

ENVIRONMENTAL COST ESTIMATE FOR THE B PLANT COMPLEX

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



**P.O. Box 1600
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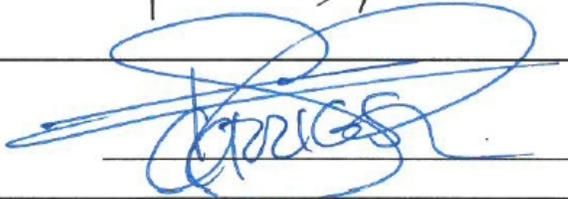
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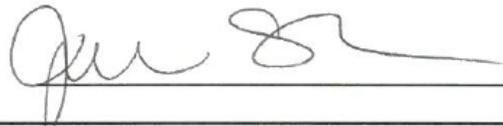
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Terms

CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
CHPRC	CH2M HILL Plateau Remediation Company
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
ECE	environmental cost estimate
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
ERDF	Environmental Restoration Disposal Facility
FY	fiscal year
G&A	general and administrative
HEPA	high-efficiency particulate air
HHE	human health and the environment
HSSA	Hanford Site Stabilization Agreement
MDBI	mobilization/demobilization/bonding/insurance
O&M	operations and maintenance
OH&P	overhead and profit
PFP	Plutonium Finishing Plant
PUREX	Plutonium Uranium Extraction (Plant)
REDOX	reduction-oxidation
S&M	surveillance and maintenance
TRACE	Tool for Response Action Cost Estimating
TSS	Technical Support Services
USACE	U.S. Army Corps of Engineers
WESF	Waste Encapsulation and Storage Facility

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1 Introduction

CH2M HILL Plateau Remediation Company (CHPRC) has prepared this environmental cost estimate (ECE) to support the evaluation of removal action alternatives presented in DOE/RL-2016-14, *Engineering Evaluation/Cost Analysis for the B Plant Complex*, hereinafter called the B Plant engineering evaluation/cost analysis (EE/CA).

Cost estimates for each building/structure summarized in this ECE have been prepared to support the selection of the removal action alternative. The cost estimates reflect specific removal action alternative approaches, scope assumptions, and exclusions, as well as cost estimating methodologies. Input parameters and related calculations used in the development of this cost estimate are found in ECF-200E-15-0130, *Cost Estimate Inputs for Engineering Evaluation/Cost Analysis for the B Plant Complex*. The removal action alternative cost estimates have expected accuracy ranges of +50/-30 percent, as described in Chapter 11, "Estimate Classification." Final costs of the selected removal action alternative will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other factors.

2 Purpose of Estimate

This ECE provides costs needed to support the B Plant EE/CA (DOE/RL-2016-14). It provides an overview of removal action specific cost inputs, methodology, and results. This ECE also documents the references that provide scope and information used to prepare these estimates. The purpose of this ECE is to accomplish the following objectives:

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

This cost estimate has been prepared 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, final project costs will vary from the estimate presented here. Because of this, project feasibility and funding needs must be carefully reviewed before making specific financial decisions to help ensure proper project evaluation and adequate funding.

3 General Project Description

The B Plant EE/CA (DOE/RL-2016-14) identifies removal action alternatives and evaluates them against the following criteria: removal action objectives, effectiveness, implementability, and estimated cost. The Washington State Department of Ecology (Ecology) is the lead regulatory agency for this action. The U.S. Department of Energy (DOE) is voluntarily seeking Ecology review and concurrence in this removal action to help ensure consistency with ongoing or subsequent related remedial actions. Removal actions taken pursuant to the B Plant EE/CA will be conducted in compliance with DOE et al., 2012, *Hanford Federal Facility Agreement and Consent Order Hanford Public Involvement Plan*, public participation requirements established in 40 CFR 300.415(n), "National Oil and Hazardous Substances Pollution Contingency Plan," "Removal Action," and any applicable DOE policies. The B Plant EE/CA will undergo a 30-day public comment period. After the public comment period, a written response to significant comments will be provided in accordance with 40 CFR 300.820(a), "Administrative Record File for a Removal Action." After consideration of the comments received from the public, DOE will confer with Ecology in the issuance of an action memorandum, which will identify the selected

alternative, either the one recommended in the B Plant EE/CA (DOE/RL-2016-14) or one of the other alternatives.

The 221B Canyon Building was built in 1945 and was designed for chemical processing of spent nuclear fuel. B Plant began separations processing using irradiated feed from the Hanford Site B and D Reactors on April 13, 1945. The original separations process used at B Plant was the bismuth-phosphate process, which produced a plutonium nitrate product that was shipped to the Los Alamos Site in New Mexico for fabrication into atomic weapons. In 1952, due to greater efficiency of a new radiochemical separations process at the Hanford Site known as reduction-oxidation (REDOX), the processing operation at B Plant was terminated.

In the early 1960s, B Plant was retrofitted for a large waste partitioning mission to separate strontium-90 and cesium-137 out of wastes stored in the tank farms associated with the Plutonium Uranium Extraction (PUREX) and REDOX Plants and out of PUREX current acid wastes and sludges. Individual strontium and cesium solutions were then transferred to the adjacent Waste Encapsulation and Storage Facility (WESF) for processing, encapsulation, and storage in pool cells. The canyon and process cells were extensively decontaminated of residual plutonium when the facility was being prepared for the cesium separations mission.

In May 1991, B Plant was taken out of operating mode, and the plant was placed in transition status in September 1995. In 1996, transition activities were initiated to isolate the structure and achieve stability through the removal and disposal or disposition of major radioactive sources, hazardous materials, and dangerous waste. B Plant has been decoupled and isolated from WESF (HNF-14804, *B Plant Documented Safety Analysis*).

4 Scope of Work

This cost estimate for the B Plant EE/CA (DOE/RL-2016-14) was developed in accordance with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (OSWER 9355.0-75), and PRC-PRO-EP-40282, *Cost Estimating Procedure for Response Action Decision-Making and Work Plans*. Quantities used in the creation of this estimate were based on the following documents:

- CP-59374, *Canyon Risk Mitigation Plan*
- HNF-14804, *B Plant Documented Safety Analysis*
- HNF-SD-WM-BIO-003, *B Plant Basis for Interim Operations*
- ECF-200E-15-0130, *Cost Estimate Inputs for Engineering Evaluation/Cost Analysis for the B Plant Complex*
- Various Hanford Site drawings

Removal action alternatives were developed for all buildings/structures evaluated within the B Plant EE/CA (DOE/RL-2016-14). These buildings/structures include the 221B Canyon Building, and the retired 291B Ventilation System. The alternatives developed include specific actions to occur within each structure. Each successive alternative includes all of the structure specific actions involved in the previous alternative, with the addition of new actions for various structures as outlined in each of the alternative subsections.

Each alternative, with the exception of Alternative 1, includes the following types of actions: surveillance and maintenance (S&M), hazard abatement, demo prep, demolition, and grouting. The following

subsections describe these action categories. For the purpose of this cost estimate, the specific quantities used for each of the following actions are discussed in Chapter 5.

Surveillance and Maintenance

S&M activities will be performed according to the most current S&M plan (DOE/RL-99-24, *Surveillance and Maintenance Plan for the 221-B Facility (B Plant)*). Activities conducted during the S&M phase are established to monitor containment of contaminants left in place, provide physical safety and security controls, and maintain the facility in a manner that will minimize risk to human health and the environment (HHE). S&M activities may be conducted on a routine and/or a nonroutine basis. Routine activities ensure that the structural and passive confinement integrity is maintained and may include periodic monitoring for potential radiological contamination, maintenance, identification, and minor repair of friable asbestos, general visual inspections, and annual roof inspections. Nonroutine activities include major responses to hazardous conditions (e.g., a leak in one area spreading radiological contamination to another area). Surveillance must satisfy the inspection requirements identified in Table 6-1, “B Plant Regulatory Compliance during Surveillance and Maintenance” of the S&M plan (DOE/RL-99-24). The S&M Plan will be revised to reflect the current facility conditions and identify appropriate surveillance requirements as needed.

Hazard Abatement

Hazard abatement differs from S&M in that it allows for a proactive response to mitigate or reduce risk before a major response would be required. Hazard abatement may range from stabilization to complete removal of equipment and waste, as needed, to mitigate hazards. Identification of areas that will receive hazard abatement will be based on S&M activities and observations.

Demolition Preparation (Demo Prep)

Demo prep may include activities such as general housekeeping and removal of equipment and waste. Decontamination, fixing/stabilization of contamination, and isolation of systems may be performed. Overhead utilities and adjacent concrete and asphalt will be removed, as needed. Fluids will be drained from piping and equipment. Piping entering or exiting a structure may be plugged, blocked, or grouted to prevent potential release pathways to the environment, as appropriate. These activities will be managed in accordance with procedures that address removing, handling, and disposing of equipment and waste in a manner that protects the safety of workers and the public, minimizes spills and releases to the environment, and meets regulatory requirements.

Demolition

Demolition can include hazard abatement and demo prep activities such as removing radioactive and hazardous substances from within and around buildings and structures; decontaminating, fixing contamination, and isolating systems; removing equipment; and plugging piping or drains entering or exiting belowgrade buildings/structures. Demolition of buildings and structures includes removal of abovegrade structures. The area will be stabilized (for example, backfill, contour, and vegetate), as necessary and appropriate. Demolition will be performed in a manner that protects HHE and reduces or eliminates the need for ongoing S&M activities.

Grouting

Grouting of structures will be performed to reduce the mobility, solubility, and/or toxicity of the structures and to support final disposition. Structures and systems, including piping, utility systems, and structural steel, may be abandoned in place and grouted. Residual radioactive materials in proposed grouted areas will remain in place and will be managed in accordance with DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions*. Void spaces would be grouted, as necessary, and/or backfilled as appropriate and practicable. A controlled

density fill material, such as grout or other similar material, may be installed to stabilize the void space, provide shielding, and facilitate demolition and/or future removal or remedial actions.

4.1 Alternative 1 – No Action

The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) requires a No Action alternative as a baseline for comparison with other removal action alternatives. Under the No Action alternative, it is assumed that 221B and 291B would be abandoned without any further action. No legal restrictions, institutional controls, or active measures are applied to 221B or 291B, in this alternative. S&M activities would be discontinued, no additional facility stabilization would be performed, and degradation would continue indefinitely. Initial risks to HHE from the No Action alternative would be minimal and, barring an unusual event, contaminants are assumed to remain confined within the structures. Risks over time are expected to increase as deterioration progresses and structural integrity is compromised. The possibility of a chemical and/or radiological contamination spread would increase due to lack of monitoring and controls. Physical hazards associated with partial structural collapse would also be anticipated.

Although Alternative 1 would not have an associated implementation cost under this analysis, it is understood that taking No Action would ultimately result in a substantial cost in the future. Alternative 1 is not consistent with DOE obligations under federal law to protect HHE; therefore, this alternative cannot be considered viable and is not considered further in the B Plant EE/CA (DOE/RL-2016-14). This alternative is used as a baseline for comparison only.

