overburden depth	15	ft
Eq Bench width(Eb)	34	ft
Lower Height(h)	15	ft

Total Volume=	54,547	CY
Contaminated Volume =	7,647	CY
Clean Volume =	46,900	CY

Figure A-4

Waste Site : 116-F-6

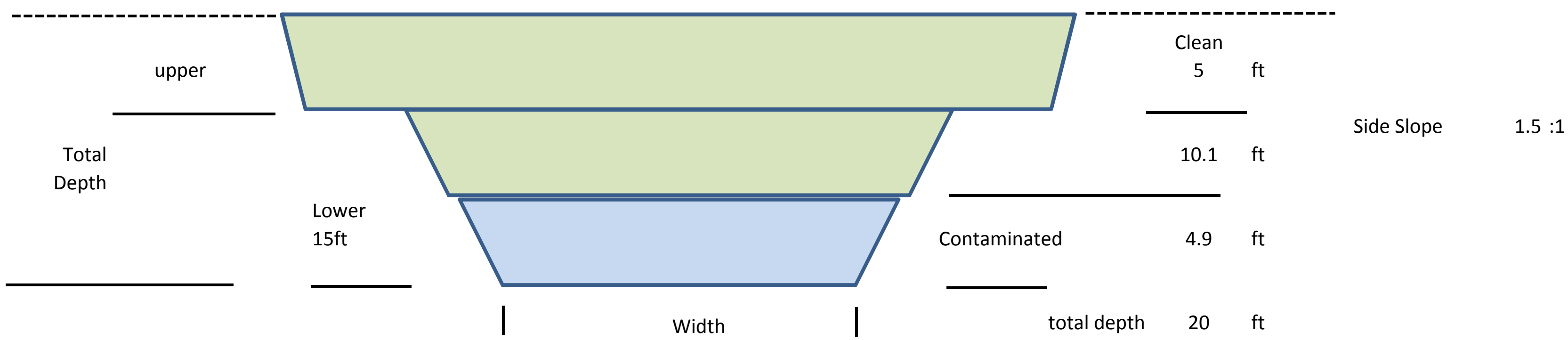


Length (L)	298 ft
Width (W)	69 ft
total depth(Dt)	20 ft
Overburden depth	17 ft
Eq Bench width(Eb)	34 ft
Lower Height(h)	15 ft

Total Volume=	28,451 CY
Contaminated Volume =	2,872 CY
Clean Volume =	25,579 CY

Figure A-5

Waste Site : **116-F-9**

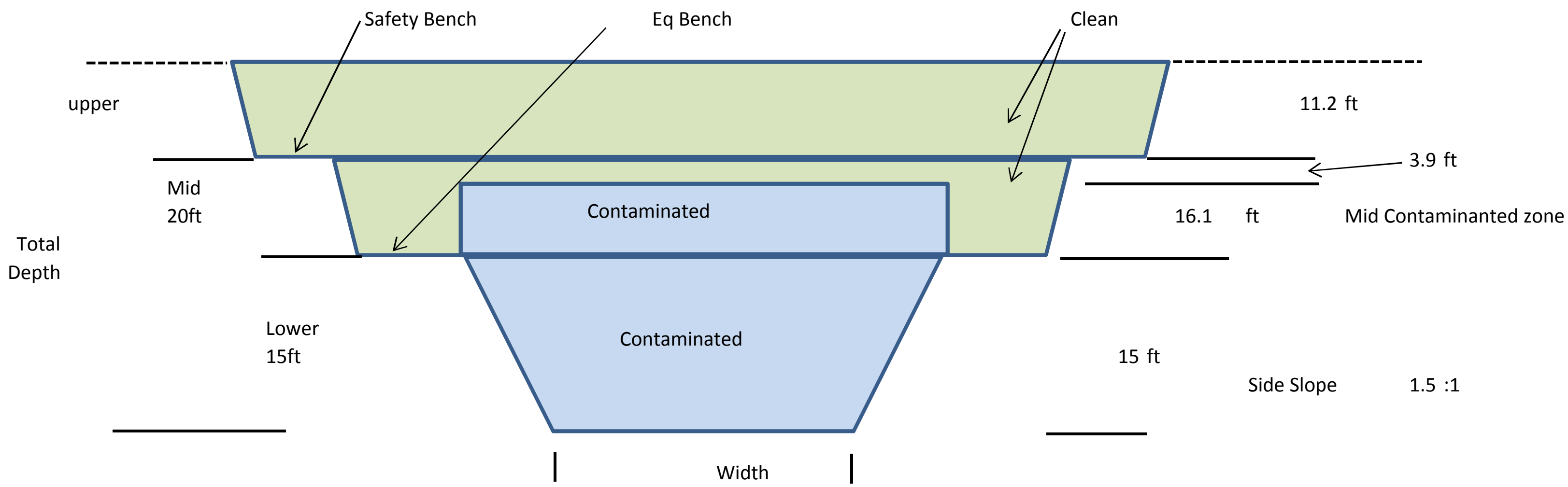


Length (L)	394 ft
Width (W)	105 ft
total depth(Dt)	20 ft
Overburden depth	15.1 ft
Eq Bench width(Eb)	34 ft
Lower Height(h)	15 ft

Total Volume=	48,426 CY
Contaminated Volume =	8,080 CY
Clean Volume =	40,346 CY

Figure A-6

Waste Site : 116-F-14



Length (L)	364.1 ft
Width (W)	524.8 ft
total depth(Dt)	46.2 ft
Overburden depth	15.1 ft
Eq Bench width(Eb)	34 ft
Safety Bench (Sb)	10 ft
Lower - Depth (h)	15 ft
Mid Depth(hm)	20 ft

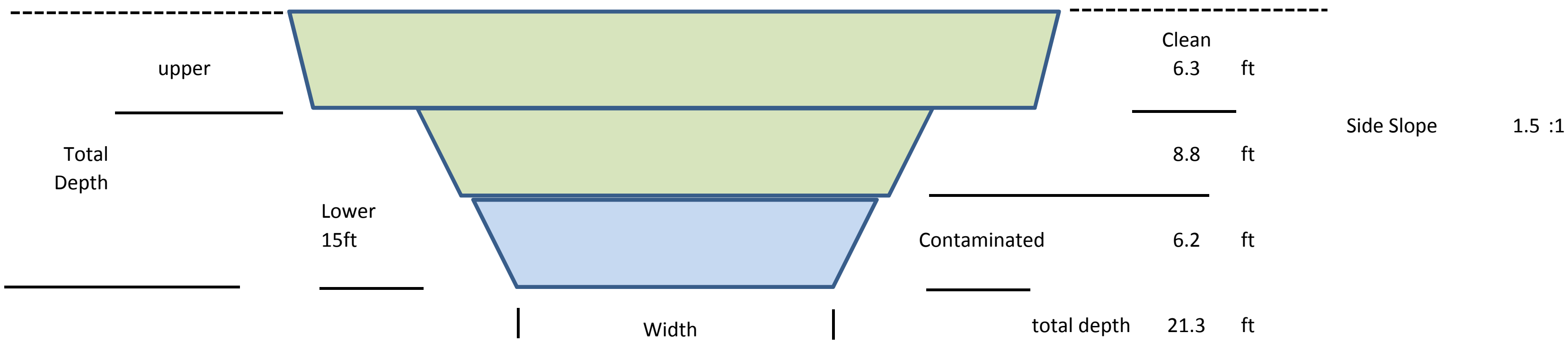
Total Volume = Lower Volume + Mid Volume + Upper Volume = 516,798 CY

Contaminated Volume = Lower Volume + Mid contaminated volume = 253,584 CY

Clean Volume = Total Volume - Contaminated Volume = 263,214 CY

Figure A-7

Waste Site : **118-F-6**

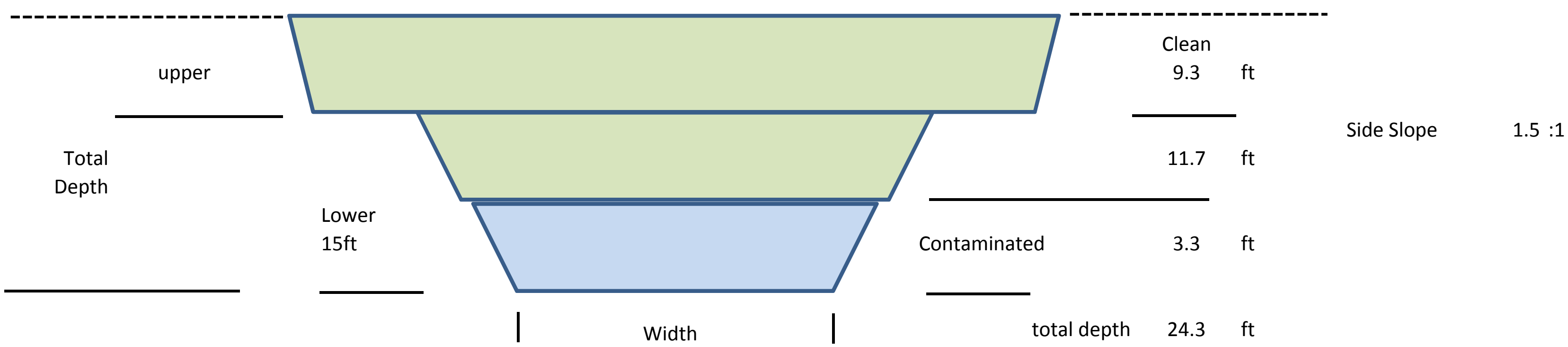


Length (L)	98.4	ft
Width (W)	49.2	ft
total depth(Dt)	21.3	ft
Overburden depth	15.1	ft
Eq Bench width(Eb)	34	ft
Lower Height(h)	15	ft

Total Volume=	10,540	CY
Contaminated Volume =	1,285	CY
Clean Volume =	9,255	CY

Figure A-8

Waste Site : **118-F-8:3**

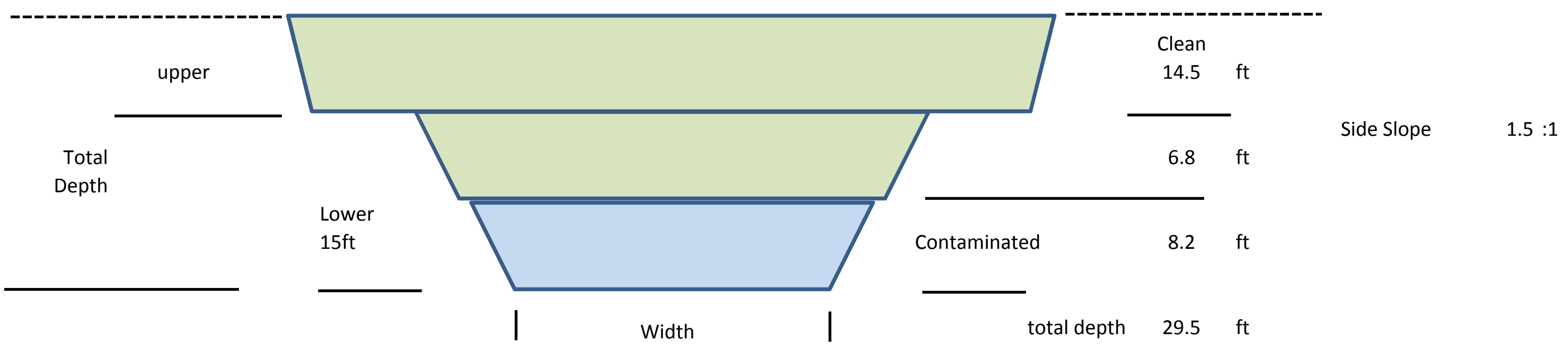


Length (L)	82	ft
Width (W)	82	ft
total depth(Dt)	24.3	ft
Overburden depth	21	ft
Eq Bench width(Eb)	34	ft
Lower Height(h)	15	ft

Total Volume=	15,865	CY
Contaminated Volume =	1,586	CY
Clean Volume =	14,279	CY

Figure A-9

Waste Site : **118-F-8:4**



Length (L)	55.8	ft
Width (W)	62.3	ft
total depth(Dt)	29.5	ft
Overburden depth	21.3	ft
Eq Bench width(Eb)	34	ft
Lower Height(h)	15	ft

Total Volume=	15,874	CY
Contaminated Volume =	1,587	CY
Clean Volume =	14,287	CY

Table A-8: Groundwater - Total Cost

Table A-8 - Groundwater Totals

COMPARISON OF TOTAL COST OF RESPONSE ACTION ALTERNATIVES*			
Site:	100 F and IU-2/6	**Base Year:**	2014
Location:	Hanford, WA	**Date:**	Oct-23-2013
Phase:	FS	**Rev:**	1

	Alternative 2	**Alternative 3**	**Alternative 4**
	GW-2- MNA and ICs	**Pump & Treat Optimized with In situ Treatment and MNA**	**Enhanced Pump-and-Treat**
Total Duration (years)	**97**	**92**	**92**
Cost Summary			
Capital Cost	$4,930,000	$80,243,000	$96,534,000
% of Total Non-discounted cost	8.27%	39.35%	43.70%
Total Annual Cost	$30,636,000	$91,840,000	$87,883,000
% of Total Non-discounted cost	51.37%	45.03%	39.78%
Total Periodic Cost	$24,073,000	$31,863,000	$36,508,000
% of Total Non-discounted cost	40%	16%	17%
Non-Discounted	**$59,639,000**	**$203,946,000**	**$220,925,000**
Real Discount Rate	**2.0%**	**2.0%**	**2.0%**
Total Present Value of Alternative (Discounted)	**$36,261,000**	**$176,780,000**	**$193,814,000**
Expected Accuracy Range for total present value is +50%/-30%			
-30%	**$25,383,000**	**$123,746,000**	**$135,670,000**
50%	**$54,392,000**	**$265,170,000**	**$290,721,000**

*Notes:
Range of accuracy is expected to be +50%/-30%

Table A-9: Groundwater – Individual Site Costs

Table A-9 - Individual Site Costs

	Alternative 2 Alternative GW-2	Alternative 3 Alternative GW-3	Alternative 4 Alternative GW-4
Site number 1			
Site name		**Cr(VI) Plume**	
Capital Cost	$ 572,000	$ 14,814,000	$ 14,232,000
Discounted Capital	$ 561,000	$ 14,524,000	$ 13,953,000
Annual	$ 6,689,000	$ 16,344,000	$ 9,995,000
Discounted-Annual	$ 5,011,000	$ 14,670,000	$ 9,085,000
Periodic	$ 2,613,000	$ 4,822,000	$ 4,759,000
Discounted - Periodic	$ 1,738,000	$ 3,842,000	$ 3,783,000
Individual Site (Non Discounted)	$ 9,874,000	$ 35,980,000	$ 28,986,000
Discounted (PV)	$ 7,310,000	$ 33,036,000	$ 26,821,000
Site number 2			
Site name		**Sr-90 Plume**	
Capital Cost	$ 447,000	$ 6,888,000	$ 6,408,000
Discounted Capital	$ 439,000	$ 6,753,000	$ 6,283,000
Annual	$ 9,055,000	$ 17,148,000	$ 17,112,000
Discounted-Annual	$ 4,190,000	$ 11,923,000	$ 11,896,000
Periodic	$ 9,233,000	$ 8,199,000	$ 8,189,000
Discounted - Periodic	$ 3,321,000	$ 3,774,000	$ 3,767,000
Individual Site (Non Discounted)	$ 18,735,000	$ 32,235,000	$ 31,709,000
Discounted (PV)	$ 7,950,000	$ 22,450,000	$ 21,946,000
Site number 3			
Site name		**TCE Plume**	
Capital Cost	$ 1,055,000	$ 6,651,000	$ 6,426,000
Discounted Capital	$ 1,035,000	$ 6,521,000	$ 6,301,000
Annual	$ 6,866,000	$ 8,076,000	$ 5,754,000
Discounted-Annual	$ 4,407,000	$ 6,960,000	$ 4,923,000
Periodic	$ 5,508,000	$ 2,865,000	$ 2,805,000
Discounted - Periodic	$ 3,026,000	$ 2,106,000	$ 2,063,000
Individual Site (Non Discounted)	$ 13,429,000	$ 17,592,000	$ 14,985,000
Discounted (PV)	$ 8,468,000	$ 15,587,000	$ 13,287,000
Site number 4			
Site name		**Nitrate Plume**	
Capital Cost	$ 2,858,000	$ 51,892,000	$ 69,470,000
Discounted Capital	$ 2,802,000	$ 50,875,000	$ 68,108,000
Annual	$ 8,026,000	$ 50,273,000	$ 55,024,000
Discounted-Annual	$ 5,802,000	$ 43,869,000	$ 48,244,000
Periodic	$ 6,722,000	$ 15,979,000	$ 20,756,000
Discounted - Periodic	$ 3,937,000	$ 10,970,000	$ 15,415,000
Individual Site (Non Discounted)	$ 17,606,000	$ 118,144,000	$ 145,250,000
Discounted (PV)	$ 12,541,000	$ 105,714,000	$ 131,767,000

Table A-9 - Individual Site Costs

Total Capital (Non-discounted)	**$**	**4,932,000**	**$**	**80,245,000**	**$**	**96,536,000**
Total Annual (Non-discounted)	**$**	**30,636,000**	**$**	**91,841,000**	**$**	**87,885,000**
Total Periodic (Non-discounted)	**$**	**24,076,000**	**$**	**31,865,000**	**$**	**36,509,000**
Total Non Discounted	**$**	**59,644,000**	**$**	**203,951,000**	**$**	**220,930,000**
Total Discounted (Discounted)	**$**	**36,269,000**	**$**	**176,787,000**	**$**	**193,821,000**

NOTE: The above plume/area totals are rounded up to nearest thousand dollars individually - if added together they will give slightly different totals (approximately 0.003% more) for each Response Action Alternative than the corresponding totals in the TRACE V3 "Totals" spreadsheet (the latter totals cost for all line items for all plumes and then rounds to the nearest thousand dollars).