4.2 Alternative 2 – Continued S&M/Hazard Abatement of 221B/Demolition and/or Grouting of 291B

Alternative 2 includes the following primary elements:

- Continued S&M
- Hazard Abatement of Operating and Pipe Galleries
- Grouting of belowgrade void spaces within the retired 291B Ventilation System
- Demolition of abovegrade structures associated with the retired 291B Ventilation System

Figure 1 summarizes the removal activities for Alternative 2, and the following subsections describe the scope of each removal activity.

4.2.1 Surveillance and Maintenance

Under Alternative 2, S&M activities for the B Plant Complex would continue.

4.2.2 Hazard Abatement

The Operating and Pipe Galleries (Figure 1) contain pipes, tanks, and equipment that are chemically and/or radiologically contaminated. Alternative 2 proposes proactive mitigation of risk from used equipment and waste in these areas that poses a threat to HHE. Hazard abatement in the Operating and Pipe Galleries include stabilization or, if possible, complete decontamination and removal of the sources of contamination. Hazard abatement also includes the complete removal of all piping and equipment, as necessary. If cleanout is not possible in either gallery, contamination would be stabilized in place. A modification to the active 296B Ventilation System may be necessary to support hazard abatement.

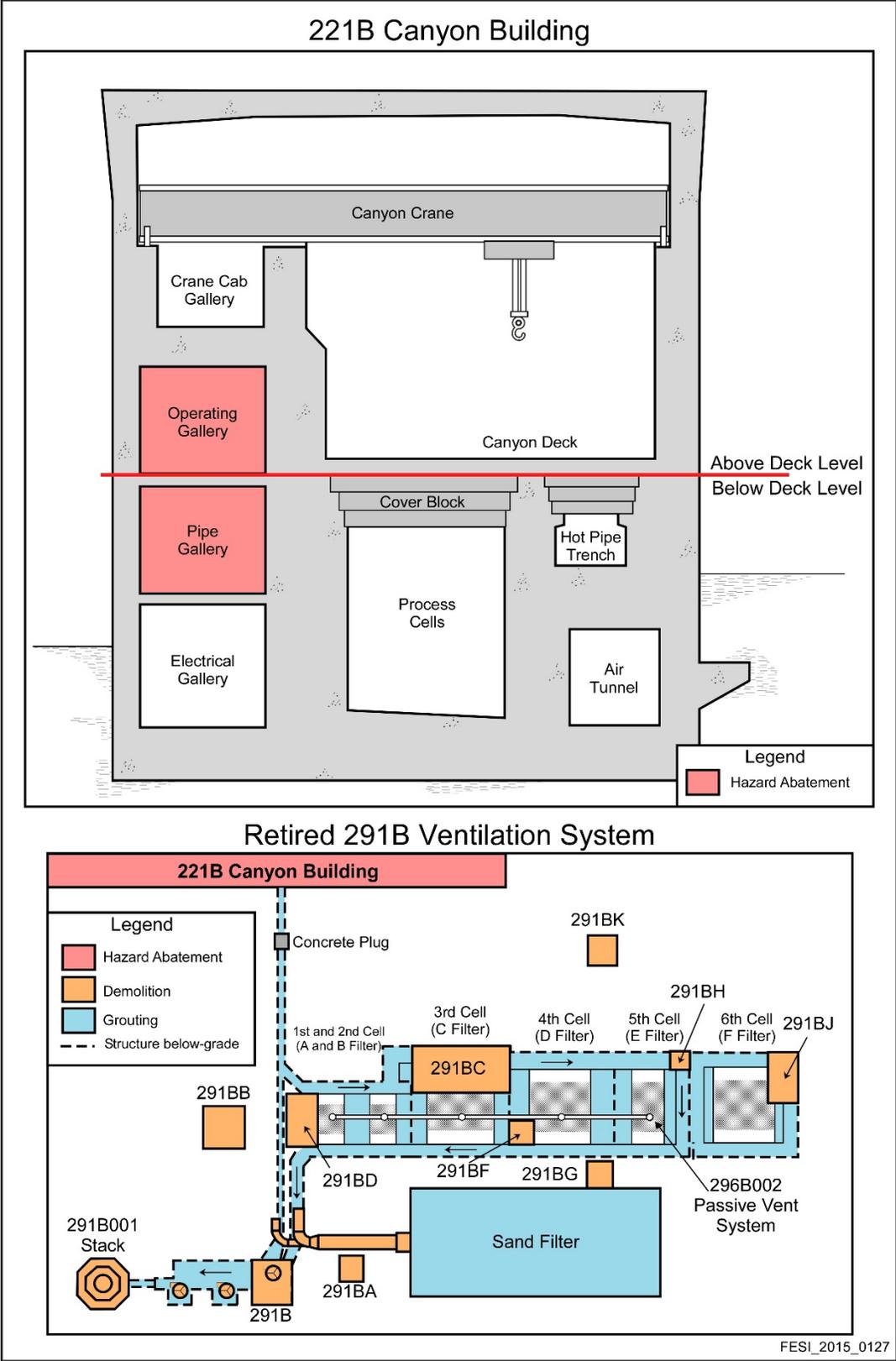


Figure 1. Alternative 2 Proposed Actions

4.2.3 Grouting/Demolition

All belowgrade void space within the retired 291B Ventilation System would be grouted. Both high-efficiency particulate air (HEPA) and sand filters associated with 291B were isolated and abandoned in place (DOE/RL-2010-54, *Engineering Evaluation/Cost Analysis for 200 East Area Tier 2 Buildings/Structures*). The filter cells contain significant radiological inventory. Under this alternative, the filter cells, sand filter, and belowgrade ducts would be grouted in place. Abovegrade structures, including fans, duct work, and the 291B001 Stack, would be demolished. The 296B002 Passive Vent System would be grouted/demolished, as necessary, once the HEPA filters are grouted.

4.3 Alternative 3 – Continued S&M/Hazard Abatement of 221B/Demolition and/or Grouting of 291B/Demo Prep of 221B

Alternative 3 includes all activities from Alternative 2, followed by the primary element of Alternative 3 listed in italics:

- Continued S&M (Alternative 2)
- Hazard Abatement of Operating and Pipe Galleries (Alternative 2)
- Grouting of belowgrade void spaces within the retired 291B Ventilation System (Alternative 2)
- Demolition of abovegrade structures associated with the retired 291B Ventilation System (Alternative 2)
- *Demo Prep of the 221B Canyon Building above deck level areas*

Demo prep would occur in all 221B above deck level areas. These areas include the Operating Gallery, Crane Cab Gallery and crane area, and Canyon Deck. Each area would be emptied of waste, equipment, furniture, and nonstructural utilities, as appropriate. Activities such as general housekeeping, fixing/stabilizing of contamination, decontaminating, draining fluid from piping and equipment, and removing equipment and waste may be performed in each area.

The Pipe and Electrical Galleries were not included for demo prep because a close-in-place cleanup approach likely will be selected as final disposition of 221B based on the U Canyon remedial decision. The close-in-place cleanup approach will include grouting these galleries. Hazard abatement, as necessary in these galleries, will address and/or prevent future hazards prior to final disposition.

Removal activities for Alternative 3 are summarized in Figure 2.

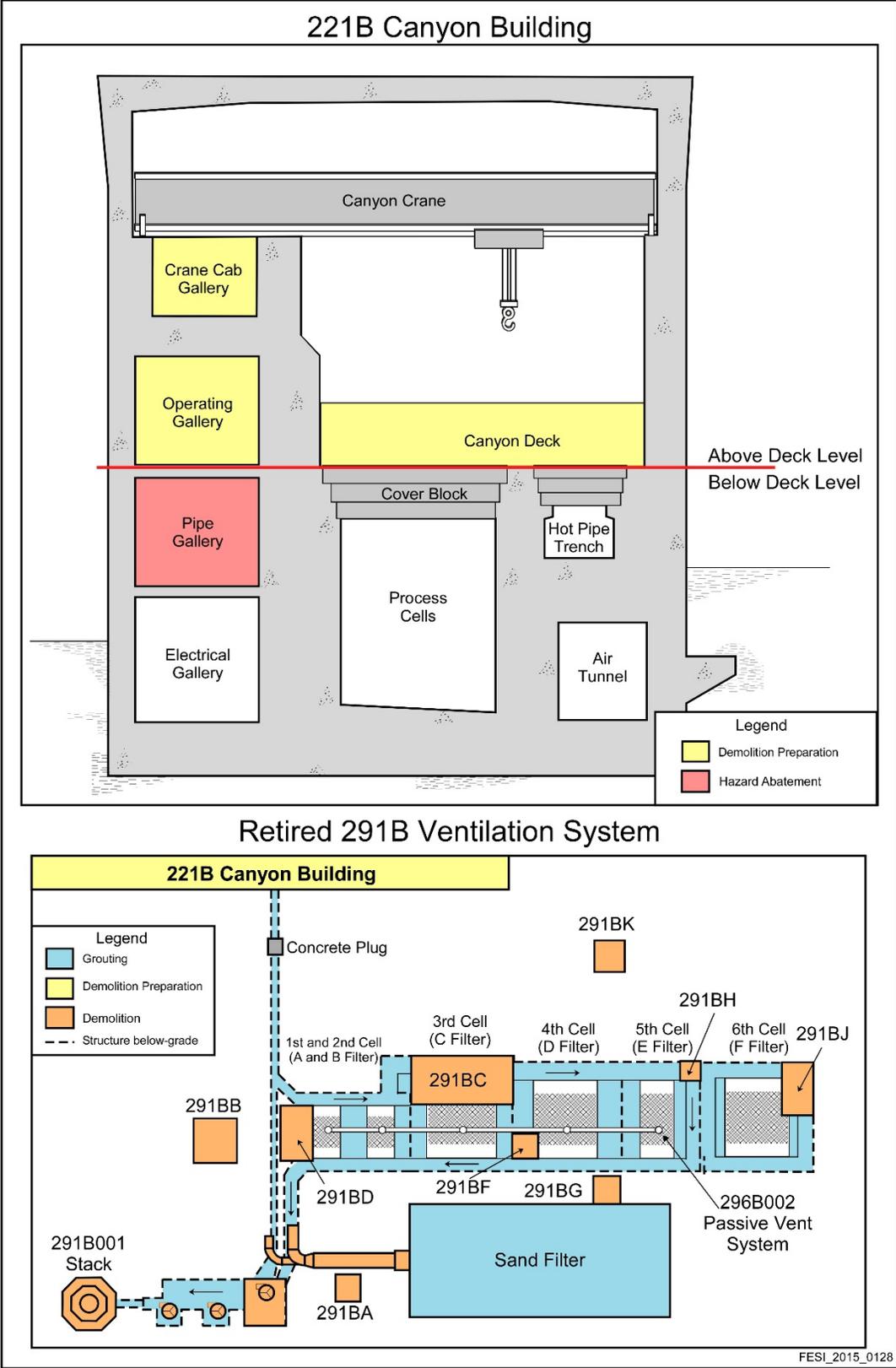


Figure 2. Alternative 3 Proposed Actions

5 Major Assumptions

The assumptions used in the estimate include general and specific cost assumptions.