Table A-10: Groundwater – Important Input Quantities to Cost Estimate

Table A-10: Important Input Quantities to Cost Estimate

TRACE V3 Setup

SCOPE PARAMETER	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
GW Monitoring			
Monitoring Duration - Cr(VI) (years)	25	5	5
Total Number of Samples - Year 1	40	40	40
Total Number of Samples/yr - Years 2&3	34	34	34
Total Number of Samples/yr - Years 4 to 10	34	10	10
Total Number of Samples - Years 11 to End (biennial)	238	0	0
Total Number of Samples per biennial yr - Years 11 to End	34	0	0
Compliance Monitoring Samples - End + 5yrs	170	170	170
Monitoring Duration - Sr-90 (years)	90	85	85
Total Number of Samples - Year 1	20	20	20
Total Number of Samples/yr - Years 2&3	17	17	17
Total Number of Samples/yr - Years 4 to 10	17	17	17
Total Number of Samples - Years 11 to End (biennial)	680	638	638
Total Number of Samples per biennial yr - Years 11 to End	17	17	17
Compliance Monitoring Samples - End + 5yrs	85	85	85
Monitoring Duration - TCE (years)	45	10	10
Total Number of Samples - Year 1	30	30	30
Total Number of Samples/yr - Years 2&3	24	24	24
Total Number of Samples/yr - Years 4 to 10	24	24	24
Total Number of Samples - Years 11 to End (biennial)	420	0	0
Total Number of Samples per biennial yr - Years 11 to End	24	0	0
Compliance Monitoring Samples - End + 5yrs	120	120	120
Monitoring Duration - Nitrate (years)	30	20	10
Monitoring Duration - Nitrate-S (years)	NA	NA	NA
Total Number of Samples - Year 1	65	65	65
Total Number of Samples/yr - Years 2&3	35	35	35
Total Number of Samples/yr - Years 4 to 10	35	35	35
Total Number of Samples/yr (S) - Years 4 to 10	(incl. in N)	0	(incl. in N)
Total Number of Samples - Years 11 to End (biennial)	350	175	0
Total Number of Samples (S) - Years 11 to End (biennial)	(incl. in N)	(incl. in N)	(incl. in N)
Total Number of Samples per biennial yr - Years 11 to End	35	35	0
Total Number of Samples per biennial yr (S) - Years 11 to End	(incl. in N)	(incl. in N)	(incl. in N)
Compliance Monitoring Samples - End + 5yrs	175	175	175
Monitoring Wells			
Wells & Aquifer Tubes to be used - Cr(VI)	34	34	34
New Wells	2	2	2
Well Depth, Ft	65	65	65
Well Casing Dia, In	6	6	6
Wells & Aquifer Tubes to be used - Sr-90	17	17	17
New Wells	1	1	1
Well Depth, Ft	65	65	65
Well Casing Dia, In	NA	NA	NA
Wells & Aquifer Tubes to be used - TCE	24	24	24
New Wells	2	2	2
Well Depth, Ft	65	65	65
Well Casing Dia, In	NA	NA	NA
Wells & Aquifer Tubes to be used - Nitrate	35	35	35
New Wells	10	10	10
Well Depth, Ft	65	65	65
Well Casing Dia, In	6	6	6
MW pump type - all plumes	NA	NA	NA
MW pump replacement, yrs	5	5	5
MW replacement, yrs	30	30	30
MW Rehab	NA	NA	NA
Extraction Wells			
# EW - Cr(VI)	NA	4	4
Flow rate per well, gpm	NA	45	45
Assumed well depth	NA	65	65
Expected Safety Level	NA	D	D
Type of Submersible Pump	NA	4", 56-95 gpm, 101'<	6", 56-95 gpm, 221'<
Well Casing Diameter, in	NA	8	8
2" HDPE Transfer Piping, ft	NA	11000	11000
6" HDPE Transfer Piping, ft	NA	NA	NA
Influent Pumping Stations (New)	NA	NA	NA
Influent Pumping Station Flow, ea	NA	NA	NA
Influent collection tanks	NA	1	1
Tank Capacity Each, gal	NA	20000	20000
# EW - Sr90	NA	1	1
Flow rate per well, gpm	NA	40	40
Assumed well depth	NA	65	65
Expected Safety Level	NA	D	D
Type of Submersible Pump	NA	6", 56-95 gpm, 221'<	6", 56-95 gpm, 221'<
Well Casing Diameter, in	NA	8	8
2" HDPE Transfer Piping, ft	NA	1980	1980
6" HDPE Transfer Piping, ft	NA	NA	NA
Influent Pumping Stations (New)	NA	NA	NA
Influent Pumping Station Flow, ea	NA	NA	NA
Influent collection tanks	NA	NA	NA
Tank Capacity Each, gal	NA	NA	NA
# EW - TCE	NA	2	2
Flow rate per well, gpm	NA	40	40
Assumed well depth	NA	65	65
Expected Safety Level	NA	D	D
Type of Submersible Pump	NA	6", 56-95 gpm, 221'<	6", 56-95 gpm, 301'<
Well Casing Diameter, in	NA	8	8
2" HDPE Transfer Piping, ft	NA	3190	3190
3" HDPE Transfer Piping, ft	NA	6930	6930
Influent Pumping Stations (New)	NA	1	1
Influent Pumping Station Flow, ea	NA	80	80
Influent collection tanks	NA	1	1
Tank Capacity Each, gal	NA	10000	10000
# EW - Nitrate	NA	11	17

Table A-10: Important Input Quantities to Cost Estimate

Flow rate per well, gpm	NA	41	41
Assumed well depth	NA	65	65
Expected Safety Level	NA	NA	NA
Type of Submersible Pump	NA	6", 56-95 gpm, 301'<	6", 56-95 gpm, 301'<
Well Casing Diameter, in	NA	8	8
2" HDPE Transfer Piping, ft	NA	26840	41360
4" HDPE Transfer Piping, ft	NA	8030	23100
Influent Pumping Stations (New)	NA	1	1
Influent Pumping Station Flow, ea	NA	455	695
Influent Collection Tanks	NA	1	1
Tank Capacity Each, gal	NA	15000	15000
EW- Rehab	NA	10	10
EW - Pump replacement	NA	5	5
EW- Well replacement	NA	20	20
Important Quantity 130	NA	NA	NA
Injection Wells			
# IW - Cr(VI)	NA	4	4
Flow rate per well, gpm	NA	55	55
Assumed well depth	NA	65	65
Expected Safety Level	NA	D	D
Type of Submersible Pump	NA	0	0
Well Casing Diameter, in	NA	8	8
2" HDPE Transfer Piping, ft	NA	8580	8580
6" HDPE Transfer Piping, ft	NA	NA	NA
Effluent Pumping Stations (New)	NA	NA	NA
Effluent Pumping Station Flow, ea	NA	NA	NA
Effluent collection tanks	NA	0	0
Tank Capacity Each, gal	NA	NA	NA
# IW - Sr90	NA	0	0
Flow rate per well, gpm	NA	0	0
Assumed well depth	NA	0	0
Expected Safety Level	NA	NA	0
Type of Submersible Pump	NA	NA	0
Well Casing Diameter, in	NA	0	0
2" HDPE Transfer Piping, ft	NA	0	0
6" HDPE Transfer Piping, ft	NA	NA	NA
Effluent Pumping Stations (New)	NA	NA	NA
Effluent Pumping Station Flow, ea	NA	NA	NA
Effluent collection tanks	NA	NA	NA
Tank Capacity Each, gal	NA	NA	NA
# IW - TCE	NA	1	1
Flow rate per well, gpm	NA	40	40
Assumed well depth	NA	65	65
Expected Safety Level	NA	D	D
Type of Submersible Pump	NA	0	0
Well Casing Diameter, in	NA	8	8
2" HDPE Transfer Piping, ft	NA	4290	4290
6" HDPE Transfer Piping, ft	NA	NA	NA
Effluent Pumping Stations (New)	NA	NA	NA
Effluent Pumping Station Flow, ea	NA	NA	NA
Effluent collection tanks	NA	NA	NA
Tank Capacity Each, gal	NA	NA	NA
# IW - Nitrate	NA	13	21
Flow rate per well, gpm	NA	37	37
Assumed well depth	NA	65	65
Expected Safety Level	NA	D	D
Type of Submersible Pump	NA	0	0
Well Casing Diameter, in	NA	0	0
2" HDPE Transfer Piping, ft	NA	55000	102850
4" HDPE Transfer Piping, ft	NA	8030	23100
Effluent Pumping Stations (New)	NA	1	1
Effluent Pumping Station Flow, gpm	NA	455	695
Effluent collection tanks	NA	1	1
Tank Capacity Each, gal	NA	20000	25000
IW- Rehab	NA	2	2
IW - Pump replacement	NA	5	5
IW- Well replacement	NA	10	10
Treatment			
Cr(VI) design flow, gpm (to IX)	NA	180	180
Bio-amended Injection for Cr, gpm		110	0
System % online time	NA	90%	90%
Sr-90 flow, gpm (to IX)	NA	40	40
System % online time	NA	90%	90%
TCE flow, gpm (to Air Stripper)	NA	80	80
Bio-amended Injection for TCE, gpm		40	0
System % online time	NA	90%	90%
NO3 flow, gpm (to IX)	NA	455	695
NO3 flow, gpm (to IX) - PHASE II	NA	335	575
NO3 flow, gpm (to IX) - PHASE III	NA	0	0
Bio-amended Injection for nitrate, gpm	NA	240	0
Bio-amended Injection for nitrate, gpm - PHASE II	NA	240	0
Bio-amended Injection for nitrate, gpm - PHASE III	NA	0	0
System % online time	NA	90%	90%
Total Treatment System Flow (initial), gpm	NA	755	995
Total Bio-amended injection flow (initial), gpm		390	0

ECF-Hanford-12-0067
Revision 0

Institutional Controls Costs Apportioned by ROD Groups

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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Revision 0

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Date Published
December 2012

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APPROVED
By Janis D. Aardal at 9:55 am, Dec 13, 2012

Release Approval　　　　Date

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Environmental Calculation Cover Page

Part 1: Completed by the Responsible Manager

Project: HANFORD PROJECT **Date: 09/17/2012**

Calculation Title & Description: Insitutional Controls Costs Apportioned by ROD Groups

Preparer: S. Ferries	**Basis of Qualification:** Geologist with 27 years of experience in environmental remediation, 15 years in cost estimating, and 13 years of RACER experience.
Checker: B. Ostapkowicz	**Basis of Qualification:** Civil Engineer with 8 years experience in hazardous waste site characterization/remediation and process design
Senior Reviewer: K. Klink	**Basis of Qualification:** Chemical Engineer with 31 years of experience; including 20 years of hazardous and radioactive waste site characterization and remediation and cost estimating, including development and application leading parametric models, CORA, RACER, and private corporate models

Part 2: Completed by Preparer

Calculation No.: ECF-Hanford-12-0067 **Revision No.:** 0

Revision History:

Revision No.	Description	Date	Affected Pages
0	Institutional Controls Costs Apportioned by ROD Groups Document	09/17/12	Entire document

Part 3: Document Review & Approval:

Preparer:

S. Ferries/Sr. Cost Estimator
NAME/POSITION

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9/18/2012
DATE

Checker:

B. Ostapkoiwicz/Engineer
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9/18/2012
DATE

Senior Reviewer:

K. Klink/Sr. Engineer
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SIGNATURE

9/18/2012
DATE

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Environmental Calculation Cover Page

Part 1: Completed by the Responsible Manager

Project: HANFORD PROJECT **Date: 09/17/2012**

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Part 2: Completed by Preparer

Calculation No.: ECF-Hanford-12-0067 **Revision No.:** 0

Responsible Manager: R. Brunke/Manager Environmental Integration

NAME/POSITION

SIGNATURE DATE 9/18/2012

EC1_Environmental_Calculation_Cover_Page A-6005-812 (REV 0)

Contents

Appendices

Tables

Terms

ICs – Institutional Controls

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980

CHPRC – CH2MHill Plateau Remediation Company

DOE – Department of Energy

ECF – Environmental Calculation File

EE/CA – Engineering Evaluation and Cost Assessment

EPA – Environmental Protection Agency

FS – Feasibility Study

MSA – Mission Support Alliance

NEP – National Estuary Program

NPL – National Priorities List

OMB – Office of Management and Budget

Plan – Hanford Sitewide Institutional Control Plan

RCRA - Resource Conservation Recovery Act of 1976

ROD – Record of Decision

TSD – Treatment Storage and Disposal Facility

1 Executive Summary

Many major Federal laws such as the Atomic Energy Act of 1954; Resource Conservation Recovery Act of 1976 (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Executive Orders; and regulations influence the use of institutional controls (ICs) at the U.S. Department of Energy (DOE) sites. Some regulatory drivers directly authorize or require the use of institutional controls, while others do not. DOE also uses institutional controls when no specific statutory requirement exists to supplement active remediation, pollution control, public and resource protection, and physical security, or to bolster the integrity of engineered remedies.

At the Hanford Site, one of the largest CERCLA cleanups in the country, there are 4 National Priority Listings (NPL) sites with a few dozen CERCLA operable units with thousands of waste sites and many square miles of contaminated groundwater. In addition, a number of RCRA operations including the Waste Treatment and Immobilization Plant Project, the Central Waste Complex, several Tank Farms; and various research and other activities taking place. There are programs in place to control access onto and specific uses of the Hanford Site that, in addition to preservation of the national monument, security and safety, also serve to protect human health and the environment by limiting potential exposure to hazardous substances. Many of these multi-purpose or programmatic controls are therefore included as required institutional controls by each CERCLA Record of Decision (ROD). The programmatic controls include site access, personnel badging, real estate and deeds, warning signs along the Columbia River bank and other access points, maintaining a current site wide institutional controls plan, controls for excavating soil, accessing and using groundwater, and irrigation restrictions. While these controls transcend any specific CERCLA ROD or even the overall CERCLA cleanup, DOE and EPA recognize the importance of maintaining these controls until unrestricted use, related to the protection of human health and the environment, is permitted.

The costs for providing the programmatic ICs were developed in a cooperative effort with the Mission Support Alliance contractor and CH2M Hill Plateau Remediation Company (CHPRC). MSA provides the majority of the programmatic ICs. Some River Corridor costs were also used as a basis for similar activities on the Central Plateau. These costs were assembled and where appropriate a 50% adjustment was made to represent CERCLA cleanup as a portion of the current Hanford Site mission. The TPA currently identifies 22 CERCLA Records of Decision, so each ROD would be allocated an equal portion of the CERCLA programmatic ICs costs.

The programmatic ICs costs are projected for the next 150 years. In 2068 ICs costs are reduced by 50% to reflect removal of the 100 area reactors, as the more active programmatic controls, like site access, would be likewise reduced.

The total non-discounted cost for the ICs for 150 years is estimated to be $562,781,000 for the Hanford site (about $25,600,000 per ROD). The total discounted cost for the ICs at Hanford are estimated at $221,299,000 (about $10,100,000 per ROD).

The total non-discounted cost for the 5-Year Reviews for 150 years is estimated to be $13,740,000 (about $625,000 per ROD). The total discounted cost for the 5-Year Reviews for 150 years is estimated to be $4,175,000 (about $190,000 per ROD).

2 Purpose

The purpose of this Environmental Calculation File document (ECF) is to document and describe cost used for the Institutional Controls (ICs) tasks associated with the Hanford Feasibility Study (FS) and Engineering Evaluation and Cost Assessment (EE/CA) cost estimates. This is the first effort to estimate costs associated with providing Programmatic Institutional Controls that would support all CERCLA Record of Decisions. The ICs tasks are based on the Hanford Sitewide Institutional Control Plan, (DOE/RL-2001-41, Rev. 5) and the costs were provided by CH2M Hill Plateau Remediation Company (CHPRC) sources associated with specific tasks.

The Institutional Controls presented in this ECF are considered programmatic costs which are assumed to be tasks called out by the Plan which are implemented across Hanford. Other costs associated with specific remediation sites and remedies within the Hanford project are not presented in this document.

This ECF will be revised as needed as cleanup work progresses and IC costs are further defined.

3 Background

The requirement to have Hanford Sitewide Institutional Controls is in the following documents:

- The Hanford Sitewide Institutional Control Plan, DOE/RL-2001-41, Rev. 5
- EPA/ROD/R10-00/122, Record of Decision for the USDOE Hanford 100-Area, Benton County, Washington
- EPA, 2001, USDOE Hanford Site, First Five-Year Review Report
- EPA/ROD/R10-01/119, Record of Decision for the USDOE Hanford 300 Area, Benton County, Washington
- DOE/EIS-0222-F, Final Hanford Comprehensive Land-Use Plan Environmental Impact Statements

The Hanford Site includes waste sites that are cleaned up under CERCLA response actions; RCRA corrective actions; and the treatment, storage, and disposal (TSD) units closed under RCRA. The CERCLA and/or RCRA decision document identify required institutional controls.

According to EPA guidance institutional controls are non-engineered instruments, such as administrative and legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. Although it is EPA's expectation that treatment or engineering controls will be used to address principal threat wastes and that groundwater will be returned to its beneficial use whenever practicable, ICs play an important role in site remedies because they reduce exposure to contamination by limiting land or resource use and guide human behavior at a site. For instance, zoning restrictions prevent site land uses, like residential uses, that are not consistent with the level of cleanup.

ICs are used when contamination is first discovered, when remedies are ongoing and when residual contamination remains onsite at a level that does not allow for unrestricted use and unlimited exposure after cleanup. The National Contingency Plan (NCP) emphasizes that ICs are meant to supplement engineering controls and that ICs will rarely be the sole remedy at a site.

Table 1 identifies types, the mechanism, and objective for ICs implemented at the Hanford Site.

Table 1 - Types, Objectives, and Mechanisms for Sitewide Institutional Control.