5.1 General Assumptions and Inputs

The following general assumptions include direct cost factors, indirect cost factors, and other general pricing assumptions:

- The project will have a duration of 25 years.
- Markups are included for mobilization/demobilization/bonding/insurance (MDBI), overhead and profit (OH&P), taxes, contingency, and general and administrative (G&A) (see Chapter 7).
- Costs for project management, removal action design, and construction management are discussed in Chapter 9.

5.2 Specific Assumptions

Specific assumptions are broken out by the following categories: site preparation, labor, waste disposal, waste treatment, waste transportation, sampling and analysis, grouting, operations and maintenance (O&M) costs, and other.

5.2.1 Site Preparation

Site preparation for the B Plant Complex will be conducted prior to removal action activities. Site preparation includes the following assumptions:

- Site prep allowance for securing the site, power connections, set up of work zones and equipment and waste areas, and set up of temporary facilities and utilities (includes 3 months of planning for initial activities)
- Ventilation modifications to do work inside of the 221B galleries
- Fire hazards analysis and documented safety analysis upgrades for work within the 221B Canyon Building
- Structural/safety analysis prior to the commencement of work at the B Plant Complex

5.2.2 Labor

Labor costs and duration include the following assumptions:

- Mockups are necessary before performing hazardous activities. A mockup is a simulation exercise for workers to practice a hazardous activity in a controlled environment prior to attempting the actual activity. Mockup costs include labor, equipment, and materials. Table A-9 (Appendix A) provides the duration of each labor activity for all alternatives, which includes time for mockups.
- An interior specialized crew is based on an actual crew from the Plutonium Finishing Plant (PFP). This crew is assumed to do all hazard abatement and demo prep activities. This crew includes 20 full-time equivalents, materials, taxes and licenses, and G&A. Table A-10 provides a breakdown of worker types and hours.

- A decontamination and decommissioning (D&D) crew is made up of 70 percent labor and 30 percent equipment. This crew is assumed to do all demolition and grouting activities. Table A-11 (Appendix A) provides a breakdown on worker types and hours.
- Labor activities are to be conducted sequentially, with only one crew working at any given time. Crews will be focused on a single cleanup activity until work is complete or a change in conditions warrants redeployment.
- Radiological control practices are not assumed to change.
- An average of 19 work days per month is assumed.

5.2.3 Waste Disposal

Calculations for equipment volumes and weights for disposal are discussed in ECF-200E-15-0130. Waste disposal includes the following assumptions:

- Hazard abatement will remove 25 percent of equipment from designated areas.
- Demo prep will remove equipment from the following locations:
 - The Canyon Deck is assumed to have 1.5 percent of removable equipment.
 - The Operating Gallery is assumed to have 10 percent of removable equipment.
 - No equipment will be removed from the Crane Cab Gallery.
- All contaminated wastes will be disposed of at the Environmental Restoration Disposal Facility (ERDF) as low-level waste or mixed low-level waste.
- The canyon crane will not be operated, so some equipment will remain on the Canyon Deck.
- Sorting of waste prior to disposal will not be necessary.
- Waste will either be left in place or removed from the 221B Canyon Building. Waste will not be consolidated below the Canyon Deck level.

5.2.4 Waste Treatment

The waste treatment cost breakdown, described in Table A-12 (Appendix A), contains the following assumptions:

- 10 percent of waste will need treatment prior to ERDF disposal.
- Treatment takes 4 hours per ERDF container.
- ERDF containers hold 13 tons of debris.

5.2.5 Waste Transportation

Transportation of waste contains the following assumptions:

- Total drive time from B Plant to ERDF is 0.3 hours ($6 \text{ mi} \div 20 \text{ mi/hr} = 0.3 \text{ hr}$).
 - Distance to ERDF ($\times 2$ for return trip) is 6 mi.
 - Average speed is 20 mi/hr
- Two teamsters are required for transportation of waste to ERDF.

- Average wait time is 0.5 hours.

5.2.6 Sampling and Analysis

Sampling and analysis include the following assumptions:

- An initial characterization campaign will occur prior to major work within the 221B Canyon Building:
 - The initial characterization effort will take 3 months.
 - A total of 65 initial characterization samples will be taken: 3 galleries (10 samples each), 3 small rooms (5 samples each), Canyon Deck (20 samples).
- Confirmatory sampling following completion of removal action activities will not be taken until the final remedial action.
- An allowance for sampling waste prior to transport to ERDF is included for all actions that remove waste.

5.2.7 Grouting

Grouting includes the following assumptions:

- The following equipment is required for grouting: grout pump, air compressor, water recycle tank and pump, slick line and appurtenances, displacement air carbon filters, foam generator, data logger, and trash pump.
- An engineering preparation allowance was included for grouting of the 291B Ventilation System. This allowance includes engineering design, technology development, and initial prep work to allow for grout placement.

5.2.8 O&M Costs

O&M includes the following cost assumptions:

- S&M cost is assumed to be the same as the fiscal year (FY) 2013 cost and will be extended for a 25-year period at the same rate without projected increase or decrease.
- A hazard abatement allowance is assumed to be necessary every 5 years. This allowance is in addition to removal and disposal of waste from hazard abatement in the Pipe and Operating Galleries.
- The following personnel support facilities will be necessary for the entire duration of the project (25 years):
 - Two single-wide trailers
 - Two double-wide trailers
 - One restroom trailer

5.2.9 Other Specific Assumptions

Other specific assumptions are included:

- Air monitoring will be performed continuously for the entire duration of the removal action.

- Percentage of void space in each area is estimated based on the total area of each room and the amount of equipment present. A discussion of void space estimating is provided in ECF-200E-15-0130.
- Revegetation activities will not occur until after the remedial action.
- A location-specific on-scene coordinator report has been allocated for the completion of each removal action activity.
- A final on-scene coordinator report has been allocated for at the completion of all proposed removal action activities.

6 Exclusions

This chapter identifies scope items and costs that have not been included in the estimates for any of the alternatives. The following items have been excluded from the estimate:

- Separate escalation (costs are all based on FY 2015 costs).
- Costs for CERCLA programmatic institutional controls.
- Significant amounts of contaminants/contaminated materials not previously identified.
- Waste material size reduction beyond the minimum needed to handle and transport to ERDF.
- All post-closure costs.
- Costs associated with final remedial decision (NOTE: All removal action activities were designed to prepare the B Plant Complex for final disposition and, as of March 2016, a final remedial decision has yet to be made for the B Plant Canyon Building. Current duration estimates for removal action activities do not span the entire 25-year project duration. Following completion of removal action activities, activities associated with final remedial activities may occur but are not included in this cost estimate).
- Facilities located within the B Plant Canyon Complex that have been evaluated under a separate EE/CA.

7 Markups

The following markups were utilized in the cost estimates for each alternative and applied in the following order (see Appendix A cost tables for delineation of subtotals and summation of markups):

- MDBI – 10 percent markup is applied to capital cost subtotals to cover contractor MDBI.
- OH&P – 15 percent markup is applied to the Capital Cost subtotal, with taxes for contractor overhead, and 10 percent markup is applied to the Capital Cost subtotal with contractor overhead for contractor profit.
- Taxes – 8.6 percent Washington State sales tax is applied to travel expenses, equipment, materials, other direct costs, and subcontractors (with the exception of laboratory services and quoted costs from subcontractors). Costs based on previous systems and components used in this estimate are assumed to include sales tax.

- Contingency – 45 percent overall capital cost contingency (25 percent scope plus 20 percent bid) and an overall 50 percent O&M contingency (30 percent scope plus 20 percent bid) are applied.
- CHPRC G&A Fee – 20 percent G&A markup is applied to the subtotal capital costs including contingencies.

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 contingencies 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. In addition to scope and bid contingencies, there is also an O&M contingency, which is discussed in Section 8.3.

Figure 3 shows how the bid and scope contingencies typically change as a project progresses through typical stages of design and implementation. Figure 3 shows the relationship between scope, bid, and total contingencies.

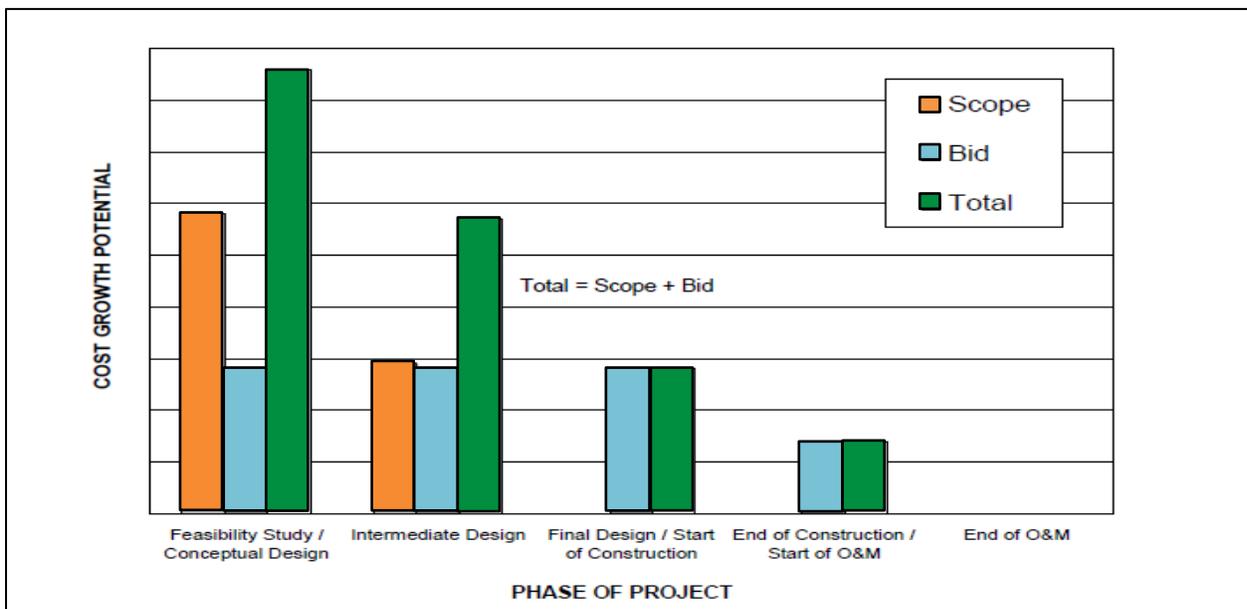


Figure 3. Relationship of Scope, Bid, and Total Contingency

8.1 Scope Contingency

Scope contingency represents project risks associated with an incomplete design. This type of contingency represents costs, unforeseeable at the time of estimate preparation, that are likely to become known as the remedial design proceeds (EPA 540-R-00-002). For this reason, scope contingency is sometimes referred to as design contingency, which is the term commonly used by the U.S. Army Corps of Engineers (USACE). In general, scope contingency should decrease as design progresses and should be 0 percent at the 100 percent design stage.