Types	Objectives	Mechanisms
Warning Notices	Provide visual identification and warning of hazardous or sensitive areas.	Signs
Entry Restrictions	Control human access to hazardous or sensitive areas. Ensure adequate training for those who enter hazardous or sensitive areas. Avoid disturbance and exposure to remedies such as engineered barriers or an effective vegetative soil layer. Provide a basis for the enforcement of access restrictions.	Procedural requirements for access, warning signs
	Prevent unauthorized human access to hazardous or sensitive areas. Provide protective barriers to standard industrial hazards. Provide visual warnings. Avoid disturbance and exposure to remedies such as engineered barriers or an effective vegetative soil layer.	Fencing
Land-Use Management	Ensure that use of the land is compatible with any hazards that exist. Ensure that any changes in use of the land are adequately assessed before being allowed. Ensure that the institutional controls are maintained beyond change of ownership, as appropriate.	Land-use and real property controls
	Avoid unplanned disturbance or infiltration. Inform and protect workers regarding potential exposure to hazardous waste. Avoid the creation of potential pathways for the migration of hazardous waste.	Excavation permits
Groundwater-Use Management	Ensure proper use of groundwater.	Land-use and real property controls, Excavation permits
Waste Site Information Management	Maintain and provide access to information on the location and nature of contamination.	Administrative

4 Methodology

The costs provided by MSA and others are assumed to be accurate and up to date. The costs presented in this ECF are CERCLA specific. The costs obtained from MSA contain both CERCLA, and RCRA requirements. In the cases where the IC task is for both CERCLA and RCRA requirements 50% was used to extract only the CERCLA portion of the cost of the requirement. This apportionment is based on the headcount of DOE and Contractors currently assigned to CERCLA related works cope, compared to the total Hanford Site headcount. The CERCLA Institutional Controls costs were subtotaled and the following markups were added:

- Contractor's Overhead: 10%
- Contractor's Profit: 8%
- Contingency: 15%
- Project Management: 10%
- CHPRC DD/G&A: 30.24%

For the non-discounted cost, the total annual and periodic cost for programmatic ICs were multiplied out for 55 years at the full cost (*to year 2067 which allows for the 75*[1] *year decay*) and then 50% of the total cost was used for the remaining 95 years for a total of 150 years of ICs. The NEPA Environmental Impact Statement (EIS) 1992, DOE/EIS-0019F states that the safe-storage period used in calculations for adequate decay time for Cobalt-60 is 75 years.

The discounted (*present worth*) cost was calculated by using the same costs as described in the paragraph above and then multiplying the annual (*this includes the annual and periodic*) cost by the 2.0% discount rate (Appendix C of the Office of Management and Budget (OMB) Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, 2012 discount Rates* for projects extending more than 30 years into the future).

The 22 Hanford Record of Decision (ROD) Groups are based on the current TPA which will have a total of 22 RODs for operable units:

- 100-BC
- 100-DH
- 100-F/IU
- 100-K
- 100-N
- 300 Area
- Outer Area
- 200-EA-1
- 200-WA-1
- 200-PW-1/3/6; CW-5
- 200-CR-1 (REDOX)
- 200-CB-1 (B Plant)

[1]*NEPA Impact Statement, DOE/EIS-0019F, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, December 1992 states that the safe-storage period used as a basis is 75 years, which is an accurate time for the decay of cobalt-60, a radionuclide that contributes significantly to occupational dose. This period permits the reactors to be decommissioned with less occupational radiation dose than in the case of immediate one-piece removal.*

- 200-CP-1 (PUREX)
- 200-CU-1 (U Plant)
- 200-SW-1
- 200-DV-1
- 200-DF-1 (ERDF)
- 200-ZP-1
- 200-UP-1
- 200-BP-5; 200-PO-1
- 1100 Area (includes ALE)
- Orchard Lands

5 Assumptions and Inputs

The costs were obtained from MSA's draft baseline budget for Fiscal Years 2012-2013 and are assumed to be accurate and current. River Corridor costs for signs were also used as a basis for the Central Plateau. Costs for the WIDs database as well as the prime contractor 5-year Review effort were based on current CHPRC costs.

6 Software Applications

Microsoft Office Excel 2010 was used to perform the calculations. Excel is a "Site Licensed Client Software" and is exempt from formal control requirements of PRC-PRO-IRM-309, Controlled Software Management.

7 Calculation

The calculations used in the 150 year Institutional Controls costs presented in this ECF follow the steps defined in the section 4-Methodology. Table 2 presents the ICs and the costs associated with each of the programmatic tasks.

Annual Cost

- The costs in column "Program Cost" were provided by MSA and CHPRC.
- The percentages used in the "% CERCLA ICs" column were estimated using historical contract/project experience to determine the percent CERCLA of the task.
- The "Annual Cost" column is calculated by multiplying the Program Cost by the associated % CERCLA ICs.
- The "# of ROD Groups Applicable" was calculated by taking the total number of ROD Groups at Hanford (22) and determining how many ROD Groups the task cost should be proportioned to. The two tasks with 6 ROD Groups listed are the tasks that pertain to the River Corridor ROD Groups.

- The “Annual Cost/ROD Group” column presents the approximate cost associated with the task per ROD Group. The “Annual Cost/ROD Group is calculated by taking the “Annual Cost” and dividing it by the “# of ROD Groups Applicable” number.
- The subtotal of the “Annual Cost” column is presented at the bottom of the table.
- The Contractor’s Overhead his calculated by multiplying 10% times the subtotal of the “Annual Cost” column.
- The subtotal of the Contractor’s Overhead is calculated by adding the Contractor’s Overhead cost and adding it to the “Program Cost” column subtotal.
- The Contractor’s Profit is calculated by multiplying 8% to the Contractor’s Overhead Subtotal.
- The subtotal of the Contractor’s Profit is calculated by adding the Contractor’s Profit to the subtotal of Contractor’s overhead.
- Contingency is calculated by multiplying 15% to the Contractor’s Profit subtotal.
- The Subtotal with Contingency is calculated by adding the Contingency result to the Contractor’s Profit subtotal.
- Project Management is calculated by multiplying 10% to the Subtotal with Contingency amount.
- No Remedial Design percent is calculated
- No Construction Management is calculated
- The Subtotal of Project Management is calculated by adding the Subtotal with Contingency to the Project management cost.
- CHPRC DD/G&A is calculated by multiplying 30% to the Project Management subtotal.
- The Total Annual Cost is calculated by adding the CHPRC DD/G&A cost to the Project Management subtotal cost.

Non-Discounted Total Cost for 150 Years

- The 150 year Non-Discounted Total Cost is calculated by adding the annual cost of $5,490,542 for the first 55 years and then for the next 95 years adding $2,745,271annually. The Total Non-Discounted cost is $562,781,000.

Present Worth, Discounted Total Cost for 150 Years

- The Present Worth cost is calculated by adding the same costs as detailed in the previous bullet and multiplying each year by the associated 2.0 % discount rate based on Office of Management and Budget (OMB) guidance for 2012.
  - Example:
    - Discount factor = ((1)/(1+2%)^year)
    - (1/(1.02)^9 (note: year 9 = 2021)
    - =0.836755

  - (Year 2021) $5,490,542 * 0.836755 = $4,594,240

- Each annual cost is multiplied by the discount factor and all of the 150 years are added up to calculate the Present Worth, discounted cost for the total 150 years. The total discounted cost is $221,299,000

Table 2 - Programmatic ICs & Costs

Category	Required IC	Related Program	Program Cost	% CERCLA ICs	Annual Cost	# of ROD Groups Applicable	Annual Cost/ROD Group
General	**Maintain Sitewide IC Plan**						
	Evaluate the implementation and effectiveness of institutional controls for the operable units on an annual basis.	MSA Stewardship + Prime Contractor	$ 50,000.00	100%	$ 50,000.00	22	$ 2,273
	DOE shall submit a report to EPA and Ecology by Month/day of each year summarizing the results of the evaluation for the preceding calendar year.	MSA Stewardship	$ 15,000	100%	$ 15,000.00	22	$ 682
	A report is required every five years to document effectiveness of the institutional controls, which must include identification of any deficiencies and corrective actions taken	MSA Stewardship + Prime Contractor	$ 9,500	100%	$ 9,500.00	22	$ 432
	DOE shall establish and maintain a records system or database that tracks locations and estimated quantities of residual contamination left in place until unrestricted use and exposure is allowed..	WIDS/CHPRC	$ 410,000.00	100%	$ 410,000.00	22	$ 18,636
Warning Signs	**Maintain Sitewide IC Plan**						
	DOE shall maintain signs that warn river users of potential hazards along the shoreline from 100 Area waste sites.	Land and Facilities Management	$ 5,000	100%	$ 5,000.00	6	$ 833
	DOE shall post and maintain in good condition "No Trespassing" signs along the shoreline.		$ 20,000	50%	$ 10,000.00	6	$ 1,667
	DOE shall post and maintain warning signs along access roads to caution site visitors and workers of potential hazards		$ 20,000	100%	$ 20,000.00	22	$ 909
Entry Restrictions	**Maintain Sitewide IC Plan**						
	DOE will continue to use a badging program to control access to the associated sites for the duration of the interim *-Visitors are required to be escorted at all times*	MSA Central Badge Office	$ 1,000,000	50%	$ 500,000.00	22	$ 22,727
	U.S. Department of Energy will maintain or implement access restrictions to prevent public access until final remedial action is completed. *-Trespass incidents will be reported to the Benton County Sheriff s Office and provide notification to EPA and Ecology*	MSA Security Operations	$ 2,000,000	50%	$ 1,000,000.00	22	$ 45,455
Land-Use Management	**Maintain Sitewide IC Plan**						
	Onsite excavation permit process to control land use (e.g., well drilling or excavation of soil) *-No intrusive work is allowed on or near the waste sites* *-DOE shall limit the removal of soil or debris from former waste site locations where contaminated soils and/or debris remain at depth (i.e., below 4.6 mn [15 ft]) above direct contact/direct exposure cleanup levels.* *-DOE shall limit access to and use of the water from seeps and springs along the columbia river shoreline as long as concentrations in the discharge water exceed drinking water standards* *-Prohibition on irrigation* *-The DOE will prevent the development and use of property for residential housing, elementary and secondary schools, childcare facilities and playgrounds.* *-Restrictions on the drilling of new groundwater in the existing plumes or their paths* *-Institutional controls are required to prevent human exposure to groundwater.* *-Well drilling and GW use is prohibited, except for monitoring or remediation wells authorized by EPA/Ecology.*	MSA Excavation Permit Program	$ 785,700.00	100%	$ 785,700.00	22	$ 35,714
				Subtotal	**$ 2,805,200**		