At the early stages of remedial design (e.g., feasibility study, which represents 0 to 10 percent design completion), concepts are not typically developed enough to identify all project components or quantities. Contributing factors include limited experience with certain technologies, potential requirements due to regulatory or policy changes, and inaccuracies in defining quantities or characteristics. Scope contingency would be expected to be higher for newer or emerging remedial technologies than for more accurately documented systems. For these reasons, scope contingency may vary between alternatives. A low percentage for scope contingency indicates an opinion that the project scope will undergo minimal change during design. A high percentage indicates an opinion that the project scope may change considerably between the feasibility study and final design.

The capital cost scope contingency has been set at 25 percent for all of the alternatives.

8.2 Bid Contingency

Bid contingency represents costs, unforeseeable at the time of estimate preparation, that are likely to become known as the remedial action construction or O&M proceeds. For this reason, bid contingency is sometimes referred to as construction contingency, which is the term commonly used by the USACE.

Bid contingency accounts for changes that occur after the construction contract is awarded. This contingency represents a reserve for quantity overruns, modifications, change orders, and/or claims during construction. Considerations include the technological, geotechnical, and other unknowns applicable to the construction phase. Examples include changes due to adverse weather, material or supply shortages, or new regulations.

The range for bid contingency is typically from 10 to 20 percent. The bid contingency for this estimate has been set at 20 percent for capital costs of all alternatives.

8.3 O&M Contingency

O&M contingencies are applied to individual annual and periodic O&M cost line items. O&M scope is generally less defined than capital scope associated with a specific alternative design, and O&M has variability in frequency, duration, activity level, and response to changes as O&M progresses; therefore, O&M cost contingencies are typically at least as high as, and often greater than, capital cost contingencies. A total O&M contingency of 50 percent was used for each annual and periodic O&M cost line items for Alternatives 2 and 3.

9 Project Management, Removal Design, Construction Management, and Technical Support Services

Project management, remedial design, and construction management capital costs are estimated using factors based on EPA 540-R-00-002 (Table 1).

All of the alternatives have estimated construction costs greater than \$10 million, so the following percentages were used in these estimates:

- Project management: 5 percent
- Remedial design: 6 percent
- Construction management: 6 percent

Table 1. Percentages for Professional/Technical Services Capital Costs

Capital Cost Element	<\$100K (%)	\$100K-\$500K (%)	\$500K-\$2M (%)	\$2M-\$10M (%)	>\$10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

Reference: EPA540-R-00-002, Exhibit 5.8

Technical support services (TSS) include project management, technical coordination, and onsite logistics and support to implement O&M activities. TSS markup is applied to individual annual and periodic O&M cost line items, with the TSS percentage varying based on the line item subtotal cost, as shown in Table 2. The line item subtotal costs corresponding to the Table 2 cost ranges include MDBI, OH&P, Washington State sales tax, and O&M contingency.

Table 2. Percentages for Technical Support Services for O&M Costs

O&M Cost Element	<\$100K (%)	\$100K-\$500K (%)	\$500K-\$2M (%)	\$2M-\$10M (%)	>\$10M (%)
Technical Support Services	45	33	26	19	17

Since the individual annual and periodic O&M line item subtotals in the alternatives range from <\$100,000 to \$2M to \$10M, the TSS markup percentages for the line items in the alternatives range from 45 to 19 percent. Appendix A tables for annual O&M markups and periodic O&M markups for each alternative list composite average TSS markup percentages.

10 Present Worth

Estimated present worth calculations for work performed in outyears are based on EPA 540-R-00-002.

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 OMB Circular No. A-94, 2015, “Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.” Based on this guidance and durations of 25 years for all alternatives, a real discount rate of 1.38 percent was used in the cost estimate present value calculations for these alternatives.

11 Estimate Classification

The expected accuracy range of the cost estimate at this stage is approximately plus 50 percent, minus 30 percent. This accuracy range is consistent with EPA 540-R-00-002 for the level of project definition available at this time.

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 percent 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 maturity of the input information, as measured by percentage completion (and related to level of project definition), are important for determining accuracy. However, factors besides the available input information also greatly affect estimate accuracy measures. Primary among these factors 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 maturity of technology selected, 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 estimating 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. Figure 4 shows an example of the expected level of accuracy for a remedial action based on project definition. This estimate, while not a remedial action, is in the -30 percent/+50 percent range due to the broad project definition. As the project continues, the level of estimate accuracy will increase.

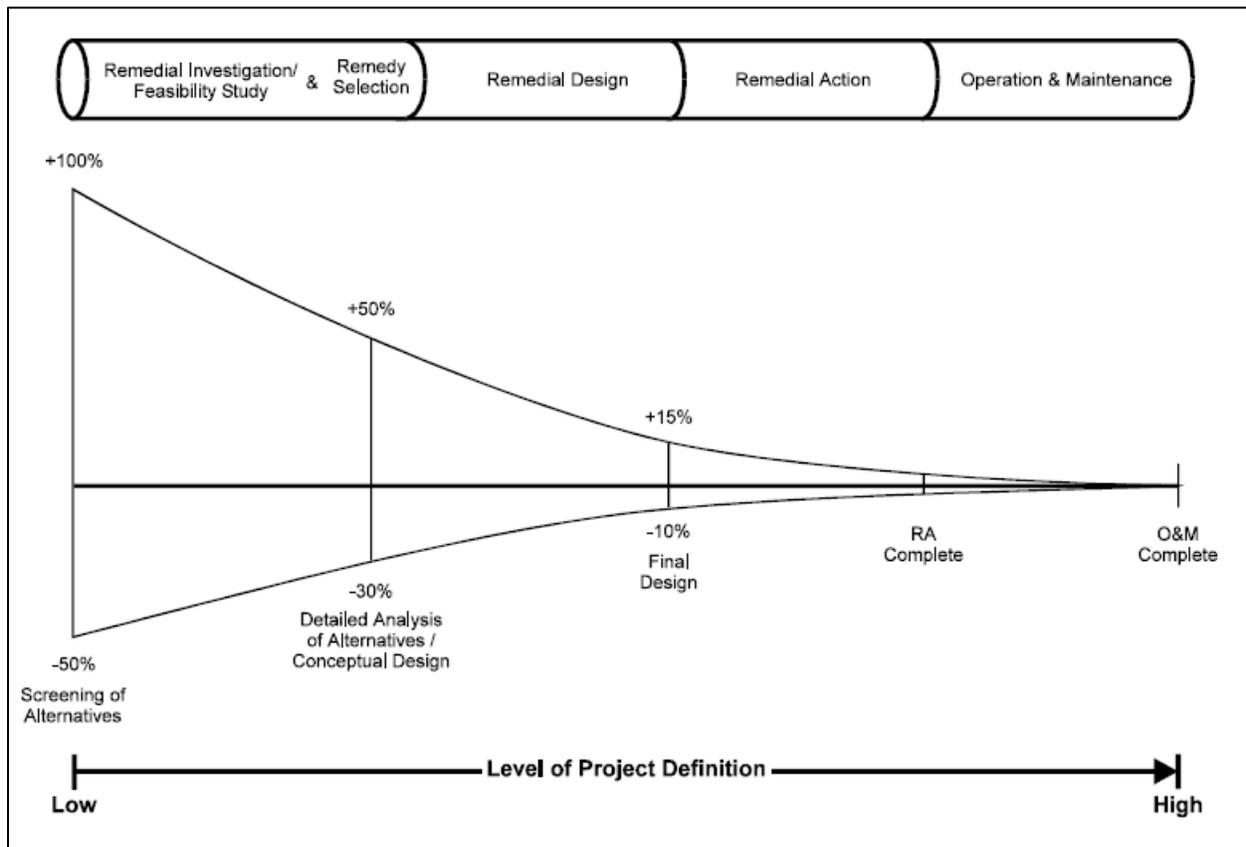


Figure 4. Expected Cost Estimate Accuracy

12 Cost Resources

The following is a list of the various resources used in the development of the cost estimate. See Tables A-7 and A-8 (Appendix A) for unit costs and associated sources for items included in the cost estimate. Sources listed in these tables include historical and other.

Historical costs include actual costs or estimated costs from past Hanford Site projects. Other costs are sourced from CHPRC project management, rate information gathered from subject matter experts, and estimator buildup utilizing information gathered from historic or other sources.

Labor unit prices reflect a burden rate, including workers compensation, unemployment taxes, fringe benefits, and medical insurance (2015 rates).

The cost estimate was generated using the most recent version of the Tool for Response Action Cost Estimating (TRACE) workbook (Version 4, Rev. 4) in Microsoft Excel[®]. Additional information on this workbook may be found in the following documents:

- ECF-HANFORD-16-0004, *Tools for Response Action Cost Estimating (TRACE) V4 – Site Summary*
- ECF-HANFORD-16-0005, *Tools for Response Action Cost Estimating (TRACE) V4 – Site and WBS Setup*
- ECF-HANFORD-16-0006, *Tools for Response Action Cost Estimating (TRACE) V4 – Project Setup*
- ECF-HANFORD-16-0007, *Tools for Response Action Cost Estimating (TRACE) V4 – Overview*
- ECF-HANFORD-16-0008, *Tools for Response Action Cost Estimating (TRACE) V4 – Operations and Maintenance Unit Cost*
- ECF-HANFORD-16-0009, *Tools for Response Action Cost Estimating (TRACE) V4 – Capital Unit Cost*
- ECF-HANFORD-16-0010, *Tools for Response Action Cost Estimating (TRACE) V4 – Alternatives Cost Comparison*
- ECF-HANFORD-16-0011, *Tools for Response Action Cost Estimating (TRACE) V4 – Alternatives 01 through 06-Site-WBS*
- ECF-HANFORD-16-0012, *Tools for Response Action Cost Estimating (TRACE) V4 – Alternatives 01 through 06*

13 Estimate Methodology

The cost estimate for the B Plant EE/CA (DOE/RL-2016-14) was developed in accordance with EPA 540-R-00-002 and contractor cost estimating procedures. The TRACE V4 cost estimating workbook in conjunction with historical cost data and estimated allowances were used to develop the cost estimate for each of the removal action alternatives. Assumed project scope items were itemized, and unit costs were applied as shown in Appendix A. Where available, costs for major systems were based on existing

[®] Excel is a registered trademark of Microsoft Corporation, Redmond, Washington.

Hanford system costs. Percentage allowances and lump sums were applied for some of the cost items, based on Hanford Site and environmental project experience.

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 in this document. 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 change significantly:

- Levels of contamination
- Newly discovered hazardous conditions
- Availability of workers
- Change in worker safety protection due to field conditions or new monitoring requirements

Because of these factors, the remedy selection process must consider differences in response action cost uncertainties/cost risks in addition to response action-specific cost estimates and ranges, and funding needs must be carefully reviewed before making specific financial decisions or establishing final budgets.

15 Labor Costs

Construction craft fixed price labor rates are those listed in Appendix A of the Hanford Site Stabilization Agreement (HSSA, 1984, *Site Stabilization Agreement for all Construction Work for the U.S. Department of Energy at the Hanford Site*). The HSSA rates include base wage, fringe benefits, and other compensation as negotiated between CHPRC and the National Building and Construction Trades Department American Federation of Labor-Congress of Industrial Organizations. Other factors that account for additional costs (Workman's Compensation, *Federal Insurance Contributions Act of 1935*, and state and federal unemployment insurance), to develop a fully burdened rate by craft, have been incorporated. The labor rates used are for 2015.

CHPRC labor rates for management, engineering, safety oversight, and technical support are based on the CHPRC approved planning rates for FY 2015.

For this estimate, labor needs were developed through discussions with CHPRC project management. As a high-level estimate, in-depth work planning and crew development was not conducted. Labor needs were grouped into two work crew categories: interior specialized and general D&D.

Following the development of these two work crew categories, past estimates and actual costs from Hanford Site projects were studied.

The interior specialized work crew was identified for all interior cleanout work of contaminated structures. For this estimate, actual crew data from recent work conducted within PFP was evaluated. The average monthly cost and labor breakdown for a single full-time crew was calculated and can be found in Table A-10 (Appendix A).

The general D&D labor category was selected for all facility demolition and grouting activities. The labor breakdown and monthly cost for this crew type were extracted from past cost estimates and can be found in Table A-11 (Appendix A).

16 Sales Tax

Washington State sales tax has been applied to all materials and equipment purchases at 8.6 percent and is included in the markups discussed in Chapter 7.

Future cost escalation is not calculated in this estimate. All costs are presented in 2016 dollars.

17 Cost Summary

Table 3 presents overall capital, annual, periodic, total nondiscounted, and total discounted (present value) costs for the B Plant Complex alternatives.

Table 3. Summary of Costs

		Alternative 1	Alternative 2	Alternative 3
Total Nondiscounted Cost		\$0	\$130.3 M	\$135.2 M
Total Capital		\$0	\$72.3 M	\$77.3 M
Total Annual		\$0	\$48.3 M	\$48.3 M
Total Periodic		\$0	\$9.6 M	\$9.6 M
Total Present Value Cost (Discounted)		\$0	\$118.4 M	\$123.1M
Total Present Value Cost Range	-30%	\$0	\$82.9 M	\$86.1 M
	+50%	\$0	\$177.6 M	\$184.6 M

Notes: Cost totals may differ slightly from the displayed values due to rounding
 Cost Estimates are order-of-magnitude with an expected accuracy range of +50%/-30%

Cost estimate summary tables and associated quantity tables are presented in Appendix A.

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- ECF-HANFORD-16-0009, 2016, *Tools for Response Action Cost Estimating (TRACE) V4 – Capital Unit Cost*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.
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Appendix A

Capital and O&M Cost Estimate

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Terms

CHPRC	CH2M HILL Plateau Remediation Company
CY	calendar year
D&D	decontamination and decommissioning
DSA	documented safety analysis
EA	each
EE/CA	engineering evaluation/cost analysis
ERDF	Environmental Restoration Disposal Facility
FHA	fire hazards analysis
FTE	full-time equivalent
FY	fiscal year
G&A	general and administrative
LLW	low-level waste
LS	lump sum
MDBI	mobilization/demobilization/bonding/insurance
MLLW	mixed low-level waste
MO	month
O&M	operations and maintenance
PUREX	Plutonium/Uranium Extraction (Plant)
TRACE	Tool for Response Action Cost Estimating
TSS	Technical Support Services
YR	year
WBS	work breakdown structure
WG	ERDF Waste Classification WG

A1 Introduction

Tables A-1 through A-8¹ are from the Tool for Response Action Cost Estimating (TRACE) Version 4 cost estimate workbook for the B Plant Complex, with formatting modifications and the addition of overall alternative-specific composite average Technical Support Services (TSS) allowances for annual and periodic operations and maintenance (O&M) costs (TRACE V4 varies this allowance by line item). The TRACE V4 Capital Cost Estimate and O&M Cost Estimate tables include the following information:

1. Site: A site integer is assigned by user and corresponds to each site name, allowing TRACE V4 to subtotal costs for sites within each alternative.
2. Site Name: Assigned by user site name within each alternative.
3. WBS Top Tier: Highest level work breakdown structure (WBS) groupings that TRACE V4 can use to create WBS specific cost subtotals. WBS groupings are assigned by user and associated with each capital and O&M cost line item.
4. Description: User enters cost descriptions in TRACE V4 Capital Unit Cost and O&M Unit Cost worksheets. The unit costs are linked with specific unit cost line item numbers already present in the TRACE V4 workbook in the worksheet rows where the unit cost descriptions and other information are entered. User then selects unit costs on the alternative specific Capital Cost Estimate and O&M Cost Estimate worksheets from pull-down lists, and the unit cost number and description are automatically displayed in the Capital and O&M Cost Estimate Description columns.
5. Quantity: User-entered or linked quantity for the line item activity.
6. Unit: Unit associated with the cost line item quantity and unit cost.
7. Unit Cost: TRACE V4 automatically populates the unit cost column on the Capital and O&M cost estimate worksheets based on the cost item selected by the user in the Description column.
8. Subtotal: TRACE V4 automatically calculates line item cost subtotals as the product of the specific line item quantity and unit cost.
9. Source: TRACE V4 displays source groupings as RACER, HISTORICAL, or OTHER on the Capital and O&M Cost Estimate worksheets. Additional unit cost source information is noted in the TRACE V4 Capital Unit Cost and O&M Unit Cost worksheets.
10. Start Year: User-entered year relative to the alternative base year (e.g., 0 = base year, 1 = 1 year after base year, and so on) when the line item activity starts. TRACE V4 uses the Start Year, End Year, and Interval to associate each capital and O&M cost line item with a specific year or years when the activity occurs. TRACE V4 then uses year-specific discount factors to multiply by each cost in each specific year of occurrence to sum and calculate present value costs.
11. End Year: User-entered year relative to the base year when the line item activity ends.
12. Interval: User-entered interval in years between occurrences of the line item activity.
13. Notes: User-supplied notes.

¹ Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A10), respectively.

Tables A-1 through A-6 also show line item specific markups for capital and O&M costs and successive cost subtotals as the markups are applied in TRACE V4.

Tables A-7 and A-8 are the TRACE V4 Capital Unit Cost Summary and O&M Unit Cost Summary worksheets showing the cost line item numbers, descriptions, unit costs, and unit cost source information and notes. All B Plant Complex capital cost and O&M cost worksheets pull unit cost information from these sheets based on drop-down lists specific the capital and O&M unit costs from the Capital and O&M Unit Cost Summary worksheets.

A2 Alternative 2

The Alternative 2 costs are divided into capital cost line items, presented in Table A-1, and O&M cost items, presented in Table A-2. A summary of the total present value for Alternative 2 is provided in Table A-3.

2.1 Capital Cost Estimate for Alternative 2

The capital cost line items for Alternative 2 are found in Table A-1. These line items include all activities to occur under the Alternative 2 removal action as described in DOE/RL-2016-14, *Engineering Evaluation/Cost Analysis for the B Plant Complex*, hereafter called the B Plant engineering evaluation/cost analysis (EE/CA). Table A-1 also includes a summary of all markups, taxes, and contingencies applied to Alternative 2 capital costs.

2.2 Operations and Maintenance Cost Estimate for Alternative 2

All O&M items for Alternative 2 are found in Table A-2. These items include all annual and periodic costs under the Alternative 2 removal action as described in the B Plant EE/CA (DOE/RL-2016-14). Table A-2 also includes a summary of all markups, taxes, and contingencies applied to Alternative 2 annual and periodic costs.

2.3 Total Present Value Estimate for Alternative 2

Total present value for all capital costs and annual and periodic O&M costs for Alternative 2 are found in Table A-3. This summary table provides the total present value for all costs associated with Alternative 2 as well as the -30/+50% expected accuracy range for this alternative.

A3 Alternative 3

The Alternative 3 costs are divided into capital cost line items, presented in Table A-4, and O&M cost items, presented in Table A-5. A summary of the total present value for Alternative 2 is provided in Table A-6.

3.1 Capital Cost Estimate for Alternative 3

The capital cost line items for Alternative 3 are found in Table A-4. These line items include all activities under the Alternative 3 removal action as described in the B Plant EE/CA (DOE/RL-2016-14). Table A-4 also includes a summary of all markups, taxes, and contingencies applied to Alternative 3 capital costs.

3.2 Operations and Maintenance Cost Estimate for Alternative 3

All O&M items for Alternative 3 are found in Table A-5. These items include all annual and periodic costs under the Alternative 3 removal action as described in the B Plant EE/CA (DOE/RL-2016-14).

Table A-5 includes a summary of all markups, taxes, and contingencies applied to Alternative 3 annual and periodic costs.

3.3 Total Present Value Estimate for Alternative 3

Total present value for all capital costs and annual and periodic O&M costs for Alternative 3 are found in Table A-6. This summary table provides the total present value for all costs associated with Alternative 3 as well as the -30/+50 percent expected accuracy range for this alternative.

Alternative 2			
Location:	B Plant Complex	Base Year:	2017
Phase:	EE/CA	Date:	3/1/2016
Description:	Continued Surveillance and Maintenance with Hazard Abatement of 221B and Demolition/Grouting of 291B		

Table A-1. Alternative 2 Capital Costs and Markups

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
Capital Costs												
1	B Plant Complex	Mob/Demob; Temporary Utilities and Facilities	01 Site Preparation	1	LS	\$1,500,000	\$1,500,000	Other	0	0	1	Secure site; establish power connections; set up work zones and equipment and waste areas; set up temporary facilities and utilities. Includes 3 months of planning.
1	B Plant Complex	Facility Modification or Upgrade	62 Life Safety Updates	1	LS	\$1,500,000	\$1,500,000	Other	0	0	1	Updates to facility to bring into compliance with life safety requirements of DSA and FHA documents.
1	B Plant Complex	Document Preparation	1051 DSA/FHA Review and Update	1	EA	\$100,000	\$100,000	Other	0	0	1	Updates to life safety documentation in response to facility modifications.
1	B Plant Complex	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	Other	0	0	1	Site air monitoring.
1	B Plant Complex	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	3	MO	\$20,000	\$60,000	Other	1	1	1	Site air monitoring (in the subsequent year).
2	221-B	Monitoring, Testing, Sampling and Analysis	650 Characterization Sampling	65	EA	\$5,000	\$325,000	Other	1	1	1	Characterization sampling campaign throughout B Plant Complex to identify contaminants of concern and associated concentrations prior to hazard abatement, demolition, and grouting activities.
2	221-B	Monitoring, Testing, Sampling and Analysis	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	1	1	1	Characterization sampling campaign labor.
2	221-B	Facility Modification or Upgrade	60 Ventilation System Modification	1	LS	\$5,000,000	\$5,000,000	Other	1	1	1	Budget allowance for bringing ventilation system into compliance for proposed work activities.
2	221-B	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (nonsoil)	1	LS	\$20,000	\$20,000	Other	1	1	1	Allowance for sampling of Pipe Gallery hazard abatement debris prior to disposal at ERDF.
2	221-B	Demolition and Removal	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	1	1	1	Hazard abatement labor, Pipe Gallery (includes 20 FTE, materials, taxes and licenses, and G&A).
2	221-B	Treatment and Disposal	811 ERDF WG	32	Ton	\$69.70	\$2,230	Other	1	1	1	Pipe Gallery hazard abatement waste disposal assumed LLW/MLLW.
2	221-B	Demolition and Removal	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	1	1	1	Hazard abatement labor, Operating Gallery (includes 20 FTE, materials, taxes and licenses, and G&A).
2	221-B	Treatment and Disposal	811 ERDF WG	63	Ton	\$69.70	\$4,391	Other	1	1	1	Operating Gallery Hazard abatement waste disposal. Assumed LLW/MLLW.
2	221-B	Treatment and Disposal	817 ERDF Waste Treatment	4.8	Ton	\$11.28	\$54	Other	1	1	1	ERDF cost for treatment/stabilization of waste.