SUBTOTAL WITH SALES TAX		
Contractors Overhead	10%	$ 280,520
SUBTOTAL		**$ 3,085,720**
Contractors Profit	8%	$ 246,858
SUBTOTAL		**$ 3,332,578**
Contingency	15%	$ 499,887
SUBTOTAL WITH CONTINGENCY		**$ 3,832,464**
Project Management	10%	$ 383,246.42
Remedial Design	0%	$ -
Construction Management	0%	$ -
SUBTOTAL		**$ 4,215,711**
CHPRC DD/G&A	30.24%	$ 1,274,831
TOTAL ANNUAL COST		**$ 5,490,542**

Table 3 - Five Year Review Periodic Cost (Not included in Programmatic (IC Costs)

Periodic Cost	5-Year Review ($458,000) MSA + Prime Contractor's effort	*$458,000	Every 5 years

** Note: This cost is not incorporated into the total cost of the ICs listed above. This is a non-discounted cost.*

8 Results/Conclusions

The Programmatic Institutional Controls costs for 150 years are:

The total non-discounted cost for the ICs for 150 years is estimated to be $562,781,000 for the Hanford site (about $25,600,000 per ROD). The total discounted cost for the ICs at Hanford are estimated at $221,299,000 (about $10,100,000 per ROD).

The total non-discounted cost for the 5-Year Reviews for 150 years is estimated to be $13,740,000 (about $625,000 per ROD). The total discounted cost for the 5-Year Reviews for 150 years is estimated to be $4,175,000 (about $190,000 per ROD).

9 References

DOE/RL-2001-41, Revision 5, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions*, June 2012

The Hanford Sitewide Institutional Control Plan, DOE/RL-2001-41, Rev. 5

EPA/ROD/R10-00/121, Record of Decision for the USDOE Hanford 100-Area, Benton County, Washington

EPA, 2001, USDOE Hanford Site, First Five-Year Review Report

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DOE/EIS-0222-F, Final Hanford Comprehensive Land-Use Plan Environmental Impact Statements

DOE/EIS-0019F, NEPA Environmental Impact Statement, Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington, December 1992.

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Appendix A

Total Programmatic IC Cost

Present Worth Calculation, 150 years

Present Value

	A	B	C	D	E	F	G	H	I
12		**Discount Rate**		2.0%					
13		**YEAR**		**CAPITAL COST**	**ANNUAL COST**	**PERIODIC COST**	**TOTAL COST**	**DISCOUNT FACTOR**	**PRESENT VALUE**
14		2012	0				$ -	1.000000	$ -
15		2013	1		$ 5,490,542		$ 5,490,542	0.980392	$ 5,382,884
16		2014	2		$ 5,490,542		$ 5,490,542	0.961169	$ 5,277,337
17		2015	3		$ 5,490,542		$ 5,490,542	0.942322	$ 5,173,860
18		2016	4		$ 5,490,542		$ 5,490,542	0.923845	$ 5,072,412
19		2017	5		$ 5,490,542		$ 5,490,542	0.905731	$ 4,972,953
20		2018	6		$ 5,490,542		$ 5,490,542	0.887971	$ 4,875,444
21		2019	7		$ 5,490,542		$ 5,490,542	0.870560	$ 4,779,847
22		2020	8		$ 5,490,542		$ 5,490,542	0.853490	$ 4,686,124
23		2021	9		$ 5,490,542		$ 5,490,542	0.836755	$ 4,594,240
24		2022	10		$ 5,490,542		$ 5,490,542	0.820348	$ 4,504,156
25		2023	11		$ 5,490,542		$ 5,490,542	0.804263	$ 4,415,840
26		2024	12		$ 5,490,542		$ 5,490,542	0.788493	$ 4,329,255
27		2025	13		$ 5,490,542		$ 5,490,542	0.773033	$ 4,244,367
28		2026	14		$ 5,490,542		$ 5,490,542	0.757875	$ 4,161,144
29		2027	15		$ 5,490,542		$ 5,490,542	0.743015	$ 4,079,553
30		2028	16		$ 5,490,542		$ 5,490,542	0.728446	$ 3,999,562
31		2029	17		$ 5,490,542		$ 5,490,542	0.714163	$ 3,921,139
32		2030	18		$ 5,490,542		$ 5,490,542	0.700159	$ 3,844,254
33		2031	19		$ 5,490,542		$ 5,490,542	0.686431	$ 3,768,877
34		2032	20		$ 5,490,542		$ 5,490,542	0.672971	$ 3,694,977
35		2033	21		$ 5,490,542		$ 5,490,542	0.659776	$ 3,622,527
36		2034	22		$ 5,490,542		$ 5,490,542	0.646839	$ 3,551,497
37		2035	23		$ 5,490,542		$ 5,490,542	0.634156	$ 3,481,859
38		2036	24		$ 5,490,542		$ 5,490,542	0.621721	$ 3,413,588
39		2037	25		$ 5,490,542		$ 5,490,542	0.609531	$ 3,346,655
40		2038	26		$ 5,490,542		$ 5,490,542	0.597579	$ 3,281,034
41		2039	27		$ 5,490,542		$ 5,490,542	0.585862	$ 3,216,700
42		2040	28		$ 5,490,542		$ 5,490,542	0.574375	$ 3,153,627
43		2041	29		$ 5,490,542		$ 5,490,542	0.563112	$ 3,091,792
44		2042	30		$ 5,490,542		$ 5,490,542	0.552071	$ 3,031,168
45		2043	31		$ 5,490,542		$ 5,490,542	0.541246	$ 2,971,733
46		2044	32		$ 5,490,542		$ 5,490,542	0.530633	$ 2,913,464
47		2045	33		$ 5,490,542		$ 5,490,542	0.520229	$ 2,856,337
48		2046	34		$ 5,490,542		$ 5,490,542	0.510028	$ 2,800,331
49		2047	35		$ 5,490,542		$ 5,490,542	0.500028	$ 2,745,422
50		2048	36		$ 5,490,542		$ 5,490,542	0.490223	$ 2,691,591
51		2049	37		$ 5,490,542		$ 5,490,542	0.480611	$ 2,638,814
52		2050	38		$ 5,490,542		$ 5,490,542	0.471187	$ 2,587,073
53		2051	39		$ 5,490,542		$ 5,490,542	0.461948	$ 2,536,346
54		2052	40		$ 5,490,542		$ 5,490,542	0.452890	$ 2,486,614
55		2053	41		$ 5,490,542		$ 5,490,542	0.444010	$ 2,437,857
56		2054	42		$ 5,490,542		$ 5,490,542	0.435304	$ 2,390,055
57		2055	43		$ 5,490,542		$ 5,490,542	0.426769	$ 2,343,192
58		2056	44		$ 5,490,542		$ 5,490,542	0.418401	$ 2,297,247
59		2057	45		$ 5,490,542		$ 5,490,542	0.410197	$ 2,252,203
60		2058	46		$ 5,490,542		$ 5,490,542	0.402154	$ 2,208,042
61		2059	47		$ 5,490,542		$ 5,490,542	0.394268	$ 2,164,747
62		2060	48		$ 5,490,542		$ 5,490,542	0.386538	$ 2,122,301
63		2061	49		$ 5,490,542		$ 5,490,542	0.378958	$ 2,080,687
64		2062	50		$ 5,490,542		$ 5,490,542	0.371528	$ 2,039,889
65		2063	51		$ 5,490,542		$ 5,490,542	0.364243	$ 1,999,891
66		2064	52		$ 5,490,542		$ 5,490,542	0.357101	$ 1,960,678
67		2065	53		$ 5,490,542		$ 5,490,542	0.350099	$ 1,922,233
68		2066	54		$ 5,490,542		$ 5,490,542	0.343234	$ 1,884,542
69		2067	55		$ 5,490,542		$ 5,490,542	0.336504	$ 1,847,591
70		2068	56		$ 2,745,271		$ 2,745,271	0.329906	$ 905,682
71		2069	57		$ 2,745,271		$ 2,745,271	0.323437	$ 887,923
72		2070	58		$ 2,745,271		$ 2,745,271	0.317095	$ 870,513
73		2071	59		$ 2,745,271		$ 2,745,271	0.310878	$ 853,444
74		2072	60		$ 2,745,271		$ 2,745,271	0.304782	$ 836,710
75		2073	61		$ 2,745,271		$ 2,745,271	0.298806	$ 820,304
76		2074	62		$ 2,745,271		$ 2,745,271	0.292947	$ 804,219
77		2075	63		$ 2,745,271		$ 2,745,271	0.287203	$ 788,450
78		2076	64		$ 2,745,271		$ 2,745,271	0.281572	$ 772,991
79		2077	65		$ 2,745,271		$ 2,745,271	0.276051	$ 757,834
80		2078	66		$ 2,745,271		$ 2,745,271	0.270638	$ 742,974
81		2079	67		$ 2,745,271		$ 2,745,271	0.265331	$ 728,406
82		2080	68		$ 2,745,271		$ 2,745,271	0.260129	$ 714,124
83		2081	69		$ 2,745,271		$ 2,745,271	0.255028	$ 700,121
84		2082	70		$ 2,745,271		$ 2,745,271	0.250028	$ 686,394
85		2083	71		$ 2,745,271		$ 2,745,271	0.245125	$ 672,935
86		2084	72		$ 2,745,271		$ 2,745,271	0.240319	$ 659,740
87		2085	73		$ 2,745,271		$ 2,745,271	0.235607	$ 646,804
88		2086	74		$ 2,745,271		$ 2,745,271	0.230987	$ 634,121
89		2087	75		$ 2,745,271		$ 2,745,271	0.226458	$ 621,688
90		2088	76		$ 2,745,271		$ 2,745,271	0.222017	$ 609,498
91		2089	77		$ 2,745,271		$ 2,745,271	0.217664	$ 597,547
92		2090	78		$ 2,745,271		$ 2,745,271	0.213396	$ 585,830
93		2091	79		$ 2,745,271		$ 2,745,271	0.209212	$ 574,343