Table A-1. Alternative 2 Capital Costs and Markups

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
Capital Costs												
2	221-B	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (nonsoil)	1	LS	\$20,000	\$20,000	Other	1	1	1	Allowance for sampling of Operating Gallery hazard abatement debris prior to disposal at ERDF.
2	221-B	Treatment and Disposal	819 ERDF Waste Transportation	8	Load	\$80.00	\$640	Other	1	1	1	Transportation cost for all LLW/MLLW generated during hazard abatement of 221-B.
3	291-B	Demolition and Removal	1069 291-B Demolition	1	LS	\$1,732,000	\$1,732,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1070 291-BA Demolition	1	LS	\$22,000	\$22,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1071 291-BB Demolition	1	LS	\$47,000	\$47,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1072 291-BC Demolition	1	LS	\$1,511,000	\$1,511,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1073 291-BD Demolition	1	LS	\$602,000	\$602,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1074 291-BF Demolition	1	LS	\$523,000	\$523,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1075 291-BG Demolition	1	LS	\$511,000	\$511,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1076 291-BH Demolition	1	LS	\$16,000	\$16,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1077 291-BJ Demolition	1	LS	\$978,000	\$978,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Demolition and Removal	1078 291-BK Demolition	1	LS	\$35,000	\$35,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54)
3	291-B	Document Preparation	1053 Demolition Analysis	1	EA	\$100,000	\$100,000	Other	2	2	1	Allowance for design and planning of abovegrade ventilation demolition.
3	291-B	Treatment and Disposal	811 ERDF WG	328	Ton	\$69.70	\$22,861	Other	2	2	1	Disposal of abovegrade ventilation not included in Tier 2.
3	291-B	Mob/Demob; Temporary Utilities and Facilities	817 ERDF Waste Treatment	32.8	Ton	\$11.28	\$370	Other	2	2	1	ERDF cost for treatment/stabilization of waste. Assumed 10% of total waste requires treatment.

Table A-1. Alternative 2 Capital Costs and Markups

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
Capital Costs												
3	291-B	Demolition and Removal	803 D&D Crew	3	MO	\$190,000	\$570,000	Other	2	2	1	Abovegrade labor for ventilation system structures not included in Tier 2.
3	291-B	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (nonsoil)	1	LS	\$20,000	\$20,000	Other	2	2	1	Allowance for sampling of debris prior to disposal at ERDF.
3	291-B	Treatment and Disposal	819 ERDF Waste Transportation	26	Load	\$80.00	\$2,080	Other	2	2	1	Transportation cost for all LLW/MLLW generated during demolition of 291-B.
3	291-B	Grout Activities	1064 Grouting Equipment	1	LS	\$500,000	\$500,000	Historical	2	2	1	Grouting equipment for 291-B. Includes grout pump, air compressor, water recycle tank and pump, slick line and appurtenances, displacement air carbon filters, foam generator, data logger, and trash pump.
3	291-B	Grout Activities	1067 Grout Preparation – 291-B Filter Cells	1	LS	\$5,000,000	\$5,000,000	Other	2	2	1	Preparation cost for grouting 291-B. Activities include engineering analysis and technology development.
3	291-B	Grout Activities	1063 Grout Material	7966	CY	\$120	\$955,920	Historical	2	2	1	Grouting material cost for 291-B.
3	291-B	Grout Activities	803 D&D Crew	6	MO	\$190,000	\$1,140,000	Other	2	2	1	Grout labor for 291-B.
3	291-B	Document Preparation	1055 On-Scene Coordinator Report - High	1	EA	\$100,000	\$100,000	Historical	2	2	1	Closeout report for 291-B.
Alternative 2 Capital Cost Markups												
Subtotal w/ MDBI						\$28,446,601						
Contractors Overhead			15%			\$3,821,490						Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included
Contractors Profit			10%			\$2,547,660						Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included
Subtotal w/ OH&P						\$34,815,751						
WA State Sales Tax			8.60%			\$717,413						Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor
Subtotal w/ Sales Tax						\$35,533,164						
Scope Contingency			25%			\$8,883,291						As per EPA 540-R-00-002, Exhibit 5-7
Bid Contingency			20%			\$7,106,633						
Subtotal With Contingency						\$51,523,088						
Project Management			5%			\$2,576,154						As per EPA 540-R-00-002, Exhibit 5-8
Remedial Design			6%			\$3,091,385						As per EPA 540-R-00-002, Exhibit 5-8
Construction Management			6%			\$3,091,385						As per EPA 540-R-00-002, Exhibit 5-8
Subtotal						\$60,282,013						
CHPRC G&A			20%			\$12,056,403						CHPRC FY 2016 Rates-Multipliers
Cost Per Year						\$72,338,416						Total Annual Capital Costs
Total Nondiscounted						\$72,338,416						Total Nondiscounted Value of Capital Cost
Total Present Value						\$69,966,540						Total Present Value of Capital Costs

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A10), respectively.

Cost totals may differ slightly from the displayed values due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

Table A-2. Alternative 2 Operations and Maintenance Costs

Annual O&M Cost												
Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
1	B Plant Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1102 Bathroom Trailer	1	YR	\$30,000	\$30,000	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Annual Surveillance	800 Surveillance and Maintenance Program	1	YR	\$533,000	\$533,000	Historical	0	25	1	Annual facility surveillance activities
Periodic O&M Cost												
1	B Plant Complex	Hazard Abatement	1104 Hazard Abatement Allowance	1	Ea	\$500,000	\$500,000	Other	0	25	5	Periodic hazard abatement allowance to mitigate hazards discovered during work activities
Alternative 2 Annual O&M Markups												
Subtotal w/ MDBI						\$627,800						
Contractors Overhead				15%	\$94,170		Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included					
Contractors Profit				10%	\$62,780		Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included					
Subtotal w/ OH&P						\$784,750						
WA State Sales Tax				8.60%	\$17,189		Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor					
Subtotal w/ Sales Tax						\$801,939						
O&M Contingency				50%	\$400,970							
Subtotal W/ Contingency						\$1,202,909						
Technical Support Services				28.81%	\$346,529		Percentage for TSS varies for each line item and ranges from 26% to 45%; percentage presented is weighted average for all Annual O&M items					
Subtotal						\$1,549,438						
CHPRC G&A				20%	\$309,888		CHPRC FY 2016 Rates-Multipliers					
Cost Per Year						\$1,859,325	Total Annual Capital Costs					
Total Nondiscounted						\$48,342,456	Total Non-Discounted Value of Annual O&M Cost					
Total Present Value						\$40,389,162	Total Present Value of Annual O&M Costs					
Alternative 2 Periodic Markups												
Subtotal with MDBI						3,299,999						
Contractors Overhead				15%	495,000		Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included					
Contractors Profit				10%	330,000		Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included					
Subtotal with OH&P						4,124,999						
WA State Sales Tax				8.60%	106,428		Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor					
Subtotal with Sales Tax						4,231,427						

Table A-2. Alternative 2 Operations and Maintenance Costs

O&M Contingency	50%	2,115,714	As per EPA 540-R-00-002, Exhibit 5-7
Subtotal with Contingency		6,347,135	
Technical Support Services	26%	1,650,258	Percentage for TSS varies for each line item and ranges from 26% to 45%; percentage presented is weighted average for all Periodic O&M items
Subtotal with Technical Support Services		7,997,392	
CHPRC G&A	20%	1,599,480	CHPRC FY 2016 Rates-Multipliers
Total Nondiscounted		\$9,596,872	Total Non-Discounted Value of Annualized Periodic O&M Cost
Total Present Value		\$8,030,522	Total Present Value of Annualized Periodic O&M Costs

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A10), respectively.

Cost totals may differ slightly from the displayed values due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

Table A-3. Alternative 2 Total Present Value

Capital Costs	\$69,966,540	Total Present Value of Capital Costs
Annual O&M Costs	\$40,389,162	Total Present Value of Annual O&M Activities
Periodic O&M Costs	\$8,030,522	Total Present Value of Periodic O&M Activities
Alternative 2 Total Present Value	\$118,386,225	Total Present Value of Alternative 2
Expected Accuracy Range for Total Present Value is -30% to +50%		
-30%		\$82,870,357
+50%		\$177,579,337

Note: Cost totals may differ slightly from the displayed values due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

Alternative 3			
Location:	B Plant Complex	Base Year:	2017
Phase:	EE/CA	Date:	3/1/2016
Description:	Continued Surveillance and Maintenance with Hazard Abatement of 221B and Demolition/Grouting of 291B, and Demolition Preparation of 221B		