Present Value

	A	B	C	D	E	F	G	H	I
13		YEAR		CAPITAL COST	ANNUAL COST	PERIODIC COST	TOTAL COST	DISCOUNT FACTOR	PRESENT VALUE
94		2092	80		$ 2,745,271		$ 2,745,271	0.205110	$ 563,082
95		2093	81		$ 2,745,271		$ 2,745,271	0.201088	$ 552,041
96		2094	82		$ 2,745,271		$ 2,745,271	0.197145	$ 541,217
97		2095	83		$ 2,745,271		$ 2,745,271	0.193279	$ 530,605
98		2096	84		$ 2,745,271		$ 2,745,271	0.189490	$ 520,200
99		2097	85		$ 2,745,271		$ 2,745,271	0.185774	$ 510,000
100		2098	86		$ 2,745,271		$ 2,745,271	0.182132	$ 500,000
101		2099	87		$ 2,745,271		$ 2,745,271	0.178560	$ 490,197
102		2100	88		$ 2,745,271		$ 2,745,271	0.175059	$ 480,585
103		2101	89		$ 2,745,271		$ 2,745,271	0.171627	$ 471,162
104		2102	90		$ 2,745,271		$ 2,745,271	0.168261	$ 461,923
105		2103	91		$ 2,745,271		$ 2,745,271	0.164962	$ 452,866
106		2104	92		$ 2,745,271		$ 2,745,271	0.161728	$ 443,986
107		2105	93		$ 2,745,271		$ 2,745,271	0.158556	$ 435,281
108		2106	94		$ 2,745,271		$ 2,745,271	0.155448	$ 426,746
109		2107	95		$ 2,745,271		$ 2,745,271	0.152400	$ 418,378
110		2108	96		$ 2,745,271		$ 2,745,271	0.149411	$ 410,175
111		2109	97		$ 2,745,271		$ 2,745,271	0.146482	$ 402,132
112		2110	98		$ 2,745,271		$ 2,745,271	0.143609	$ 394,247
113		2111	99		$ 2,745,271		$ 2,745,271	0.140794	$ 386,517
114		2112	100		$ 2,745,271		$ 2,745,271	0.138033	$ 378,938
115		2113	101		$ 2,745,271		$ 2,745,271	0.135326	$ 371,508
116		2114	102		$ 2,745,271		$ 2,745,271	0.132673	$ 364,223
117		2115	103		$ 2,745,271		$ 2,745,271	0.130072	$ 357,082
118		2116	104		$ 2,745,271		$ 2,745,271	0.127521	$ 350,080
119		2117	105		$ 2,745,271		$ 2,745,271	0.125021	$ 343,216
120		2118	106		$ 2,745,271		$ 2,745,271	0.122569	$ 336,486
121		2119	107		$ 2,745,271		$ 2,745,271	0.120166	$ 329,888
122		2120	108		$ 2,745,271		$ 2,745,271	0.117810	$ 323,420
123		2121	109		$ 2,745,271		$ 2,745,271	0.115500	$ 317,078
124		2122	110		$ 2,745,271		$ 2,745,271	0.113235	$ 310,861
125		2123	111		$ 2,745,271		$ 2,745,271	0.111015	$ 304,766
126		2124	112		$ 2,745,271		$ 2,745,271	0.108838	$ 298,790
127		2125	113		$ 2,745,271		$ 2,745,271	0.106704	$ 292,931
128		2126	114		$ 2,745,271		$ 2,745,271	0.104612	$ 287,188
129		2127	115		$ 2,745,271		$ 2,745,271	0.102561	$ 281,556
130		2128	116		$ 2,745,271		$ 2,745,271	0.100550	$ 276,036
131		2129	117		$ 2,745,271		$ 2,745,271	0.098578	$ 270,623
132		2130	118		$ 2,745,271		$ 2,745,271	0.096645	$ 265,317
133		2131	119		$ 2,745,271		$ 2,745,271	0.094750	$ 260,115
134		2132	120		$ 2,745,271		$ 2,745,271	0.092892	$ 255,014
135		2133	121		$ 2,745,271		$ 2,745,271	0.091071	$ 250,014
136		2134	122		$ 2,745,271		$ 2,745,271	0.089285	$ 245,112
137		2135	123		$ 2,745,271		$ 2,745,271	0.087534	$ 240,306
138		2136	124		$ 2,745,271		$ 2,745,271	0.085818	$ 235,594
139		2137	125		$ 2,745,271		$ 2,745,271	0.084135	$ 230,974
140		2138	126		$ 2,745,271		$ 2,745,271	0.082486	$ 226,445
141		2139	127		$ 2,745,271		$ 2,745,271	0.080868	$ 222,005
142		2140	128		$ 2,745,271		$ 2,745,271	0.079283	$ 217,652
143		2141	129		$ 2,745,271		$ 2,745,271	0.077728	$ 213,385
144		2142	130		$ 2,745,271		$ 2,745,271	0.076204	$ 209,201
145		2143	131		$ 2,745,271		$ 2,745,271	0.074710	$ 205,099
146		2144	132		$ 2,745,271		$ 2,745,271	0.073245	$ 201,077
147		2145	133		$ 2,745,271		$ 2,745,271	0.071809	$ 197,134
148		2146	134		$ 2,745,271		$ 2,745,271	0.070401	$ 193,269
149		2147	135		$ 2,745,271		$ 2,745,271	0.069020	$ 189,479
150		2148	136		$ 2,745,271		$ 2,745,271	0.067667	$ 185,764
151		2149	137		$ 2,745,271		$ 2,745,271	0.066340	$ 182,122
152		2150	138		$ 2,745,271		$ 2,745,271	0.065039	$ 178,551
153		2151	139		$ 2,745,271		$ 2,745,271	0.063764	$ 175,050
154		2152	140		$ 2,745,271		$ 2,745,271	0.062514	$ 171,617
155		2153	141		$ 2,745,271		$ 2,745,271	0.061288	$ 168,252
156		2154	142		$ 2,745,271		$ 2,745,271	0.060086	$ 164,953
157		2155	143		$ 2,745,271		$ 2,745,271	0.058908	$ 161,719
158		2156	144		$ 2,745,271		$ 2,745,271	0.057753	$ 158,548
159		2157	145		$ 2,745,271		$ 2,745,271	0.056621	$ 155,439
160		2158	146		$ 2,745,271		$ 2,745,271	0.055510	$ 152,391
161		2159	147		$ 2,745,271		$ 2,745,271	0.054422	$ 149,403
162		2160	148		$ 2,745,271		$ 2,745,271	0.053355	$ 146,474
163		2161	149		$ 2,745,271		$ 2,745,271	0.052309	$ 143,602
164		2162	150		$ 2,745,271		$ 2,745,271	0.051283	$ 140,786
1015									
1016				**$ -**	**$ 562,781,000**	**$ -**	**$ 562,781,000**		**$ 221,299,000**

Appendix B

Total Programmatic 5-Year Review Cost

Present Worth Calculation, 150 years

Present Value (5-yr)