Table A-4. Alternative 3 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
1	B Plant Complex	Mob/Demob; Temporary Utilities and Facilities	01 Site Preparation	1	LS	\$1,500,000	\$1,500,000	Other	0	0	1	Secure site; establish power connections; set up work zones, equipment, and waste areas; set up temporary facilities and utilities. Includes 3 months of planning.
1	B Plant Complex	Facility Modification or Upgrade	62 Life Safety Updates	1	LS	\$1,500,000	\$1,500,000	Other	0	0	1	Updates to facility to bring into compliance with life safety requirements of DSA and FHA documents.
1	B Plant Complex	Document Preparation	1051 DSA / FHA Review and Update	1	EA	\$100,000	\$100,000	Other	0	0	1	Updates to life safety documentation in response to facility modifications.
1	B Plant Complex	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	Other	0	0	1	Site air monitoring.
1	B Plant Complex	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	3	MO	\$20,000	\$60,000	Other	1	1	1	Site air monitoring (in the subsequent year).
2	221-B	Monitoring, Testing, Sampling and Analysis	650 Characterization Sampling	65	EA	\$5,000	\$325,000	Other	1	1	1	Characterization sampling campaign throughout B Plant Complex to identify contaminants of concern and associated concentrations prior to hazard abatement, demolition, and grouting activities.
2	221-B	Monitoring, Testing, Sampling and Analysis	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	1	1	1	Characterization sampling campaign labor.
2	221-B	Facility Modification or Upgrade	60 Ventilation System Modification	1	LS	\$5,000,000	\$5,000,000	Other	1	1	1	Budget allowance for bringing ventilation system into compliance for proposed work activities.
2	221-B	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (nonsoil)	1	LS	\$20,000	\$20,000	Other	1	1	1	Allowance for sampling of Pipe Gallery hazard abatement debris prior to disposal at ERDF.
2	221-B	Demolition and Removal	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	1	1	1	Hazard abatement labor, Pipe Gallery (includes 20 FTE, materials, taxes and licenses, and G&A).
2	221-B	Treatment and Disposal	811 ERDF WG	32	Ton	\$69.70	\$2,230	Other	1	1	1	Pipe Gallery hazard abatement waste disposal assumed LLW/MLLW.
2	221-B	Demolition and Removal	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	1	1	1	Hazard abatement labor, Operating Gallery (includes 20 FTE, materials, taxes and licenses, and G&A).
2	221-B	Treatment and Disposal	811 ERDF WG	63	Ton	\$69.70	\$4,391	Other	1	1	1	Operating Gallery hazard abatement waste disposal. Assumed LLW/MLLW.
2	221-B	Treatment and Disposal	817 ERDF Waste Treatment	5	Ton	\$11.28	\$54	Other	1	1	1	ERDF cost for treatment/stabilization of waste.
2	221-B	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (nonsoil)	1	LS	\$20,000	\$20,000	Other	1	1	1	Allowance for sampling of Operating Gallery hazard abatement debris prior to disposal at ERDF.
2	221-B	Treatment and Disposal	819 ERDF Waste Transportation	8	Load	\$80	\$640	Other	1	1	1	Transportation cost for all LLW/MLLW generated during hazard abatement of 221-B.

Table A-4. Alternative 3 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
3	291-B	Demolition and Removal	1069 291-B Demolition	1	LS	\$1,732,000	\$1,732,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1070 291-BA Demolition	1	LS	\$22,000	\$22,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1071 291-BB Demolition	1	LS	\$47,000	\$47,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1072 291-BC Demolition	1	LS	\$1,511,000	\$1,511,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1073 291-BD Demolition	1	LS	\$602,000	\$602,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1074 291-BF Demolition	1	LS	\$523,000	\$523,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1075 291-BG Demolition	1	LS	\$511,000	\$511,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1076 291-BH Demolition	1	LS	\$16,000	\$16,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1077 291-BJ Demolition	1	LS	\$978,000	\$978,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Demolition and Removal	1078 291-BK Demolition	1	LS	\$35,000	\$35,000	Other	2	2	1	Cost estimate for demolition and associated waste disposal from EE/CA for 200 East Area Tier 2 Buildings/Structures (DOE/RL-2010-54).
3	291-B	Document Preparation	1053 Demolition Analysis	1	EA	\$100,000	\$100,000	Other	2	2	1	Allowance for design and planning of abovegrade ventilation demolition.
3	291-B	Treatment and Disposal	811 ERDF WG	328	Ton	\$69.70	\$22,861	Other	2	2	1	Disposal of abovegrade ventilation not included in Tier 2.
3	291-B	Mob/Demob; Temporary Utilities and Facilities	817 ERDF Waste Treatment	33	Ton	\$11.28	\$370	Other	2	2	1	ERDF cost for treatment/stabilization of waste. Assumed 10% of total waste requires treatment.
3	291-B	Demolition and Removal	803 D&D Crew	3	MO	\$190,000	\$570,000	Other	2	2	1	Abovegrade labor for ventilation system structures not included in Tier 2.
3	291-B	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (nonsoil)	1	LS	\$20,000	\$20,000	Other	2	2	1	Allowance for sampling of debris prior to disposal at ERDF.
3	291-B	Treatment and Disposal	819 ERDF Waste Transportation	26	Load	\$80	\$2,080	Other	2	2	1	Transportation cost for all LLW/MLLW generated during demolition of 291-B.

Table A-4. Alternative 3 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
3	291-B	Grout Activities	1064 Grouting Equipment	1	LS	\$500,000	\$500,000	Historical	2	2	1	Grouting equipment for 291-B. Includes grout pump, air compressor, water recycle tank and pump, slick line and appurtenances, displacement air carbon filters, foam generator, data logger, trash pump.
3	291-B	Grout Activities	1067 Grout Preparation - 291-B Filter Cells	1	LS	\$5,000,000	\$5,000,000	Other	2	2	1	Preparation cost for grouting 291-B. Activities include engineering analysis and technology development.
3	291-B	Grout Activities	1063 Grout Material	7966	CY	\$120	\$955,920	Historical	2	2	1	Grouting material cost for 291-B.
3	291-B	Grout Activities	803 D&D Crew	6	MO	\$190,000	\$1,140,000	Other	2	2	1	Grout labor for 291-B.
3	291-B	Document Preparation	1055 On-Scene Coordinator Report - High	1	EA	\$100,000	\$100,000	Historical	2	2	1	Closeout report for 291-B.
2	221-B	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	6	MO	\$20,000	\$120,000	Other	3	3	1	Site air monitoring.
2	221-B	Demolition and Removal	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	3	3	1	Demolition preparation labor, Operating Gallery (includes 20 FTE, materials, taxes and licenses, and G&A).
2	221-B	Treatment and Disposal	811 ERDF WG	189	Ton	\$69.70	\$13,173	Other	3	3	1	Operating Gallery demolition preparation waste disposal assumed LLW/MLLW.
2	221-B	Demolition and Removal	801 Work Crew, Interior Specialized	3	MO	\$300,000	\$900,000	Historical	3	3	1	Demolition preparation labor, Canyon Deck (includes 20 FTE, materials, taxes and licenses, and G&A).
2	221-B	Treatment and Disposal	811 ERDF WG	221	Ton	\$69.70	\$15,404	Other	3	3	1	Canyon Deck demolition preparation waste disposal assumed LLW/MLLW.
2	221-B	Treatment and Disposal	817 ERDF Waste Treatment	41	Ton	\$11.28	\$462	Other	3	3	1	ERDF cost for treatment/stabilization of waste.
2	221-B	Treatment and Disposal	819 ERDF Waste Transportation	21	Load	\$80	\$1,680	Other	3	3	1	Transportation cost for all LLW/MLLW generated during hazard abatement of 221-B.
2	221-B	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (nonsoil)	3	LS	\$20,000	\$60,000	Other	3	3	1	Allowance for sampling of demolition preparation debris prior to disposal at ERDF.
1	B Plant Complex	Document Preparation	1057 On-Scene Coordinator Report - Final	1	Ea	\$100,000	\$100,000	Other	3	3	1	Closeout report for the removal activity

Table A-4. Alternative 3 Capital Costs

Alternative 3 Capital Cost Markups			
Subtotal w/ MDBI		\$30,768,392	
Contractors Overhead	15%	\$3,872,759	Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included
Contractors Profit	10%	\$2,581,839	Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included
Subtotal w/ OH&P		\$37,222,990	
WA State Sales Tax	8.60%	\$727,346	Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor
Subtotal		\$37,950,336	
Scope Contingency	25%	\$9,487,584	As per EPA 540-R-00-002, Exhibit 5-7
Bid Contingency	20%	\$7,590,067	
Subtotal W/ Contingency		\$55,027,987	
Project Management	5%	\$2,751,399	As per EPA 540-R-00-002, Exhibit 5-8
Remedial Design	6%	\$3,301,679	As per EPA 540-R-00-002, Exhibit 5-8
Construction Management	6%	\$3,301,679	As per EPA 540-R-00-002, Exhibit 5-8
Subtotal		\$64,382,745	
CHPRC G&A	20%	\$12,876,549	CHPRC FY 2016 Rates-Multipliers
Cost Per Year		\$77,259,294	Total Annual Capital Costs
Total Nondiscounted		\$77,259,294	Total Nondiscounted Value of Capital Cost
Total Present Value		\$74,624,905	Total Present Value of Capital Costs

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A10), respectively.

Cost totals may differ slightly from the displayed values due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

Table A-5. Alternative 3 Operations and Maintenance Costs

Annual O&M Cost												
Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
1	B Plant Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Facility Maintenance	1102 Bathroom Trailer	1	YR	\$30,000	\$30,000	Historical	0	25	1	Annual rental and maintenance
1	B Plant Complex	Annual Surveillance	800 Surveillance and Maintenance Program	1	YR	\$533,000	\$533,000	Historical	0	25	1	Annual facility surveillance activities
Periodic O&M Cost												
1	B Plant Complex	Hazard Abatement	1104 Hazard Abatement Allowance	1	Ea	\$500,000	\$500,000	Other	0	25	5	Periodic hazard abatement allowance to mitigate hazards discovered during work activities
Alternative 3 Annual O&M Markups												
Subtotal w/ MDBI			\$627,800									
Contractors Overhead		15%	\$94,170	Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included								
Contractors Profit		10%	\$62,780	Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included								
Subtotal w/ OH&P			\$784,750									
WA State Sales Tax		8.60%	\$17,189	Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor								
Subtotal w/ Sales Tax			\$801,939									
O&M Contingency		50%	\$400,970									
Subtotal W/ Contingency			\$1,202,909									
Technical Support Services		28.81%	\$346,529	Percentage for TSS varies for each line item and ranges from 26% to 45%; percentage presented is weighted average for all Annual O&M items								
Subtotal			\$1,549,438									
CHPRC G&A		20%	\$309,888	CHPRC FY 2016 Rates-Multipliers								
Cost Per Year			\$1,859,325	Total Annual Capital Costs								
Total Nondiscounted			\$48,342,456	Total Non-Discounted Value of Annual O&M Cost								
Total Present Value			\$40,389,162	Total Present Value of Annual O&M Costs								
Alternative 3 Periodic O&M Markups												
Subtotal with MDBI			3,299,999									
Contractors Overhead		15%	495,000	Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included								
Contractors Profit		10%	330,000	Per RS Means Building Construction Cost Data, 68th annual edition. Excludes line items with OH&P already included								
Subtotal with OH&P			4,124,999									
WA State Sales Tax		8.60%	106,428	Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor								

Table A-5. Alternative 3 Operations and Maintenance Costs

Subtotal with Sales Tax		4,231,427	
O&M Contingency	50%	2,115,714	As per EPA 540-R-00-002, Exhibit 5-7
Subtotal with Contingency		6,347,135	
Technical Support Services	26%	1,650,258	Percentage for TSS varies for each line item and ranges from 26% to 45%; percentage presented is weighted average for all Periodic O&M items
Subtotal with Technical Support Services		7,997,392	
CHPRC G&A	20%	1,599,480	CHPRC FY 2016 Rates-Multipliers
Total Nondiscounted		\$9,596,872	Total Non-Discounted Value of Annualized Periodic O&M Cost
Total Present Value		\$8,030,522	Total Present Value of Annualized Periodic O&M Costs

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A10), respectively.

Cost totals may differ slightly from the displayed values due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

Table A-6. Alternative 3 Total Present Value

Capital Costs	\$74,624,905	Total Present Value of Capital Costs
Annual O&M Costs	\$40,389,162	Total Present Value of Annual O&M Activities
Periodic O&M Costs	\$8,030,522	Total Present Value of Periodic O&M Activities
Alternative 3 Total Present Value	\$123,044,590	Total Present Value of Alternative 3
Expected Accuracy Range for Total Present Value is -30% to +50%		
-30%	\$86,131,213	
+50%	\$184,566,885	

Note: Cost totals may differ slightly from the displayed values due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

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A4 Capital Unit Cost Summary

Table A-7 provides capital unit costs for Alternatives 2 and 3. This table includes information about capital costs, including if overhead and profit was added, if the unit cost contained labor only, and the percentage of the item to be taxed.

A5 Operations and Maintenance Unit Cost Summary

Table A-8 provides O&M unit costs for Alternatives 2 and 3. This table includes information about capital costs, including if overhead and profit was added, if the unit cost contained labor only, and the percentage of the item to be taxed.

Table A-7. Capital Unit Cost Summary

Line Item	Item	Unit Cost	Units	Source	Add Overhead and Profit?	Labor Only?	% of Non-Labor Item to Be Taxed	Notes/References
Mobilization/Demobilization; Temporary Utilities and Facilities: #1 - 49								
1	Site Preparation	\$1,500,000	LS	Other	Yes	No	30%	CHPRC Project manager allowance to secure site; establish power connections; set up work zones, equipment, and waste areas; set up temporary facilities and utilities.
Site Work: #50-99								
60	Ventilation System Modification	\$5,000,000	LS	Other	Yes	No	30%	CHPRC Project manager allowance for bringing ventilation system into compliance for proposed work activities.
62	Life Safety Updates	\$1,500,000	LS	Other	Yes	No	30%	CHPRC Project manager allowance for bringing ventilation system into compliance for proposed work activities.
Monitoring, Testing, Sampling and Analysis: #650 - 749								
650	Characterization Sampling	\$5,000	EA	Other	Yes	No	0%	CHPRC Project manager estimate.
656	Miscellaneous Sampling and Analysis (Nonsoil)	\$20,000	LS	Other	Yes	No	30%	CHPRC Project manager allowance.
662	Site Air Monitoring	\$20,000	MO	Other	Yes	No	100%	CHPRC Project manager allowance.

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Table A-7. Capital Unit Cost Summary

Line Item	Item	Unit Cost	Units	Source	Add Overhead and Profit?	Labor Only?	% of Non-Labor Item to Be Taxed	Notes/References
Demolition and Removal: #800 – 849								
801	Work Crew, Interior Specialized	\$300,000	MO	Historical	No	No	0%	From Plutonium Finishing Plant actuals (Table A-10).
803	D&D Crew	\$190,000	MO	Other	Yes	No	30%	Estimator buildup, assumed 70% labor and 30% equipment and materials.
811	ERDF WG	\$69.70	Ton	Other	Yes	No	0%	ERDF Waste rates 9/30/2015.
817	ERDF Waste Treatment	\$11.28	Ton	Other	Yes	No	0%	Estimator buildup.
819	ERDF Waste Transportation	\$80	Load	Other	Yes	No	0%	Estimator buildup.
Reserved for Project-Specific Unit Costs: #1050 - 1999								
1051	DSA/FHA Review and Update	\$100,000	EA	Other	Yes	No	30%	CHPRC Project manager allowance.
1053	Demolition Analysis	\$100,000	EA	Other	Yes	No	30%	CHPRC Project manager allowance.
1055	On-Scene Coordinator Report - High	\$100,000	EA	Historical	Yes	No	30%	ERQA unit cost.
1057	On-Scene Coordinator Report - Final	\$100,000	EA	Other	Yes	No	30%	CHPRC Project manager allowance.
1063	Grout Material	\$120	CY	Historical	Yes	No	100%	U Canyon grout material cost.
1064	Grouting Equipment	\$500,000	LS	Historical	Yes	No	100%	U Canyon grout equipment cost.
1067	Grout Preparation - 291-B Filter Cells	\$5,000,000	LS	Other	Yes	No	30%	CHPRC Project manager allowance.

Note: Cost totals may differ slightly from the displayed values due to rounding.

Table A-8. Operations and Maintenance Unit Cost Summary

Line Item	Item	Unit Cost	Units	Source	Add Overhead and Profit?	Labor Only?	% of Non-Labor Item to Be Taxed	Notes/References
Surveillance: #800 - 849								
800	Surveillance and Maintenance Program	\$533,000	YR	Historical	Yes	No	30%	Annual Surveillance and Maintenance Program cost for the B Plant Complex, based on 2013 costs.
Reserved for Project-Specific Unit Costs: #1100 - 1999								
1100	Single Wide Trailer	\$12,000	YR	Historical	Yes	No	100%	Yearly rental and operation costs (\$1,000/mo).
1101	Double Wide Trailer	\$20,400	YR	Historical	Yes	No	100%	Yearly rental and operation costs (\$1,700/mo).
1102	Bathroom Trailer	\$30,000	YR	Historical	Yes	No	100%	Yearly rental and operation costs (\$2,500/mo).
1104	Hazard Abatement Allowance	\$500,000	EA	Other	Yes	No	30%	CHPRC Project manager allowance for future hazard abatement activities.

Note: Cost totals may differ slightly from the displayed values due to rounding.

A6 Project Duration Summary Table

Table A-9 presents the estimated durations for all labor activities to occur within the B Plant Complex, as described in the B Plant EE/CA (DOE/RL-2016-14).

Table A-9. Duration of Actions

Alternative	Action	Duration (months)
2	Hazard Abatement of Operating Gallery	3
	Hazard Abatement of Pipe Gallery	3
	Demolition of 291-B Abovegrade	3
	Grouting of 291-B Belowgrade	6
3	Demolition Preparation of Operating Gallery	3
	Demolition Preparation of Canyon Deck	3

A7 Interior Specialized Crew Breakdown

Table A-10 presents the cost breakdown for the interior specialized crew proposed for removal actions within the B Plant Complex. This table presents the total cost for each labor category and monthly usage. In addition to crew labor, this estimate includes materials, subcontractor labor, taxes and licenses, overhead, and general and administrative allocations. This information is derived from actual crew data from the Plutonium Finishing Plant from October and November 2015. The average of these 2 months is used for this cost estimate.

Table A-10. Interior Specialized Crew Breakdown

Category	Average Monthly Expenses (\$1,000s)	Average Monthly Crew Size (FTE)
0 - Labor and Staff Aug	201.51	
C060 - Millwrights	0.37	0.03
C081 - Plumbers & Pipe (Pipefitter)	16.70	1.64
C121 - Other Crafts (Insulators)	1.64	0.16
M010 - First Line Supervisors	17.93	0.96
R051 - Nuclear Waste Process Operators (Nuclear Chemical Operators)	28.37	2.28
R052 - Nuclear Waste Process Operators (D&D)	68.77	8.68
R070 - Utilities System Operators	9.25	1.09
T050 - Health Physics Technicians	58.61	5.89
Z030 - Variance Distribution	-0.30	0.00

Table A-10. Interior Specialized Crew Breakdown

Category	Average Monthly Expenses (\$1,000s)	Average Monthly Crew Size (FTE)
Z050 - Non-Standard Pay	0.18	0.00
1 - Materials	43.13	
10 - Material and Equipment	42.34	
FR - Freight	0.79	
2 - Subcontractors	5.55	
24 - Taxes and Licenses	5.55	
6 - Overhead Allocations	48.85	
7D - General & Administrative	48.85	
Total	299.04	20.73
Modified Total for Estimate	\$300,000	20

A8 General D&D Crew Breakdown

Table A-11 presents the labor breakdown for the general D&D crew proposed for demolition activities within the B Plant Complex. This table presents the actual crew breakdown for a recent demolition activity at the 200 West “Gypsy Camp.” A similar crew makeup is assumed for this cost estimate. Recent cost estimates for the Plutonium/Uranium Extraction (PUREX) facility were used to develop a D&D crew cost. ECE-200E15-00003, *Cost Estimate for the PUREX North Closure Plan*, uses a daily crew of six personnel, split equally between hot zone and support personnel. Actual crew breakdown will vary, depending on activity, but is assumed to use personnel similarly to the gypsy camp demolition.

Table A-11. General D&D Crew Breakdown

Actual Crew Breakdown from Gypsy Camp Demolition	
AG00CPC - Contract Labor	2.42%
C010CPN - Carpenters	1.34%
C020CPN - Electricians	0.11%
C121CPN - Other Crafts-Insulators	3.16%
E040CPN - Electrical Engineers	0.04%
E070CPN - Mechanical Engineers	0.07%
E100CPN - Plant Engineers	0.03%
E120CPN - Safety Engineers	2.16%
E130CPN - Other Engineers	1.21%
M010CPN - First Line Supervisors	13.25%
M020CPN - Managers & Executives	4.80%
P070CPN - Planner/Scheduler/Estimator	9.70%
P080CPN - Health Physicists	0.80%
P090CPC - Industrial Hygienists	5.45%
P090CPN - Industrial Hygienists	0.06%
P140CPN - Safeguards & Security Specialist	2.54%
P160CPC - Technical Writer	0.32%
P170CPN - Other Professionals	6.92%
R051CPN - Nuclear Waste Process Operator	1.45%
R052CPN - Nuclear Waste Process Operator	36.37%
S010CPN - Chemists	0.33%
S020CPN - Environmental Scientists	3.90%
T021CPN - Drafters - Exempt	0.14%
T050CPN - Health Physics Technicians	3.43%

General D&D Cost Breakdown	
Average Daily Cost (Assumed)	\$10,000
Number of Working Days per Month (Assumed)	19
Total Monthly Cost	\$190,000
Crew Expense (70%)	\$133,000
Equipment & Materials Expense (30%)	\$57,000

A9 Waste Treatment Cost Breakdown

Table A-12 presents the cost breakdown for Waste Treatment conducted at the Environmental Restoration and Disposal Facility prior to disposal of low level and mixed low level waste.

Table A-12. Waste Treatment Cost Breakdown

ERDF Hourly Rate	\$36.66
Production Rate (Hours to Treat One Container)	4
Cost per Container	\$146.64
Average ERDF Load, Tons	13
Treatment Cost per Ton	\$11.28

A10 References

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<http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084169>
- DOE/RL-2016-14, 2016, *Engineering Evaluation/Cost Analysis for the B Plant Complex*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.
- ECE-200E15-00003, 2016, *Cost Estimate for the PUREX North Closure Plan*, Draft, CH2M HILL Plateau Remediation Company, Richland, Washington.
- 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. Available at:
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- Means, R.S., 2010, *Building Construction Cost Data*, 68th Annual Edition, R.S. Means, Company Inc., Kingston, Massachusetts.