	A	B	C	D	E	F	G	H	I
12		**Discount Rate**		2.0%					
13		**YEAR**		**CAPITAL COST**	**ANNUAL COST**	**PERIODIC COST**	**TOTAL COST**	**DISCOUNT FACTOR**	**PRESENT VALUE**
14		2012	0				$ -	1.000000	$ -
15		2013	1		$ -		$ -	0.980392	$ -
16		2014	2		$ -		$ -	0.961169	$ -
17		2015	3		$ -		$ -	0.942322	$ -
18		2016	4		$ -		$ -	0.923845	$ -
19		2017	5		$ -	$ 458,000	$ 458,000	0.905731	$ 414,825
20		2018	6		$ -		$ -	0.887971	$ -
21		2019	7		$ -		$ -	0.870560	$ -
22		2020	8		$ -		$ -	0.853490	$ -
23		2021	9		$ -		$ -	0.836755	$ -
24		2022	10		$ -	$ 458,000	$ 458,000	0.820348	$ 375,720
25		2023	11		$ -		$ -	0.804263	$ -
26		2024	12		$ -		$ -	0.788493	$ -
27		2025	13		$ -		$ -	0.773033	$ -
28		2026	14		$ -		$ -	0.757875	$ -
29		2027	15		$ -	$ 458,000	$ 458,000	0.743015	$ 340,301
30		2028	16		$ -		$ -	0.728446	$ -
31		2029	17		$ -		$ -	0.714163	$ -
32		2030	18		$ -		$ -	0.700159	$ -
33		2031	19		$ -		$ -	0.686431	$ -
34		2032	20		$ -	$ 458,000	$ 458,000	0.672971	$ 308,221
35		2033	21		$ -		$ -	0.659776	$ -
36		2034	22		$ -		$ -	0.646839	$ -
37		2035	23		$ -		$ -	0.634156	$ -
38		2036	24		$ -		$ -	0.621721	$ -
39		2037	25		$ -	$ 458,000	$ 458,000	0.609531	$ 279,165
40		2038	26		$ -		$ -	0.597579	$ -
41		2039	27		$ -		$ -	0.585862	$ -
42		2040	28		$ -		$ -	0.574375	$ -
43		2041	29		$ -		$ -	0.563112	$ -
44		2042	30		$ -	$ 458,000	$ 458,000	0.552071	$ 252,848
45		2043	31		$ -		$ -	0.541246	$ -
46		2044	32		$ -		$ -	0.530633	$ -
47		2045	33		$ -		$ -	0.520229	$ -
48		2046	34		$ -		$ -	0.510028	$ -
49		2047	35		$ -	$ 458,000	$ 458,000	0.500028	$ 229,013
50		2048	36		$ -		$ -	0.490223	$ -
51		2049	37		$ -		$ -	0.480611	$ -
52		2050	38		$ -		$ -	0.471187	$ -
53		2051	39		$ -		$ -	0.461948	$ -
54		2052	40		$ -	$ 458,000	$ 458,000	0.452890	$ 207,424
55		2053	41		$ -		$ -	0.444010	$ -
56		2054	42		$ -		$ -	0.435304	$ -
57		2055	43		$ -		$ -	0.426769	$ -
58		2056	44		$ -		$ -	0.418401	$ -
59		2057	45		$ -	$ 458,000	$ 458,000	0.410197	$ 187,870
60		2058	46		$ -		$ -	0.402154	$ -
61		2059	47		$ -		$ -	0.394268	$ -
62		2060	48		$ -		$ -	0.386538	$ -
63		2061	49		$ -		$ -	0.378958	$ -
64		2062	50		$ -	$ 458,000	$ 458,000	0.371528	$ 170,160
65		2063	51		$ -		$ -	0.364243	$ -
66		2064	52		$ -		$ -	0.357101	$ -
67		2065	53		$ -		$ -	0.350099	$ -
68		2066	54		$ -		$ -	0.343234	$ -
69		2067	55		$ -	$ 458,000	$ 458,000	0.336504	$ 154,119
70		2068	56		$ -		$ -	0.329906	$ -
71		2069	57		$ -		$ -	0.323437	$ -
72		2070	58		$ -		$ -	0.317095	$ -
73		2071	59		$ -		$ -	0.310878	$ -
74		2072	60		$ -	$ 458,000	$ 458,000	0.304782	$ 139,590
75		2073	61		$ -		$ -	0.298806	$ -
76		2074	62		$ -		$ -	0.292947	$ -
77		2075	63		$ -		$ -	0.287203	$ -
78		2076	64		$ -		$ -	0.281572	$ -
79		2077	65		$ -	$ 458,000	$ 458,000	0.276051	$ 126,431
80		2078	66		$ -		$ -	0.270638	$ -
81		2079	67		$ -		$ -	0.265331	$ -
82		2080	68		$ -		$ -	0.260129	$ -
83		2081	69		$ -		$ -	0.255028	$ -
84		2082	70		$ -	$ 458,000	$ 458,000	0.250028	$ 114,513
85		2083	71		$ -		$ -	0.245125	$ -
86		2084	72		$ -		$ -	0.240319	$ -
87		2085	73		$ -		$ -	0.235607	$ -
88		2086	74		$ -		$ -	0.230987	$ -
89		2087	75		$ -	$ 458,000	$ 458,000	0.226458	$ 103,718
90		2088	76		$ -		$ -	0.222017	$ -
91		2089	77		$ -		$ -	0.217664	$ -
92		2090	78		$ -		$ -	0.213396	$ -
93		2091	79		$ -		$ -	0.209212	$ -
94		2092	80		$ -	$ 458,000	$ 458,000	0.205110	$ 93,940

Present Value (5-yr)

	A	B	C	D	E	F	G	H	I
13		YEAR		CAPITAL COST	ANNUAL COST	PERIODIC COST	TOTAL COST	DISCOUNT FACTOR	PRESENT VALUE
95		2093	81		$ -		$ -	0.201088	$ -
96		2094	82		$ -		$ -	0.197145	$ -
97		2095	83		$ -		$ -	0.193279	$ -
98		2096	84		$ -		$ -	0.189490	$ -
99		2097	85		$ -	$ 458,000	$ 458,000	0.185774	$ 85,085
100		2098	86		$ -		$ -	0.182132	$ -
101		2099	87		$ -		$ -	0.178560	$ -
102		2100	88		$ -		$ -	0.175059	$ -
103		2101	89		$ -		$ -	0.171627	$ -
104		2102	90		$ -	$ 458,000	$ 458,000	0.168261	$ 77,064
105		2103	91		$ -		$ -	0.164962	$ -
106		2104	92		$ -		$ -	0.161728	$ -
107		2105	93		$ -		$ -	0.158556	$ -
108		2106	94		$ -		$ -	0.155448	$ -
109		2107	95		$ -	$ 458,000	$ 458,000	0.152400	$ 69,799
110		2108	96		$ -		$ -	0.149411	$ -
111		2109	97		$ -		$ -	0.146482	$ -
112		2110	98		$ -		$ -	0.143609	$ -
113		2111	99		$ -		$ -	0.140794	$ -
114		2112	100		$ -	$ 458,000	$ 458,000	0.138033	$ 63,219
115		2113	101		$ -		$ -	0.135326	$ -
116		2114	102		$ -		$ -	0.132673	$ -
117		2115	103		$ -		$ -	0.130072	$ -
118		2116	104		$ -		$ -	0.127521	$ -
119		2117	105		$ -	$ 458,000	$ 458,000	0.125021	$ 57,259
120		2118	106		$ -		$ -	0.122569	$ -
121		2119	107		$ -		$ -	0.120166	$ -
122		2120	108		$ -		$ -	0.117810	$ -
123		2121	109		$ -		$ -	0.115500	$ -
124		2122	110		$ -	$ 458,000	$ 458,000	0.113235	$ 51,862
125		2123	111		$ -		$ -	0.111015	$ -
126		2124	112		$ -		$ -	0.108838	$ -
127		2125	113		$ -		$ -	0.106704	$ -
128		2126	114		$ -		$ -	0.104612	$ -
129		2127	115		$ -	$ 458,000	$ 458,000	0.102561	$ 46,973
130		2128	116		$ -		$ -	0.100550	$ -
131		2129	117		$ -		$ -	0.098578	$ -
132		2130	118		$ -		$ -	0.096645	$ -
133		2131	119		$ -		$ -	0.094750	$ -
134		2132	120		$ -	$ 458,000	$ 458,000	0.092892	$ 42,545
135		2133	121		$ -		$ -	0.091071	$ -
136		2134	122		$ -		$ -	0.089285	$ -
137		2135	123		$ -		$ -	0.087534	$ -
138		2136	124		$ -		$ -	0.085818	$ -
139		2137	125		$ -	$ 458,000	$ 458,000	0.084135	$ 38,534
140		2138	126		$ -		$ -	0.082486	$ -
141		2139	127		$ -		$ -	0.080868	$ -
142		2140	128		$ -		$ -	0.079283	$ -
143		2141	129		$ -		$ -	0.077728	$ -
144		2142	130		$ -	$ 458,000	$ 458,000	0.076204	$ 34,901
145		2143	131		$ -		$ -	0.074710	$ -
146		2144	132		$ -		$ -	0.073245	$ -
147		2145	133		$ -		$ -	0.071809	$ -
148		2146	134		$ -		$ -	0.070401	$ -
149		2147	135		$ -	$ 458,000	$ 458,000	0.069020	$ 31,611
150		2148	136		$ -		$ -	0.067667	$ -
151		2149	137		$ -		$ -	0.066340	$ -
152		2150	138		$ -		$ -	0.065039	$ -
153		2151	139		$ -		$ -	0.063764	$ -
154		2152	140		$ -	$ 458,000	$ 458,000	0.062514	$ 28,631
155		2153	141		$ -		$ -	0.061288	$ -
156		2154	142		$ -		$ -	0.060086	$ -
157		2155	143		$ -		$ -	0.058908	$ -
158		2156	144		$ -		$ -	0.057753	$ -
159		2157	145		$ -	$ 458,000	$ 458,000	0.056621	$ 25,932
160		2158	146		$ -		$ -	0.055510	$ -
161		2159	147		$ -		$ -	0.054422	$ -
162		2160	148		$ -		$ -	0.053355	$ -
163		2161	149		$ -		$ -	0.052309	$ -
164		2162	150		$ -	$ 458,000	$ 458,000	0.051283	$ 23,488
1015									
1016				**$ -**	**$ -**	**$ 13,740,000**	**$ 13,740,000**		**$ 4,175,000**